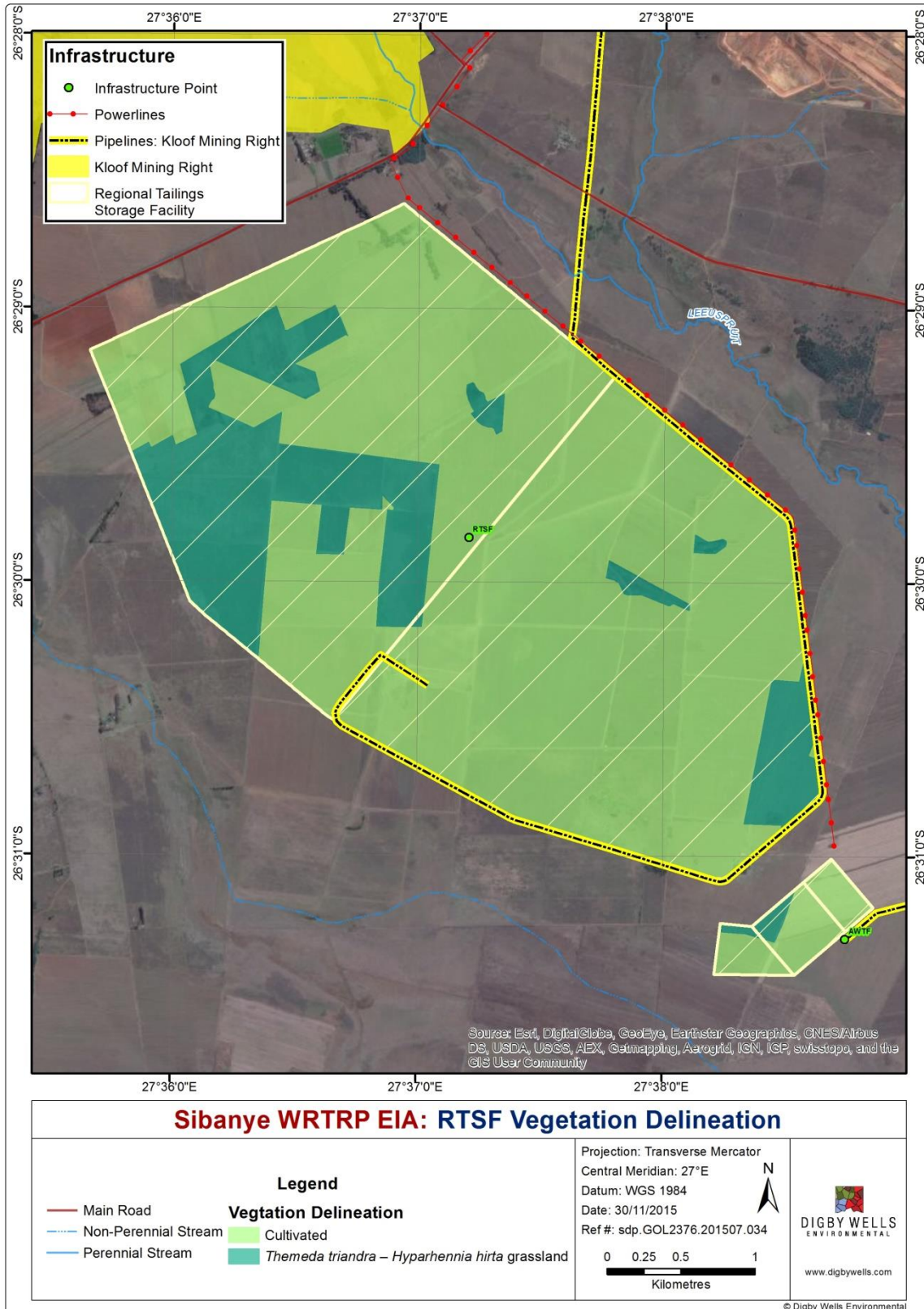


**Figure 7-6: Pipeline Vegetation Zoom 5**



**Figure 7-7: Vegetation delineation of the RTSF**



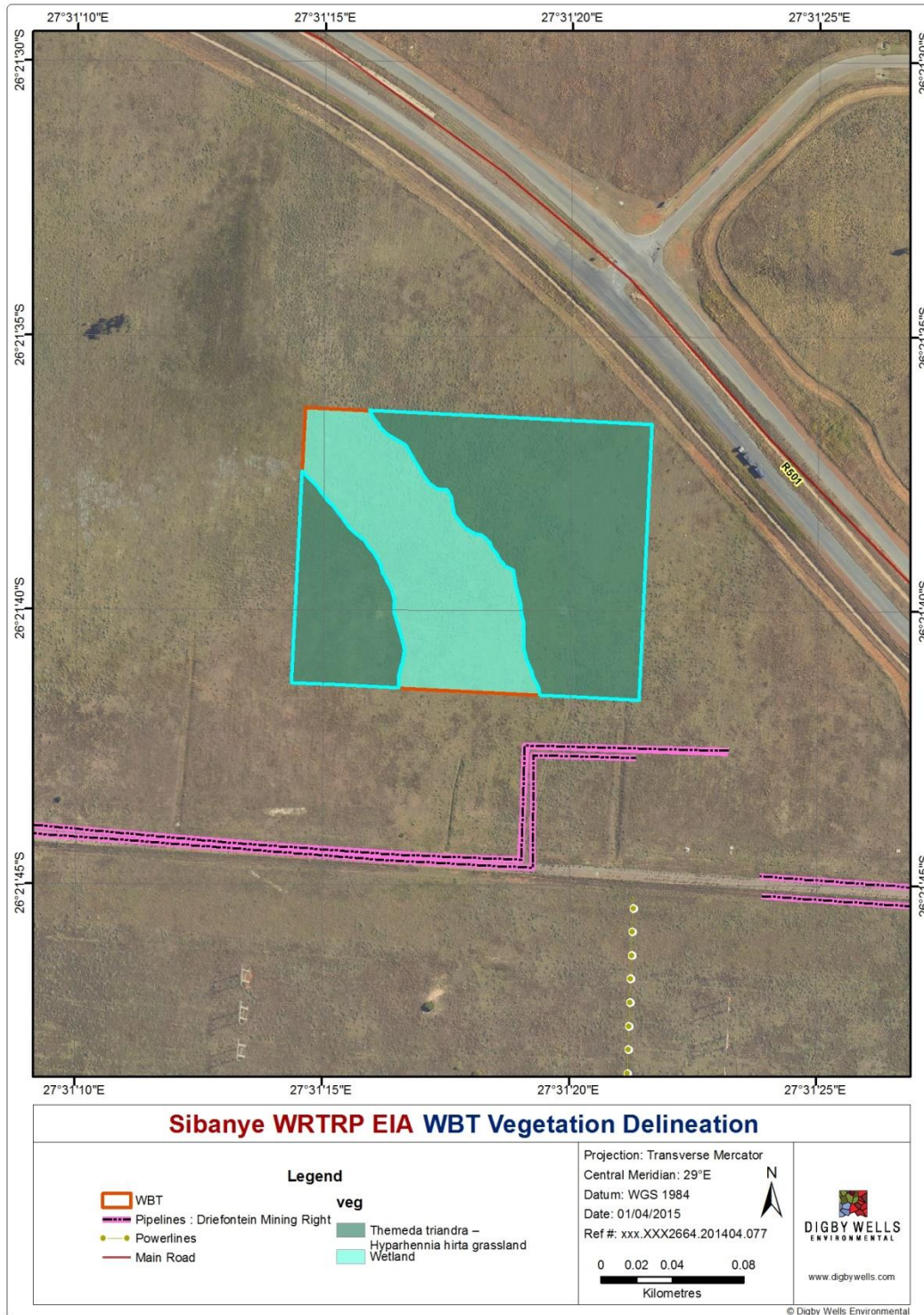


Figure 7-8: WBT Vegetation Delineation

**Table 7-1: Habitat to be disturbed according to MRA, and Infrastructure**

Vegetation	MRA	Area (Ha)	Infrastructure
Agriculture / Alien Vegetation / Transformed	Cooke	48.51	Pipelines
Grassland	Cooke	15.99	Pipelines
Ridge	Cooke	1.39	Pipelines
Agriculture / Alien Vegetation / Transformed	Driefontein	85.04	Pipelines
Grassland	Driefontein	65.39	Pipelines
Ridge	Driefontein	7.48	Pipelines
Wetland	Driefontein	6.76	Pipelines
Agriculture / Alien Vegetation / Transformed	Ezulwini	36.53	Pipelines
Grassland	Ezulwini	16.73	Pipelines
Ridge	Ezulwini	3.35	Pipelines
Wetland	Ezulwini	6.00	Pipelines
Agriculture / Alien Vegetation / Transformed	Kloof	60.71	Pipelines
Grassland	Kloof	30.30	Pipelines
Wetland	Kloof	1.90	Pipelines
Grassland	Kloof	55.66	CPP
Wetland	Kloof	10.73	CPP
Grassland	Kloof	259.67	RTSF
Cultivated	Kloof	1120.65	RTSF

### 7.1.1.1 Grassland Community

The grassland is composed of a dominant and well-developed graminoid component as well as a healthy forb component. Within the broad grassland vegetation community 73 flora species were identified. Within this broad community three sub communities were identified, which displayed different composition and dominant species namely; *Eragrostis gummiflua* – *Themeda triandra*; 2. *Cymbopogon excavatus* – *Themeda triandra* – *Acacia karroo* open to closed woodland and 3. *Themeda triandra* – *Hyparrhenia hirta* grassland.

#### 7.1.1.1.1 *Eragrostis gummiflua* – *Themeda triandra* grassland

The *Eragrostis gummiflua* – *Themeda triandra* grassland community was found predominantly in the northern part of the project area. This grassland community, illustrated in Figure 7-9 below falls within the Carletonville Dolomite Grassland (Mucina and Rutherford, 2006). Seventy three (73) species in total were identified within this community. A dominance of Common Thatching Grass (*Hyparrhenia hirta*) and a large number of problem plants indicated poor ecological health. This was further confirmed through comparison of expected species listed for Carletonville Dolomite Grassland which actual identification.



**Figure 7-9: *Eragrostis gummiflua* – *Themeda triandra* grassland community**

**7.1.1.1.2 *Cymbopogon excavatus* – *Helichrysum regulosum* grassland**

Areas within the grassland community can be described as *Cymbopogon excavatus* – *Helichrysum regulosum* dominated grassland with the often occurring *Acacia karroo* (Sweet Thorn) also dominating, as illustrated in Figure 7-10 below. This vegetation sub community also falls within the Rand Highveld Grassland (Mucina and Rutherford, 2006).

Due to the favourable microclimate created by *Acacia karroo* there are a larger number of small shrubs and forbs in the areas where it occurs. A total of 72 species were identified within the grassland, 18 of the 72 expected species listed to occur within the vegetation type were identified. The ecological health is estimated to moderate to poor, due to the high number of alien invasive species, such as Wild Verbena (*Verbena bonariensis*).





**Figure 7-10: *Cymbopogon excavatus* – *Helichrysum regulosum* dominated grassland**

**7.1.1.1.3 *Themeda triandra* – *Hyparhennia hirta* grassland**

The RTSF and southern pipeline infrastructure area is predominantly described as *Themeda triandra* – *Hyparhennia hirta* grassland, which falls within the Soweto Highveld Vegetation type, as illustrated in Figure 7-11 below. Fifty four (54) species were identified within this sub community. Nine of the 71 species expected to occur within the vegetation were identified. This area is estimated to be 19% natural, through comparison of expected species (Mucina and Rutherford, 2006) and identified species. Much of this vegetation type is assumed to have been transformed for agricultural purposes.



**Figure 7-11: *Themeda triandra* – *Hyparrhennia hirta* grassland**

Much of the grassland community described is regarded as being slightly to largely modified; not representing the original grassland vegetation type. The extent of the degradation is illustrated through diminished species richness and the presence of alien invasive vegetation. African grasslands are particularly old, stable, resilient ecosystems. Most plants are perennials, with very few species which are pioneer plants needed to restore disturbance. As a result grasslands are vulnerable to destruction by cultivation; once ploughed they are invaded by weed pioneer plants that are predominantly alien (Ferrar and Lotter, 2006).

A detailed species list of species identified during the survey is attached as Appendix B. The findings within the sub-communities are described in Table 7-2 below. As illustrated, a high number of species were identified within the various grassland sub communities, however these species are not typical of the vegetation type (many of the species are alien invasive), and therefore the conclusion is that the grassland is largely modified from the original state, with poor ecological integrity.

**Table 7-2: Grassland Sub-communities Summary**

<b>Grassland Sub-Communities</b>			
<b>Sub-community</b>	<b><i>Eragrostis gummiflua</i> – <i>Themeda triandra</i> grassland</b>	<b><i>Cymbopogon excavates</i> – <i>Helichrysum regulosum</i></b>	<b><i>Themeda triandra</i> – <i>Hyparrhennia hirta</i> grassland,</b>
Vegetation Type	Carletonville Dolomite Grassland/Andesite Mountain Bushveld	Rand Highveld Grassland	Soweto Highveld Grassland
Location	Northern	Middle	Southern
Expected Species	63	71	47
Identified Expected Species	10	18	9
Identified Species	73	72	54
Ecological Integrity (%)	(10/63= 15.9% Natural)	(18/71 = 25% Natural)	(9/47 = 19% Natural)
Ecological Integrity	Moderate - Poor	Moderate - Poor	Moderate - Poor

### **7.1.1.2 Ridge Areas**

The ridge area vegetation differs from the grassland vegetation. Similar species do exist, however, the increased rockiness and shallow soils mean that these areas have largely escaped anthropogenic disturbances and transformation. Ridges provide diverse habitat and refuge for a number of species and are generally regarded to be sensitive habitats due to the high levels of biodiversity that they host. The ridges within the project area are elevated above the grassland and host abundant woody species, as seen in Figure 7-12 below. These species are not present in the grassland community. There is increased shade as a result which provides habitat for shade loving graminoids and forbs. Ridges are regarded as sensitive habitats as many of these species are specifically adapted to this microclimate.

Sixty seven (67) flora species were identified within the various ridge areas. Species identified within these areas are typical of Andesite Mountain Bushveld and Gauteng Shale Mountain Bushveld types within which these areas fall according to Mucina and Rutherford (2006). Woody species include Velvet Bushwillow (*Combretum molle*), Buffalo Thorn (*Ziziphus mucronata*), Star Apple (*Diospyros lycoides*), as illustrated in Figure 7-12 below, as well as a number of flora species specifically adapted to rocky areas occur in these areas. Alien invasive vegetation was minimal (11 species) while seventeen medicinal species were encountered, these species are listed in Appendix B.





**Figure 7-12: Ridges vegetation type**

#### **7.1.1.3 Wetland / Riparian Vegetation**

Wetland vegetation is distinctly noted within the landscape by the presence of species such as Cotton Wool Grass (*Imperata cylindrica*), *Schoenoplectus corymbosus*, various sedges (Cyperaceae spp.) and moisture and clay loving grasses and forbs such as *Berkheya sp.* and Golden Bristle Grass (*Setaria sphacelata*). Thirty six (36) flora species were identified to occur within the wetland vegetation community type. Common Reed (*Phragmites australis*) and Common Bulrush (*Typha capensis*) form dense stands in the riparian areas, as illustrated in Figure 7-13 below. The dominance of these two species indicates degraded river health as they are generally indicators of nitrification and sedimentation. This is thought to be the result of mining and agriculture in the area. Wetlands are important habitats and are protected by the National Water Act, Act 36 of 1998 (NWA, 1998).



**Figure 7-13: Wetlands Vegetation Type**



#### **7.1.1.4 Transformed Habitat**

Large portions of natural vegetation have been replaced by both alien vegetation which is comprised of exotic tree stands, disturbed areas which have been colonised by alien invasive vegetation and agricultural lands.

##### **7.1.1.4.1 Exotic Vegetation**

Alien vegetation features prominently in the grassland landscape however whole areas occur in which the natural grassland vegetation has been transformed, and replaced with exotic vegetation. This is typically in the form of stands of exotic trees that have been planted, usually for the uptake of water. Red River Gum (*Eucalyptus camaldulensis*) surrounds much of the mining areas, often planted for their robust nature and ability to take up toxic leachates from the groundwater surrounding retention dams. Pampas grass (*Cortaderia selloana*) is a similarly robust plant which has been planted in an effort to rehabilitate areas which have been mined. These transformed areas, dominated by high numbers of alien invasive and exotic species are typically illustrated in Figure 7-14 and Table 7-3 below.

Alien plant species in South Africa have been classified according to NEMBA (No. 10 of 2004), as published in August 2014 (GN R599 in GG 37886 of 1 August 2014) into the following categories:

- Category 1a: Species requiring compulsory control;
- Category 1b: Invasive species controlled by an invasive species management programme;
- Category 2: Invasive species controlled by area, and;
- Category 3: Invasive species controlled by activity.

**Table 7-3: Alien plant species recorded on site**

<b>Species Name</b>	<b>Common Name</b>	<b>Alien Category</b>
<i>Acacia baileyana</i>	Baileys Wattle	Alien Invasive 3
<i>Acacia cyclops</i>	Redeye	Alien Invasive 1b
<i>Acacia dealbata</i>	Silver wattle	Alien Invasive 2
<i>Acacia mearnsii</i>	Black wattle	Alien Invasive 2
<i>Alternanthera pungens</i>	Khaki burweed	Alien invasive
<i>Amaranthus hybridus</i>	Common pigweed	Alien invasive
<i>Amaranthus viridis</i>	Slender amaranth	Alien invasive
<i>Araujia sericifera</i>	Moth catcher	Alien invasive 1b
<i>Aristida junceiformis</i>	Ngongoni Three-awn	Invasive



Species Name	Common Name	Alien Category
<i>Arundo donax</i>	Spanish Reed	Alien invasive 1b
<i>Asclepias fruticosa</i>	Shrubby milkweed	Alien invasive
<i>Bidens bipinnata</i>	Spanish blackjack	Alien invasive
<i>Bidens formosa</i>	Cosmos	Alien invasive
<i>Bidens pilosa</i>	Common blackjack	Alien invasive
<i>Chamaesyce hirta</i>	Red milkweed	Alien invasive
<i>Chenopodium album</i>	Fat hen	Alien invasive
<i>Chenopodium carinatum</i>	Green goosefoot	Alien invasive
<i>Cirsium vulgare</i>	Spear Thistle	Alien Invasive 1b
<i>Convolvulus farinosus</i>	Wild bindweed	Alien invasive
<i>Conyza albida</i>	Tall fleabane	Alien invasive
<i>Conyza bonariensis</i>	Horseweed	Alien invasive
<i>Conyza podocephala</i>	Conyza	Alien invasive
<i>Cortaderia jubata</i>	Pampas Grass	Alien invasive 1b
<i>Cortaderia selloana</i>		Alien invasive 1b
<i>Cotoneaster franchetii</i>	Cotoneaster	Alien invasive 1b
<i>Cucumis myriocarpus</i>	Striped wild cucumber	Alien invasive
<i>Cuscuta campestris</i>	Dodder	Alien invasive
<i>Datura ferox</i>	Thorn apple	Alien invasive 1b
<i>Datura stramonium</i>	Common thorn apple	Alien invasive 1b
<i>Echium vulgare</i>	Blue echium	Alien invasive 1b
<i>Eucalyptus camaldulensis</i>	Red River Gum	Alien Invasive 1b
<i>Eucalyptus sideroxylon</i>	Black Ironbark	Alien Invasive
<i>Euphorbia helioscopia</i>	Umbrella milkweed	Alien Invasive
<i>Gomphocarpus physocarpus</i>	Milkweed	Alien Invasive
<i>Gomphrena celosioides</i>	Bachelor's button	Alien Invasive
<i>Lantana camara</i>	Tickberry	Alien Invasive 1b
<i>Melia azedarach</i>	Syringa	Alien Invasive 1b
<i>Opuntia ficus-indica</i>	Sweet Prickly Pear	Alien Invasive 1b
<i>Paspalum urvillei</i>	Vasey Grass	Exotic
<i>Phytolacca octandra</i>	Inkberry/Pokeweed	Medicinal/Weed 1b





<b>Species Name</b>	<b>Common Name</b>	<b>Alien Category</b>
<i>Pinus patula</i>	Patula Pine	Alien invasive 2
<i>Pinus pinaster</i>	Cluster Pine	Alien invasive 2
<i>Polygonum lapathifolium</i>	Spotted Knotweed	Alien Invasive
<i>Populus alba</i>	White Poplar	Alien invasive 2
<i>Populus x canescens</i>	Grey Poplar	Alien invasive 2
<i>Pseudognaphalium luteo-album</i>	Cudweed	Alien invasive 2
<i>Pyracantha angustifolia</i>	Yellow Firethorn	Alien invasive 1b
<i>Richardia brasiliensis</i>	Tropical Richardia	Alien Invasive
<i>Schkuhria pinnata</i>	Dwarf Marigold	Weed
<i>Senecio ilicifolius</i>	Sprinkaan-Senecio	Alien Invasive
<i>Seriphium plumosum</i>	Bankrupt Bush	Weed
<i>Solanum mauritanum</i>	Bugweed	Alien Invasive 1b
<i>Solanum panduriforme</i>	Poison Apple	Alien Invasive
<i>Solanum sisymbriifolium</i>	Dense-thorned bitter apple	Alien Invasive 1b
<i>Stellaria media</i>	Starwort	Alien Invasive
<i>Tagetes minuta</i>	Tall Khaki Weed	Alien invasive 1b
<i>Tamarix ramosissima</i>	Pink Tamarisk	Alien invasive 1b
<i>Verbena bonariensis</i>	Tall Verbena	Alien invasive
<i>Xanthium strumarium</i>	Burweed	Alien invasive 1b
<i>Zea mays</i>	Maize	Alien invasive
<i>Zinnia peruviana</i>	Redstar Zinnia	Alien invasive



**Figure 7-14: Examples of alien plant species recorded on site (*Euclya camuldulensis*, *Pinus patula*, *Acacia mearnsii*, *Amaranthus hybridus*, *Verbena bonariensis*, *Cirsium vulgare*, *Schkuria pinnata*, *Solanum panduriforme* and *Datura ferox*)**

#### **7.1.1.4.2 Agriculture**

Agricultural crops which have replaced natural vegetation include Maize (*Zea mays*) which is the primary crop in the area, Soybean (*Glycine max*) and Sunflowers (*Helianthus annulus*), as illustrated in Figure 7-15 below. Small plots of commercial vegetables, Lucerne and Peaches are also cultivated in the area. Livestock farming (including sheep and cattle) is also popular, which has resulted in degradation of the natural grassland biodiversity. See Figure 7-15 below. This is evident through the presence of Bankrupt Bush (*Seriphium plumosum*), which has overtaken numerous fields in the area, as well as a number of other problem plants and general assumed diminished species richness.



**Figure 7-15: Examples of Agriculture; 1) Maize (*Zea mays*), 2) Sunflowers (*Helianthus annuus*) and 3) Livestock Grazing**

### 7.1.2 Medicinal Plant Species

Ethnobotany is a branch of botany that focuses on the use of plants for medicines and other practical purposes. The use of native plants for ethnobotanical uses can be detrimental to populations that are overexploited.

South Africa has a rich diversity of medicinal plants that not only have a global significance, but also have a cultural and historical role (van Wyk *et al.* 2009). There is a rapidly growing concern for conservation of medicinal plants that are dwindling in number due to illegal harvesting (Institute of Natural Resources 2003). This is particularly apparent in rural areas where medicinal plants are overexploited by traditional doctors. Table 7-4 lists medicinal plant species recorded within the study site. There may be additional medicinal plant species on site that are utilised by the local community but have not been incorporated into literature. Interviews with members of the community showed that individuals were not forthcoming with disclosing information regarding plant species that are put to medicinal use. This places a limitation on the accuracy of this component of the study.

**Table 7-4: Medicinal Species**

Species Name	Common Name	Category
<i>Acacia karoo</i>	Sweet thorn	Medicinal
<i>Aloe greatheadii</i>	Spotted aloe	Medicinal
<i>Aloe marlothi</i>	Mountain Aoe	Medicinal
<i>Asparagus setaceus</i>	-	Charm
<i>Cucumis zeyheri</i>	Wild cucumber	Medicinal
<i>Dombeya rotundifolia</i>	Wild Pear	Medicinal
<i>Euclea crispa</i>	Blue Guarri	Medicinal
<i>Eucomis autumnalis</i>	Pineapple flower	Medicinal
<i>Grewia occidentalis</i>	Cross Berry	Medicinal





Species Name	Common Name	Category
<i>Helichrysum aureonitens</i>	Golden everlasting	Medicinal
<i>Hypoxis argentea</i>	-	Medicinal
<i>Hypoxis hemerocallidea</i>	Star-flower	Medicinal/Declining
<i>Ledebouria ovatifolia</i>	-	Medicinal
<i>Leonotis leonurus</i>	Wild dagga	Medicinal
<i>Leonotis microphylla</i>	Rock Dagga	Medicinal
<i>Olea europaeae subsp. africana</i>	African Olive	Medicinal
<i>Pachycarpus sp.</i>	-	Medicinal
<i>Peltophorum africanum</i>	Weeping wattle	Medicinal
<i>Phytolacca octandra</i>	Inkberry/Pokeweed	Medicinal/Weed 1b
<i>Polygala hottentotta</i>	Small Purple Broom	Medicinal
<i>Scabiosa columbaria</i>	Wild Scabiosa	Medicinal
<i>Solanum incanum</i>	Grey Bitter-apple	Medicinal
<i>Sphenostylis angustifolia</i>	Wild sweetpea bush	Medicinal
<i>Typha capensis</i>	Bulrush	Medicinal
<i>Vangueria infausta</i>	Wild medlar	Medicinal
<i>Vernonia oligocephala</i>	Bicoloured-leaved Vernonia	Medicinal

### 7.1.3 Ecological Importance

The ecological importance of the vegetation communities is described in the below Table 7-5. The remnant natural vegetation communities illustrate high ecological importance due to their ecosystem functioning. Despite their diminished ecological integrity they are seen to be valuable for biodiversity maintenance and therefore these communities, namely; grasslands, ridge vegetation and wetland vegetation should be conservation priorities. Transformed vegetation is not regarded to have high ecological importance due to poor integrity, limited ecosystem functioning and abundance of introduced alien vegetation species.



**Table 7-5: Ecological Integrity of the vegetation communities within the Proposed RTSF and pipeline infrastructure project area**

Community	Ecological State	Ecological Function	Conservation Importance	Reasoning
Grassland Vegetation	Natural	Moderate	High	Grassland areas have been transformed and impacted by surrounding land uses and must be protected.
Ridge Vegetation	Natural	Good	High	Largely natural/undisturbed. Important habitat
Wetland vegetation	Natural	Moderate	High	Impacted by surrounding land uses. Important Habitat. Protected (NWA).
Transformed Vegetation	Transformed	Poor	Low	Largely modified vegetation. High number of alien invasive species.

The ecological importance of the vegetation communities is illustrated, in relation to the proposed developments in Figure 8-1, Figure 8-2, and Figure 8-3.

#### **7.1.3.1 Plant species of special concern**

After consultation with Lorraine Mills, the Red List Manager from Gauteng Nature Conservation, GDARD, the following species of plants were identified as having previous distribution over the study areas. Examples of these species are represented in Figure 7-16 and Figure 7-17 below.

**Table 7-6: Expected list of plant SSC**

Plant species	Threat Status	Current Threats	Proffered habitat on site
<i>Hypoxis hemerocallidea</i>	Declining	Commercial exploitation, habitat loss and degradation	Open, rocky grassland, dry, stony, grassy slopes
<i>Boophone disticha</i>	Declining	habitat loss, trade, harvesting	Grassland, rocky areas
<i>Adromischus umbraticola subsp. umbraticola</i>	NT	South African endemic, habitat loss	South-facing rock crevices on ridges, restricted to Gold Reef Mountain Bushveld in the northern parts of its range, and Andesite Mountain Bushveld.



Plant species	Threat Status	Current Threats	Proffered habitat on site
<i>Drimia sanguinea</i>	NT	Highly poisonous bulb that has caused mass livestock mortality in the pass and was subject to frequent land clearance by farmers, hence its status	Open veld and scrubby woodland in a variety of soil types.
<i>Khadia beswickii</i>	VU	Habitat loss, invasive alien species (direct effects), harvesting	Yes, open shallow soil over rocks in grassland.
<i>Kniphofia typhoides</i>	NT	Habitat loss, plant invasion	Wetlands and seasonally wet areas in climax <i>Themeda triandra</i> grasslands on heavy black clay soils.
<i>Gunnera perpensa</i>	Declining	Traditional medicine	Grassland areas.
<i>Lithops lesliei</i> <i>subsp.lesliei</i>	NT	Harvesting (gathering), specifically for commercial sale	Arid grasslands, usually in rocky places, growing under the protection of forbs and grasses.





**Figure 7-16: A. *Hypoxis hemerocallidea*, B. *Boophone disticha*, C. *Khadia beswickii*, D. *Lithops lesliei* subsp. *lesliei*.**





**Figure 7-17: A. *Kniphofia typhoides*, B. *Gunnera perpensa*, C. *Adromischus umbraticola* subsp. *umbraticola*, D. *Drimia sanguinea***

The species *Hypoxis hemerocallidea* and *Boophone disticha* were encountered on site, these species are designated as declining, which means they do not enjoy the same conservation regulations as Threatened, Vulnerable or Near Threatened. However when encountering these plant species, regulations as set out by Gauteng Nature conservation authorities must be adhered to. Consultation with these authorities will form the basis of the regulations.

According to the Red List Plant Guidelines (Mills 2012), three basic rules of conservation apply to populations of Red List Plant Species, as set out hereunder.

- All populations of Near Threatened and Threatened plant taxa must be conserved in situ.
- All populations of Near Threatened and Threatened plant taxa must be protected with a buffer zone in accordance with guidelines as set out below.
- An Ecological Management Plan must be compiled in respect of all actions that affect populations of Red List Plant Species, and such Ecological Management Plans must conform with the Guidelines set out below.



### **7.1.3.2 Ecological Management Plans**

A person/organization/applicant wishing to undertake any action that affects a population of a Red List Plant Species must prepare an Ecological Management Plan. An Ecological Management Plan must be compiled by a suitably qualified ecologist (at least a BSc (Hons) in Plant Ecology or equivalent) as approved by the Department.

- The implementation of the Ecological Management Plan is the responsibility of an appropriate management authority, such as a body corporate or section 21 company, vested with the authority to ensure the correct ecological management of the area where the Red List Plant Species population is growing.
- The Ecological Management Plan must –
  - Ensure the persistence of the Red List Plant Species population;
  - Include a monitoring program that monitors the size, stage structure and vigour of the Red List Plant Species population as well as threats to the population;
  - Facilitate/augment natural ecological processes such as fire and herbivory;
  - Provide for the habitat and life history needs of important pollinators;
  - Minimise artificial edge effects (e.g. water runoff from developed areas and application of chemicals);
  - Include an ongoing monitoring and eradication programme for non-indigenous species with specific emphasis on invasive and weedy species;
  - Result in a report back to the Department on an annual basis.
- Mitigatory measures are required to protect the Red List Plant Species population during construction.
- Only species indigenous to South Africa may be used for landscaping, with plant species locally indigenous to the region or found naturally growing in areas authorized for development being preferred.
- Landscaping must include forage and host plants required by pollinators.
- Before construction is initiated, all areas earmarked for an authorized development must be fenced off from those areas to be retained as an open space system, and all construction-related impacts (including service roads) must be contained within the fenced-off development areas.

## **7.2 Fauna**

As described in the Flora findings, much of the terrestrial vegetation and habitat has been modified within the project area. It is assumed that these impacts have had a subsequent effect on the fauna species diversity and abundance. The findings of the fauna survey are used as a secondary reflection of the ecosystem health. Low numbers of Mammalia, Avifauna, Reptiles, Amphibians and Invertebrates were identified within the project area and





many of these species are associated with the sensitive habitats described in the following section.

### 7.2.1 Sensitive Habitat

Various habitats were identified which correspond with the vegetation communities delineated within the project area and are described in Figure 8-1; the following habitats are regarded as particularly sensitive to impacts.

#### 7.2.1.1 Grassland Habitat

The grasslands provide abundant food and shelter for a number of species. These areas are especially attractive to small mammals, grassland birds and invertebrates. The flora species provide abundant food which attracts high numbers and diversity of species.

#### 7.2.1.2 Ridge Habitat

Ridges provide a varied habitat through the multiple microclimates which are associated with these areas. Ridge areas often act as a refuge for species whose habitat (surrounding grasslands) has been transformed. These areas are especially attractive to reptiles and invertebrates as well as being host to abundant mammal and avifauna species.

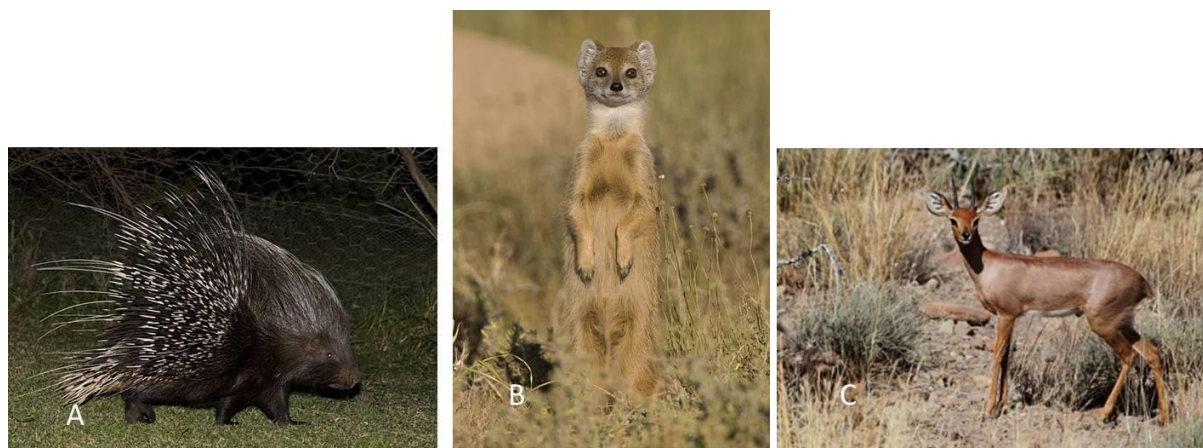
#### 7.2.1.3 Wetland Habitat

Wetlands are sensitive habitats due to the high levels of biodiversity associated with them. The intersection of aquatic and terrestrial habitat results in a varied habitat which attracts a high number of species. Amphibian diversity is especially high in these areas, as well as avifauna especially the Grass Owl (*Tyto capensis*) (listed as nationally Vulnerable), and although not found, may occur in these areas. These three habitats, as described in Figure 8-1 are regarded as being particularly sensitive as a result of the associated faunal species which rely on them.

Areas which have been transformed still provide habitat to numerous faunal species however due to the nature of terrestrial ecology modification much of the species which exists here are transitional or introduced. The alien vegetation in these areas provide habitat for a number of species which would not usually occur in the project area. Cultivated areas do not necessarily provide shelter for species; however they do provide abundant food. Small mammal species and avifauna species benefit from these areas, however, as a result the farmers see these animals as a nuisance.

### 7.2.2 Mammals

A number of small mammals were identified within the project area such as Steenbok (*Raphicerus campestris*), Ground Squirrels (*Xerus inauris*), and Porcupine (*Hystrix africaeaustralis*). Species were identified through actual sightings and visual evidence, as illustrated in Figure 7-18 below.



**Figure 7-18: Mammals recorded on site: A. Cape Porcupine (*Hystrix africae australis*), B. Yellow Mongoose (*Cynictis penicillata*) and C. Steenbuck (*Raphicerus campestris*) TSF and pipeline infrastructure study area (Pictures courtesy of Trevor Hardaker)**

None of the identified species are considered SSC. As a NEMA requirement, potential Red Data listed species must be listed for the proposed development. Red Data mammals which may potentially occur within the Sibanye project areas are listed as Red Data, and are described in Table 7-7 below.

**Table 7-7: Expected Mammals for Sibanye**

Family	Species	Common Name	Recorded on site	Status
Bovidae	<i>Raphicerus campestris</i>	Steenbok	X	LC
Bovidae	<i>Sylvicapra grimmia</i>	Common Duiker	X	LC
Bovidae	<i>Damaliscus pygargus phillips</i>	Blesbuck	X	LC
Chrysochloridae	<i>Chrysospalax pillosus</i>	Rough Haired Golden Mole		VU
Chrysochloridae	<i>Amblysomus septentrionalis</i>	Highveld Golden Mole		NT
Herpestidae	<i>Cynictis penicillata</i>	Yellow Mongoose	X	LC
Herpestidae	<i>Galerella sanguineus</i>	Slender Mongoose	X	LC
Hysticidae	<i>Hystrix africae australis</i>	Porcupine	X	LC
Muridae	<i>Rhabdomys pumilio</i>	Striped Field Mouse	X	LC

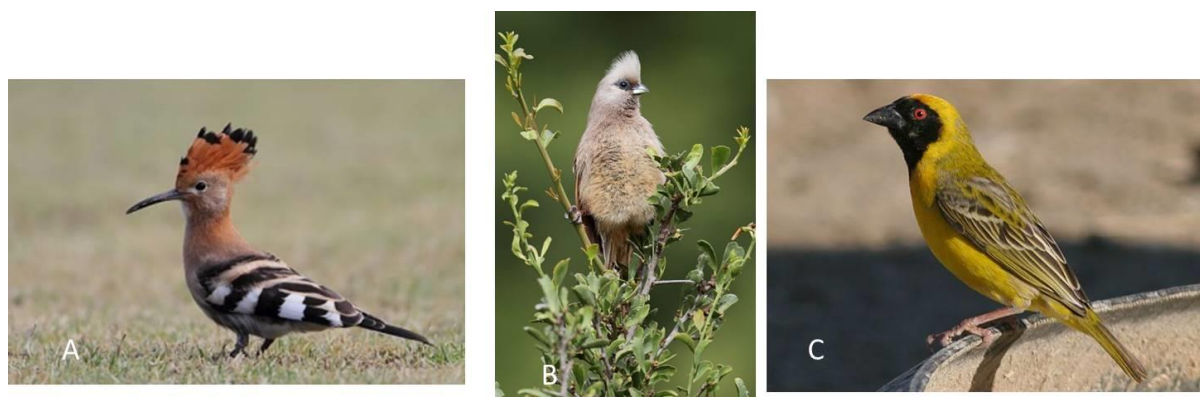


Family	Species	Common Name	Recorded on site	Status
Muridae	<i>Mus musculus</i>	House Mouse	X	LC
Muridae	<i>Rattus rattus</i>	House Rat	X	LC
Muridae	<i>Myosorex varius</i>	Forest Shrew		LC
Muridae	<i>Dasmys incomtus</i>	African Marsh Rat House rat		LC
Muridae	<i>Hydrictis maculicollis</i>	Spotted Necked Otter		NT
Muridae	<i>Xerus inauris</i>	Ground Squirrel	X	LC
Mustelidae	<i>Mystromys albicaudatus</i>	White-Tailed Mouse		EN

No mammal SSC were identified during the wet and dry season surveys. As per the minimum requirements from GDARD, the following mammal species were specifically searched for in all wetland habitat: *Chrysospalax villosus*, *Mystromys albicaudatus*, *Lutra maculicollis*, *Amblysomus septentrionalis*, *Dasmys incomtus* and none were confirmed. This does not necessarily infer, however, that they do not occur at all.

### 7.2.3 Avifauna

A number of birds were identified within the area of the proposed RTSF and pipeline routes. The birds are associated with a variety of habitats which correspond with the vegetation communities namely, grassland, ridges, riparian and wetland and transformed habitat. Identification of species was enabled through actual sightings as well as evidence (feathers, nests etc.) as illustrated in Figure 7-19 below.



**Figure 7-19: A. African Hoopoe (*Upapa Africana*), B. Speckled Mousebird (*Colius striatus*) and C. Masked Weaver (*Ploceus velatus*) (Pictures courtesy of Trevor Hardaker)**





Thirty Seven (37) bird species were identified during the survey, their habitat (in which they were identified) and their International Union of Conservation of Nature (IUCN) status is described below. No Listed Red Data bird species were identified during the field survey. The Grass Owl (*Tyto capensis*), has previously been identified within the project area (Golder, 2008) and is expected to occur within the wetland habitats identified within the project area. This species has been allocated a status of Vulnerable. No additional Red Data bird species were identified during the survey.

**Table 7-8: Bird species identified**

Scientific Name	Common Name	IUCN
<i>Accipiter badius</i>	Shikra	Least concern
<i>Acridotheres tristis</i>	Common Myna	Least concern
<i>Acrocephalus baeticatus</i>	African Reed-Warbler	Least concern
<i>Acrocephalus gracilirostris</i>	Lesser Swamp-Warbler	Least concern
<i>Actitis hypoleucos</i>	Common Sandpiper	Least concern
<i>Alopochen aegyptiacus</i>	Egyptian Goose	Least concern
<i>Amblyospiza albifrons</i>	Thick-billed Weaver	Least concern
<i>Anas erythrorhyncha</i>	Red-billed Teal	Least concern
<i>Anas undulata</i>	Yellow-billed Duck	Least concern
<i>Anthus cinnamomeus</i>	African Pipit	Least concern
<i>Apus affinis</i>	Little Swift	Least concern
<i>Apus caffer</i>	White-rumped Swift	Least concern
<i>Bradypterus baboecala</i>	Little Rush-Warbler	Least concern
<i>Bubulcus ibis</i>	Cattle egret	Least concern
<i>Cercomela familiaris</i>	Familiar chat	Least concern
<i>Colius striatus</i>	Speckled Mousebird	Least concern
<i>Egretta garzetta</i>	Little egret	Least concern
<i>Elanus caeruleus</i>	Blackshouldered kite	Least concern
<i>Euplectes afer</i>	Golden bishop	Least concern
<i>Euplectes orix</i>	Southern red bishop	Least concern
<i>Euplectes progne</i>	Longtailed widow	Least concern
<i>Francolinus swainsonii</i>	Swainson's francolin	Least concern
<i>Myrmecocichla formicivora</i>	Southern anteating chat	Least concern
<i>Numida meleagris</i>	Helmeted guineafowl	Least concern



Scientific Name	Common Name	IUCN
<i>Plegadis falcinellus</i>	Glossy ibis	Least concern
<i>Ploceus velatus</i>	Masked Weaver	Least concern
<i>Saxicola torquata</i>	Common stonechat	Least concern
<i>Scopus umbretta</i>	Hamerkop	Least concern
<i>Streptopelia capicola</i>	Cape turtle dove	Least concern
<i>Streptopelia senegalensis</i>	Palm dove	Least concern
<i>Terpsiphone viridis</i>	African paradise flycatcher	Least concern
<i>Tyto alba</i>	Barn owl	Least concern
<b><i>Tyto capensis</i></b>	<b>Grass owl</b>	<b>Vulnerable</b>
<i>Upapa Africana</i>	African Hoopoo	Least concern
<i>Vanellus coronatus</i>	Crowned plover	Least concern
<i>Vanellus lugubris</i>	Lesser blackwinged plover	Least concern
<i>Vidua macroura</i>	Pintailed whydah	Least concern

#### 7.2.4 Reptiles

One species of reptile, a Rinkhals (*Hemachatus haemachatus*) was identified during the field survey. It should be noted that all land tortoises are protected in the Gauteng Province, however the probability of occurrence of the species in the study area are seen as low. Red Data species include Giant Girdled Lizard (*Cordylus giganteus*) listed as Vulnerable and Striped Harlequin Snake (*Homoroselaps dorsalis*) identified as Rare. Both are allocated a low probability of occurrence. It is important for Sibanya and contractors to report these species should they be identified on site. Figure 7-20 (digitalnature.org)



Figure 7-20: Protected Reptile Species



## 7.2.5 Amphibians

According to Du Preez and Carruthers (2009), frogs occur throughout southern Africa. A number of factors influence their distribution, and they are generally restricted to the habitat type they prefer, especially in their choice of breeding site. The choices available of these habitats coincide with different biomes, these biomes in turn, are distinguished by means of biotic and abiotic features prevalent within them. Therefore a collection of amphibians associated with the Grassland biome will all choose to breed under the prevailing biotic and abiotic features present. Further niche differentiation is encountered by means of geographic location within the biome, this differentiation includes, banks of pans, open water, inundated grasses, reed beds, trees, rivers and open ground, all of which are present within the area of interest.

Six amphibians were encountered during the field survey. The expected amphibian species for the area are listed in Table 7-9, the species identified on site are highlighted. The species listed as encountered below were all encountered within the wetlands habitat types.

**Table 7-9: Amphibian Species**

Scientific Name	Common Name	Occurrence	Habitat
<i>Afrana angolensis</i>	Common River Frog	Widespread; confirmed	Grassland, savanna and forest fringe, breeds in shallow water of pools, dams, streams and slow-flowing rivers
<i>Afrana fuscigula</i>	Cape River Frog	Widespread; high; SA Endemic.	Streams and ponds. Prefers well-vegetated waterways.
<i>Amietophrynus gutturalis</i>	Guttural Toad	Widespread; confirmed	Habitat generalist; breeds in open pools, dams, or streams
<i>Amietophrynus rangeri</i>	Raucous Toad	Marginal, low	Grassland, usually when inundated, man-made impoundments
<i>Cacosternum boettgeri</i>	Common Caco	Widespread; confirmed	Varied including grassland; breeds in vleis and inundated grassland or shallow pans
<i>Kassina senegalensis</i>	Bubbling Kassina	Widespread; confirmed	Grasslands; breeds in vleis, pans and dams
<i>Phrynobatrachus natalensis</i>	Snoring Puddle Frog	Marginal; medium	Breeds in pools or marshy areas associated with pans, streams or vleis
<i>Pyxicephalus adspersus</i>	Giant Bullfrog	Confirmed;	Mainly grassland and savanna; breeds in temporary pans or pans.





Scientific Name	Common Name	Occurrence	Habitat
<i>Schismaderma carens</i>	Red Toad	Widespread; high	Streams and rivers, and still permanent bodies water
<i>Strongylopus fasciatus</i>	Striped Stream Frog	Widespread; confirmed	Streams and rivers, and still permanent bodies water
<i>Tomopterna cryptotis</i>	Tremolo Sand Frog	Widespread; high	Varied habitats; breeds in water bodies that have vegetation
<i>Tomopterna natalensis</i>	Natal Sand frog	Widespread; high	Savanna; breeds in temporary pans
<i>Xenopus laevis</i>	Common Platanna	Widespread; confirmed	Breeds in shallow permanent streams, of temporary water bodies in grassland

### 7.2.6 Invertebrates

A number of invertebrates were identified during the field survey, these are listed in Appendix D. A number of threatened butterflies have been identified within the surrounding area; these species were not identified within the project area..

Due to the timing of the survey it is possible that certain species were not present during this survey, but could be encountered during other times. These species are listed in Table 7-10 below.

**Table 7-10: Butterfly SSC**

Species	Common Name	Status	Identified	Host plant/Habitat
<i>Aloeides dentatis</i>	Roodepoort Copper	Vulnerable	Yes (2009)	<i>Hermannia depressa</i> and <i>Lotononis erianthra</i>
<i>Chrysoritis aureus</i>	Golden Copper	Vulnerable	No(2009)	<i>Clutia pulchella</i>
<i>Lepidochrysops praeterita</i>	Highveld Blue	Endangered	Yes(2009)	<i>Becium grandiflorum</i>
<i>Metisella meninx</i>	Marsh Sylph	Vulnerable	Yes(2009)	<i>Leersia hexandra</i>
<i>Orachrysops mijburghi</i>	Mijburgh's Blue	Vulnerable	No(2009)	<i>Indigofera evansiana</i>
<i>Platylesches dolomitica</i>	Dolomite hopper	Vulnerable	No(2009)	<i>Parinari capensis</i>



## 8 Sensitivity Analysis and No-Go Areas

The sensitivity assessment takes into account all of the desktop information (C-Plan, Threatened Ecosystems and the NPAES), as well as the field data gathered on the site visits. This forms an assessment of the perceived biodiversity value as outlined in the Methodology section above. The result assigns sensitivity to the vegetation occurring within the four MRA study areas (Figure 8-1, Figure 8-2, Figure 8-3 and Figure 8-4).

Ridges and wetlands constitute **High Sensitivity** areas due to their role as process areas within the ecosystem. In addition, high sensitivity was given to areas occurring within a Threatened Ecosystem, and those areas that were pristine or close to pristine with low or no anthropogenic impacts. Areas occurring within Highly Significant C-Plan areas (unless heavily degraded) were also given a High Sensitivity, as were areas on steep rocky slopes and those that have high numbers of species of special concern.

Areas of **medium sensitivity** include those natural areas with some anthropogenic change or degradation, with high numbers of species of special concern and moderate rocky slopes.

**Low sensitivity** was assigned to areas completely transformed or heavily degraded, on relatively flat ground.

The result of this assessment is an area with recommended management strategies developed to conserve and promote areas of high ecological importance, and allow for development in areas of low ecological importance. It is recommended that areas of high sensitivity be actively conserved throughout the life of the project, as well as after decommissioning and closure. These areas should not be cleared or impacted in any way by construction activities. Areas of medium sensitivity should be avoided as far as possible, and ideally conserved along with areas of high sensitivity. Construction of pipelines and associated infrastructure should proceed with caution in these areas. Areas of low sensitivity are recommended for construction activities, but any Species of Special Concern occurring in these areas should be avoided, or rescued from the area. If this cannot be done, the appropriate permits should be obtained for their destruction.

Before we jump into the maps let's just have a short paragraph that put the above into context for the project i.e. how much of the footprints are considered sensitive and to what extent and what infrastructure is this and so on. This will make the maps more sensible.

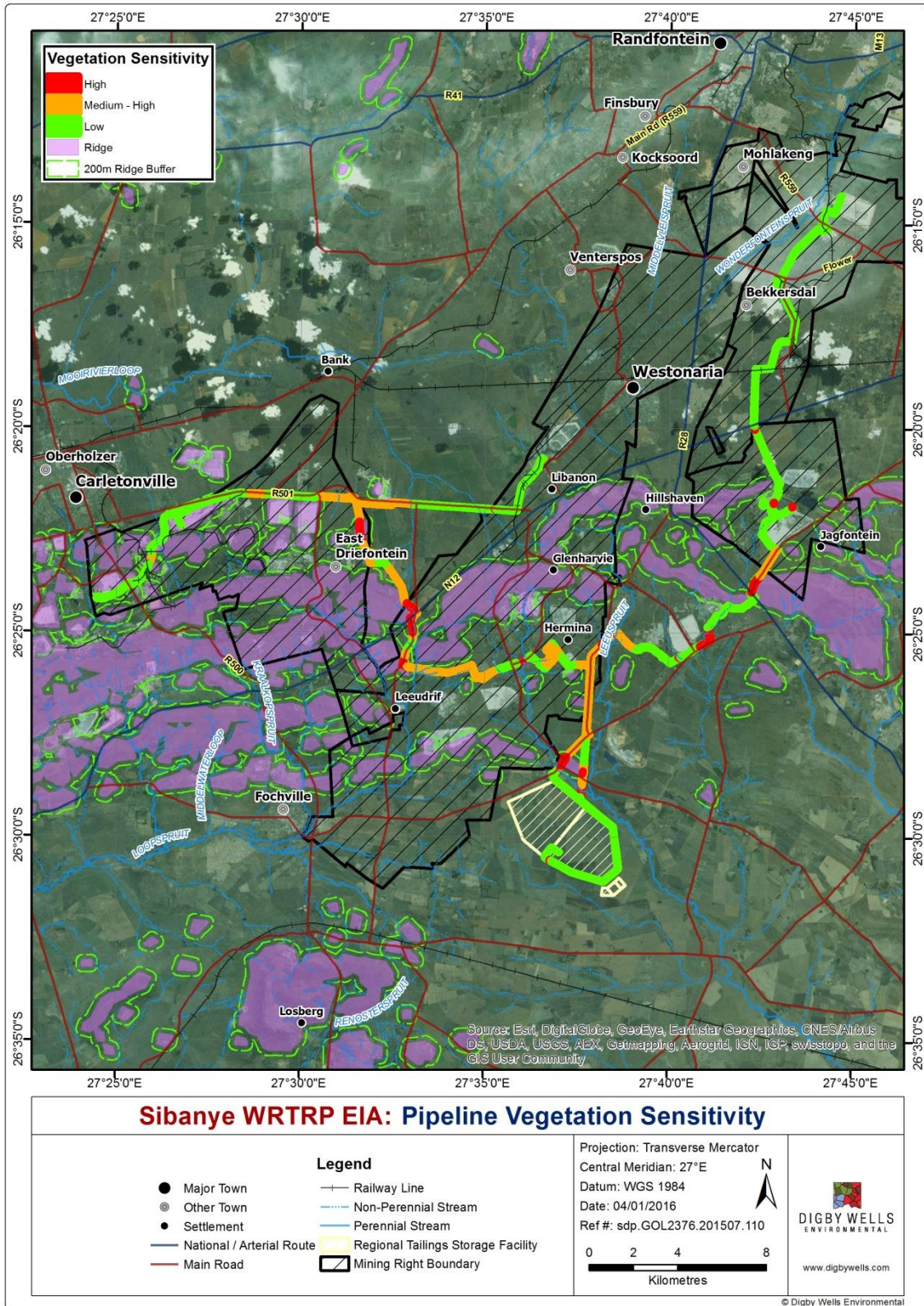


Figure 8-1: Sensitivity Pipelines





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The RTSF corresponds with large areas of cultivated land, used for maize, soybean and sunflowers, these areas are designates as having low (green) sensitivity as is depicted in Figure 8-2. The red areas indicated, correspond with wetland delineations performed by Digby Wells.

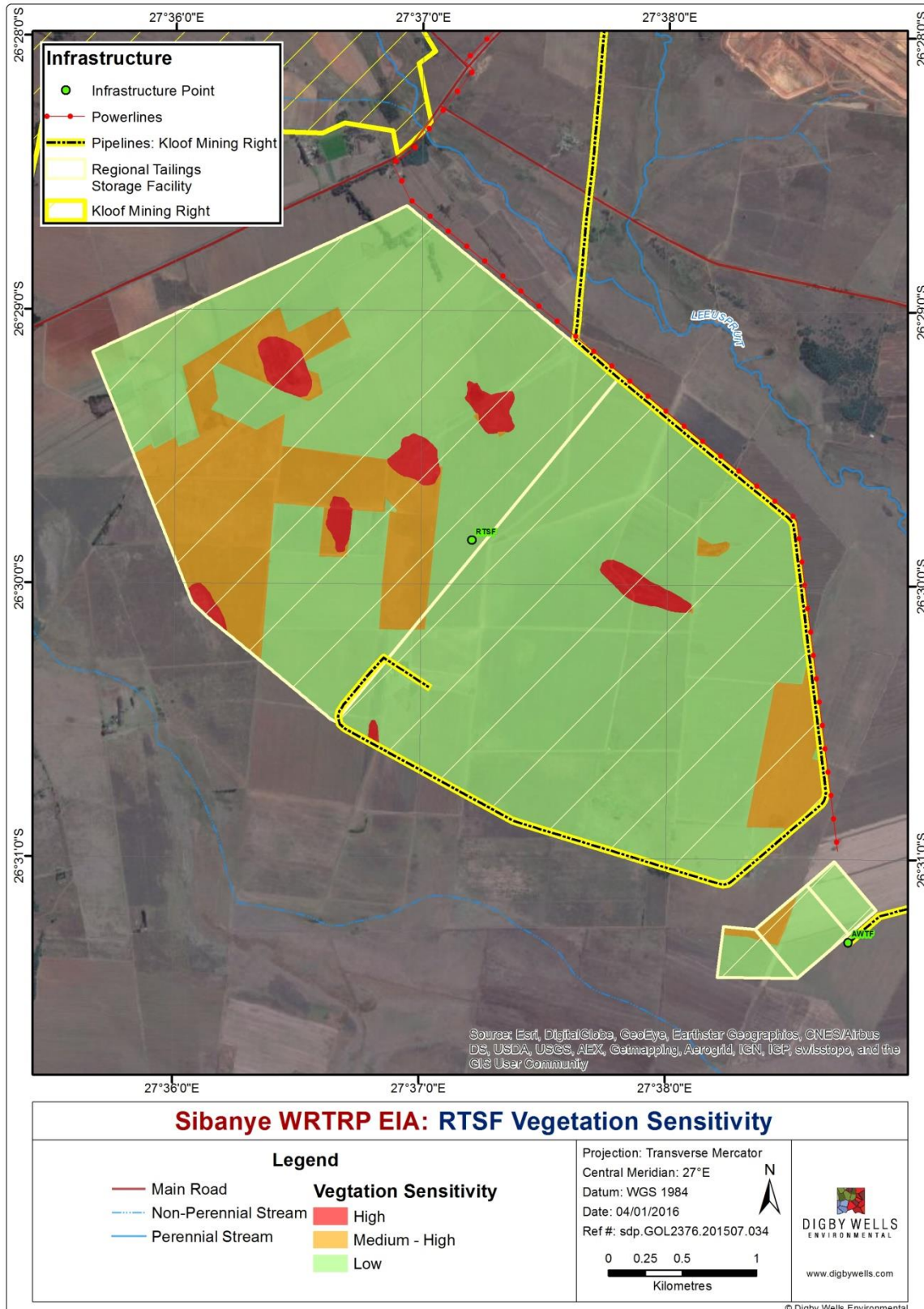
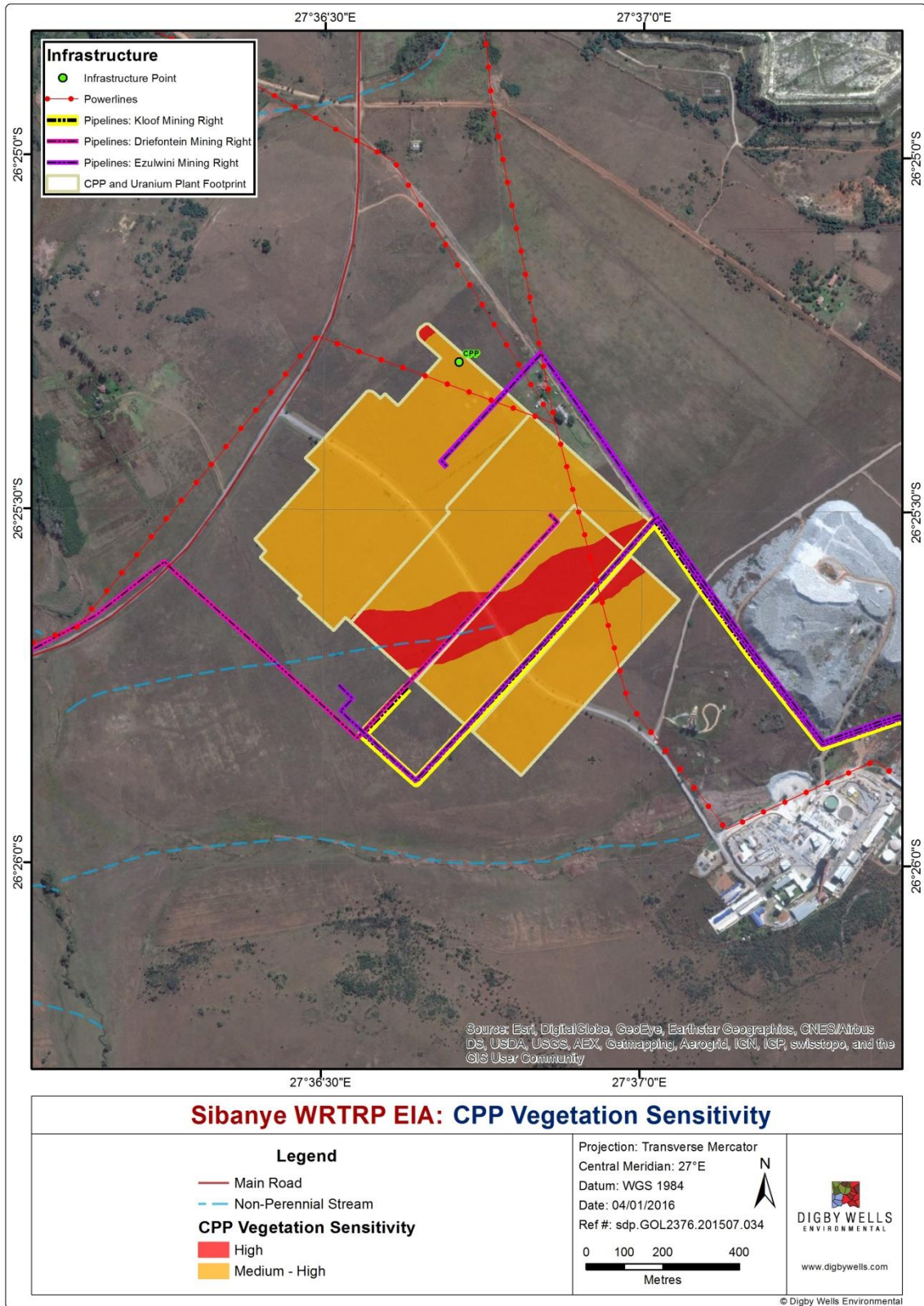


Figure 8-2: Sensitivity RTSF



The CPP area consists of high and medium high sensitivity vegetation/habitat types, as depicted in Figure 8-3. These areas correspond with grassland areas and wetlands. The Digby Wells Wetland Report (2015) can be read in conjunction with this report for clarification.



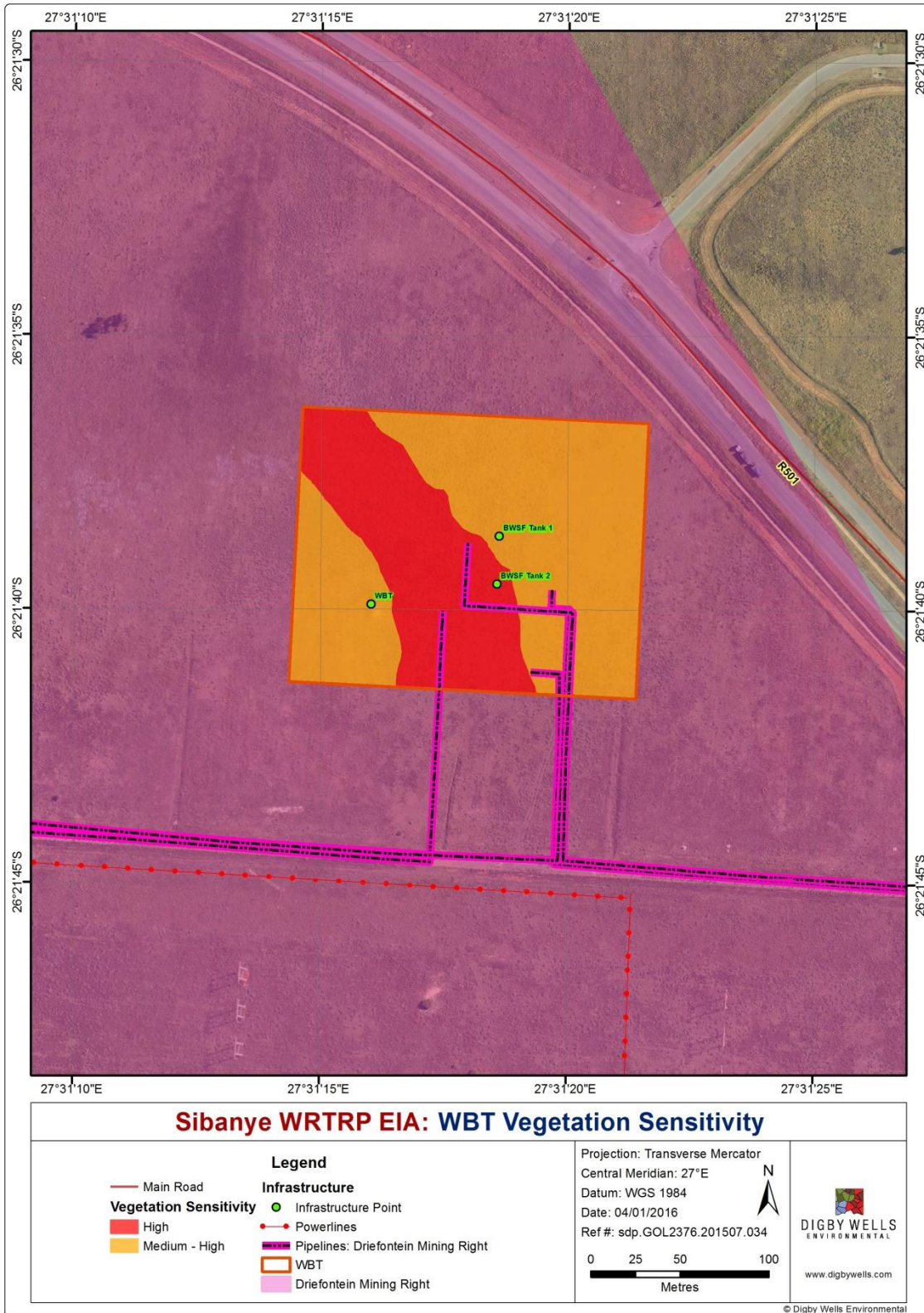


**Figure 8-3: Sensitivity CPP**



The EBT study area was found to consist of high and medium high sensitivity vegetation/habitat types, as depicted in Figure 8-4. These areas correspond with grassland areas and wetlands. It is understood that this structure is close to a known breeding site for Giant Bullfrogs (within 500), it is therefore suggested that prior to construction, a walkthrough of the area is performed to identify any Bullfrogs that might be present. Furthermore, the location of the Bullfrog breeding site must be delineated and identified as a no go zone. The Digby Wells Wetland Report (2015), can be read in conjunction with this report for clarification.





**Figure 8-4: WBT Vegetation Sensitivity**





## 9 Impact Assessment

The impacts are assessed based on the impact's magnitude as well as the receiver's sensitivity, culminating in an impact significance which identifies the most important impacts that require management.

Based on international guidelines and South African legislation, the following criteria are taken into account when examining potentially significant impacts:

- Nature of impacts (direct/indirect, positive/ negative);
- Duration (short/medium/long-term, permanent(irreversible) / temporary (reversible), frequent/seldom);
- Extent (geographical area, size of affected population/habitat/species);
- Intensity (minimal, severe, replaceable/irreplaceable);
- Probability (high/medium/low probability); and
- Possibility to mitigate, avoid or offset significant adverse impacts.

Details of the impact assessment methodology used to determine the significance of physical, bio-physical and socio-economic impacts are provided below.

The significance rating process follows the established impact/risk assessment formula:

$$\text{Significance} = \text{Consequence} \times \text{Probability} \times \text{Nature}$$

Where

$$\text{Consequence} = \text{Intensity} + \text{Extent} + \text{Duration}$$

And

$$\text{Probability} = \text{Likelihood of an impact occurring}$$

And

$$\text{Nature} = \text{Positive (+1) or negative (-1) impact}$$

**Note:** In the formula for calculating consequence, the type of impact is multiplied by +1 for positive impacts and -1 for negative impacts



The matrix calculates the rating out of 147, whereby Intensity, Extent, Duration and Probability are each rated out of seven as indicated in Table 9-2. The weight assigned to the various parameters is then multiplied by +1 for positive and -1 for negative impacts.

Impacts are rated prior to mitigation and again after consideration of the mitigation measure proposed in this EIA/EMP Report. The significance of an impact is then determined and categorised into one of eight categories, as indicated in Table 9-2, which is extracted from Table 9-1. The description of the significance ratings is discussed in Table 9-3.

It is important to note that the pre-mitigation rating takes into consideration the activity as proposed, i.e. there may already be certain types of mitigation measures included in the design (for example due to legal requirements). If the potential impact is still considered too high, additional mitigation measures are proposed.

**Table 9-1: Impact assessment parameter ratings**

RATING	INTENSITY/REPLACABILITY		EXTENT	DURATION/REVERSIBILITY	PROBABILITY
	Negative impacts	Positive impacts			
7	Irreplaceable damage to highly valued items of great natural or social significance or complete breakdown of natural and / or social order.	Noticeable, on-going natural and / or social benefits which have improved the overall conditions of the baseline.	<u>International</u> The effect will occur across international borders.	Permanent: The impact is irreversible, even with management, and will remain after the life of the project.	Definite: There are sound scientific reasons to expect that the impact will definitely occur. >80% probability.
6	Irreplaceable damage to highly valued items of natural or social significance or breakdown of natural and / or social order.	Great improvement to the overall conditions of a large percentage of the baseline.	<u>National</u> Will affect the entire country.	Beyond project life: The impact will remain for some time after the life of the project and is potentially irreversible even with management.	Almost certain / Highly probable: It is most likely that the impact will occur. <80% probability.
5	Very serious widespread natural and / or social baseline changes. Irreparable damage to highly valued items.	On-going and widespread benefits to local communities and natural features of the landscape.	<u>Province/ Region</u> Will affect the entire province or region.	Project Life (>15 years): The impact will cease after the operational life span of the project and can be reversed with sufficient management.	Likely: The impact may occur. <65% probability.
4	On-going serious natural and / or social issues. Significant changes to structures / items of natural or social significance.	Average to intense natural and / or social benefits to some elements of the baseline.	<u>Municipal Area</u> Will affect the whole municipal area.	Long term: 6-15 years and impact can be reversed with management.	Probable: Has occurred here or elsewhere and could therefore occur. <50% probability.



RATING	INTENSITY/REPLACABILITY		EXTENT	DURATION/REVERSIBILITY	PROBABILITY
	Negative impacts	Positive impacts			
3	On-going natural and / or social issues. Discernible changes to natural or social baseline.	Average, on-going positive benefits, not widespread but felt by some elements of the baseline.	<u>Local</u> Local extending only as far as the development site area.	Medium term: 1-5 years and impact can be reversed with minimal management.	Unlikely: Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur. <25% probability.
2	Minor natural and / or social impacts which are mostly replaceable. Very little change to the baseline.	Low positive impacts experience by a small percentage of the baseline.	<u>Limited</u> Limited to the site and its immediate surroundings.	Short term: Less than 1 year and is reversible.	Rare / improbable: Conceivable, but only in extreme circumstances. The possibility of the impact materialising is very low as a result of design, historic experience or implementation of adequate mitigation measures. <10% probability.
1	Minimal natural and / or social impacts, low-level replaceable damage with no change to the baseline.	Some low-level natural and / or social benefits felt by a very small percentage of the baseline.	<u>Very limited</u> Limited to specific isolated parts of the site.	Immediate: Less than 1 month and is completely reversible without management.	Highly unlikely / None: Expected never to happen. <1% probability.

**Table 9-2: Probability/Consequence Matrix**

		Significance																																					
		-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Probability	7	-147	-140	-133	-126	-119	-112	-105	-98	-91	-84	-77	-70	-63	-56	-49	-42	-35	-28	-21	21	28	35	42	49	56	63	70	77	84	91	98	105	112	119	126	133	140	147
	6	-126	-120	-114	-108	-102	-96	-90	-84	-78	-72	-66	-60	-54	-48	-42	-36	-30	-24	-18	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120	126
	5	-105	-100	-95	-90	-85	-80	-75	-70	-65	-60	-55	-50	-45	-40	-35	-30	-25	-20	-15	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105
	4	-84	-80	-76	-72	-68	-64	-60	-56	-52	-48	-44	-40	-36	-32	-28	-24	-20	-16	-12	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	84
	3	-63	-60	-57	-54	-51	-48	-45	-42	-39	-36	-33	-30	-27	-24	-21	-18	-15	-12	-9	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60	63
	2	-42	-40	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42
	1	-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21



**Table 9-3: Significance Rating Description**

Score	Description	Rating
109 to 147	A very beneficial impact that may be sufficient by itself to justify implementation of the project. The impact may result in permanent positive change	Major (positive)
73 to 108	A beneficial impact which may help to justify the implementation of the project. These impacts would be considered by society as constituting a major and usually a long-term positive change to the (natural and / or social) environment	Moderate (positive)
36 to 72	An important positive impact. The impact is insufficient by itself to justify the implementation of the project. These impacts will usually result in positive medium to long-term effect on the natural and / or social environment	Minor (positive)
3 to 35	A small positive impact. The impact will result in medium to short term effects on the natural and / or social environment	Negligible (positive)
-3 to -35	An acceptable negative impact for which mitigation is desirable but not essential. The impact by itself is insufficient even in combination with other low impacts to prevent the development being approved. These impacts will result in negative medium to short term effects on the natural and / or social environment	Negligible (negative)
-36 to -72	An important negative impact which requires mitigation. The impact is insufficient by itself to prevent the implementation of the project but which in conjunction with other impacts may prevent its implementation. These impacts will usually result in negative medium to long-term effect on the natural and / or social environment	Minor (negative)
-73 to -108	A serious negative impact which may prevent the implementation of the project. These impacts would be considered by society as constituting a major and usually a long-term change to the (natural and / or social) environment and result in severe effects	Moderate (negative)
-109 to -147	A very serious negative impact which may be sufficient by itself to prevent implementation of the project. The impact may result in permanent change. Very often these impacts are immitigable and usually result in very severe effects. The impacts are likely to be irreversible and/or irreplaceable.	Major (negative)





## 9.1 Kloof Mining Right Area Impact Assessment

The Kloof MRA will include the construction of the new CPP, where tailings material will be centrally treated for gold and uranium extraction. The RTSF is also to be constructed under this MRA and the pipeline that runs from the CPP to the RTSF is included in this section.

### 9.1.1 No Go-Option and Current Impacts

The general vegetation and habitat types present have been impacted on by current and historical land uses, which include mining and agriculture, the main impacts, are as a result of these land uses are discussed and rated below. The impacts in this MRA arises from the cultivated areas (1120 ha) which on its own constitutes a large area of disturbance from natural vegetation. However, such areas do provide food for seed eating birds (granivores), and can support small rodents and reptiles that feed on them. Also encountered here was 61 hectares of transformed or alien vegetation, these areas mostly occurred in areas of previous disturbance or was utilised as wind breaks (surrounds of most TSF's) or for soil stabilisation. If the project is not pursued, these current impacts (rated below) will remain in perpetuity.

**Table 9-4: Current interaction and impacts to the fauna and flora in the Kloof MRA**

Interaction	Impact
Mining which includes open pit and underground mining and resulting TSF's, road and pipeline infrastructure. Agriculture including cultivation of crops and cattle farming and associated infrastructure.	Loss of vegetation and habitat types and biodiversity. (Plants and animals)
	Alien vegetation recruitment.

**Table 9-5: Impact rating for the No-Go Option**

Activity and Interaction: Current and historical Mining and Agriculture			
Dimension	Rating	Motivation	Significance
<b>Impact Description: Loss of vegetation and habitat types and biodiversity. (Plants and animals).</b>			
<b>Duration</b>	Permanent (7)	Grassland, Ridges and Riparian/Wetland areas are continually being impacted on.	-112 "Major negative"
<b>Extent</b>	Local (3)	This impact occurs locally.	
<b>Intensity</b>	Irreplaceable loss (6)	Loss of the grassland vegetation and habitat is not being managed therefore no rehabilitation is being done.	
<b>Probability</b>	Definite (7)	This is a current impact	
<b>Nature</b>	Negative		



Activity and Interaction: Current and historical Mining and Agriculture			
Dimension	Rating	Motivation	Significance
<b>Impact Description: Alien vegetation recruitment</b>			
<b>Duration</b>	Beyond 'Project' Life (6)	This impact will persist as long as activity persists	-105 "Moderate negative"
<b>Extent</b>	Municipal (4)	Alien plants can spread beyond the local area, as no management is in place to stop this.	
<b>Intensity</b>	Serious damage (5)	Alien vegetation by its nature outcompetes indigenous vegetation	
<b>Probability</b>	Definite (7)	This is a current impact	
<b>Nature</b>	Negative		

The current condition of the vegetation and habitat types in the project area and beyond have been impacted upon by activities emanating from agricultural and mining land use. It has been assessed in this report that the current state of these natural landscapes are in a relatively degraded state with many areas not resembling the historical descriptions of themselves.

### 9.1.2 Construction Phase

#### 9.1.2.1 Project activity: Construction of Surface Infrastructure

The construction of various surface infrastructure components will mean the removal, partial or complete of vegetation/habitat types present.

**Table 9-6: Interactions and Impacts of Kloof Infrastructure**

Interaction	Impact
Site clearing for infrastructure placement	Direct loss of floral species/vegetation types and biodiversity.
	Direct habitat loss and degradation.
	Loss of species of special concern (protected species).
	Alien vegetation recruitment

#### 9.1.2.2 Impact Description

The construction of surface infrastructure within the Kloof MRA will take place in various areas which will affect the current habitat and vegetation types present. There are three main types of habitat found on site, grassland areas (346 ha) (of which 3 differentiations were encountered), wetland areas (12.6 ha) and agricultural/alien vegetation (1181.6 ha).



The activities that have been rated as having the most significant impacts (moderately negative) are the construction of the CPP (55.6 ha of grassland and 10.7 ha of wetlands), RTSF (260 ha of grassland) and pipelines (2 ha of wetlands and 30.3 ha of grassland). The reasons for the ratings are the fact that the CPP will impact heavily on grassland and wetland vegetation and habitat types present here. The RTSF will in turn impact on the secondary grassland and agricultural fields, some of which have been fallow for a long period of time and as a result has been taken over by alien vegetation.

Further disturbance is expected from the construction of the K10 water supply pipeline and portions of the pipelines that connect the Kloof MRA to the Driefontein 3 and 5 TSF's (Driefontein MRA). Construction will constitute the complete removal of vegetation on the footprint of the CPP and RTSF and partial removal in areas where pipeline infrastructure will be placed. This will remove the remaining habitat that the existing vegetation types currently provide.

The partial degradation of habitat for animal life has already taken place within the surrounding environment due to current land use practices this includes mining (and associated impacts) and agriculture (and associated impacts). This impact has and will continue to result in the permanent reduction of natural habitat for reptiles and amphibians that may occur and birds, frogs and mammals that are present within the -Kloof MRA construction areas.

The Nationally protected plants *Boophane disticha* (Poison bulb) (nationally Declining) was encountered throughout the grassland and ridge vegetation categories; this included the footprint of the CPP. The plant species *Hypoxis hemerocallidea* (Star Flower) (provincially protected, nationally Declining) was encountered in the grassland vegetation type in the region of the pipeline to the west of the CPP. The protected species listed under 7.1.3.1, are expected to occur within the grassland habitat type and must be managed appropriately. Mitigation measures could include obtaining permits and translocating these plants if encountered.

With the clearing of vegetation, open areas will occur, here indigenous vegetation will be replaced by fast growing alien and weed vegetation. This impact can be greatly reduced with the correct implementation of alien vegetation management plan.

#### **9.1.2.2.1 Management Objectives**

Management objectives are to inform SGL where there are vegetation and habitat types interactions with the proposed activities during the construction of the WRTRP infrastructure in the Kloof MRA.

Management objectives will be to prevent the loss of important/protected landscapes, species of plants and animals (such as those with Red Data Status, National and Provincial). This is achieved by avoiding destruction of areas where these species are located. In the case of plants, if this is not possible relocation permits are required.



The destruction of the vegetative cover must be limited, this can be achieved by restricting the removal and disturbance of vegetation to those areas absolutely essential for the infrastructure placements.

The ecosystem present must be preserved, this includes areas not directly affected by project activities, and can be achieved by limiting project activities to areas where they are essential. The risk of habitat fragmentation must be reduced through preservation of natural corridors. Rehabilitation plans must be initiated during construction to minimise disturbed areas. Habitat/vegetation degradation must be prevented through the implementation of an alien invasive plant management strategy.

#### **9.1.2.2.2 Management Actions and Targets**

Red Data Status plants located in areas of development (*Boophone disticha* (Poison bulb) and *Hypoxis hemerocallidea* (Star Flower) should be marked prior to construction of any infrastructure and the necessary permits for relocations of these protected species must be obtained from the relevant government department. The relocation strategy must be approved by relevant authorities (GDARD) prior to relocation to a safe place to avoid destruction and stipulations made by GDARD must be followed. A nursery should be developed on site for this purpose. No protected plant species can be disturbed without authorisation.

Three basic rules of conservation apply to populations of Red List Plant Species, as set out hereunder, according to Red List Plant Guidelines (2012).

- All populations of Near Threatened and Threatened plant taxa must be conserved *in situ*.
- All populations of Near Threatened and Threatened plant taxa must be protected with a buffer zone in accordance with guidelines.
- An Ecological Management Plan must be compiled in respect of all actions that affect populations of Red List Plant Species, and such Ecological Management Plans must conform with the Guidelines set out for buffer zone widths.

An alien plant management strategy must be implemented to preserve natural habitat. Such a strategy will entail the identification of areas where such infestation occurs and what the extent of it is. Thereafter specific eradication measures can be prescribed for species present. The alien invasive plant strategy must reduce the number of these plant species that occur in the project area, this can be measured against the number of plants that were identified in this and previous studies. Currently there are approximately 60.7 ha of alien vegetation that will form part of the infrastructure areas for this MRA, the aim will be to reduce this infestation to 0 ha.

Illegal waste dumping, including building waste and rubble, should be prohibited. Such illegal dumping sites are prone to alien vegetation recruitment. The environmental manager must ensure that after each building site is rehabilitated, there are no rubble piles remaining.





Training should be given to onsite staff on which plants and animals have red data status and how they may be identified. Thereafter the Environmental Officer must initiate the red data management plan. The incidence of plant or animal red data removal or death must be quantified and records kept, this will ensure that management actions are adapted if they are not successful.

Destruction of vegetation should be limited to the areas essential for the development; this includes specifically the CPP, RTSF footprints and pipeline routes, if construction is finalised the environmental officer must ensure the construction areas are rehabilitated. Areas of erosion must be marked and attended to before the following wet season starts.

Rehabilitation of disturbed areas should take place within a week of construction, all bare patches of soil should be vegetated, preferably with pioneer species which will colonise open and disturbed areas relatively quickly, and prevent erosion and alien vegetation establishing.

Community awareness should be implemented as part of the stakeholder engagement procedure to create awareness of biodiversity and preservation of natural habitats.

### 9.1.2.2.3 Impact Ratings

**Table 9-7: Potential impacts of Construction of Infrastructure**

Activity and Interaction (Construction of infrastructure (RTSF) require vegetation clearing)			
Dimension	Rating	Motivation	Significance
<b>Impact Description: Direct loss of floral species/vegetation types and biodiversity</b>			
<i>Prior to mitigation/ management</i>			
<b>Duration</b>	Permanent (7)	Total loss of 358 ha of floral species/vegetation will occur.	Moderate (negative) – 84
<b>Extent</b>	Limited (2)	Species/habitat loss will only occur within and immediately around the project site.	
<b>Intensity x type of impact</b>	Moderate(3)	The RTSF footprint covers disturbed grassland and agricultural areas.	
<b>Probability</b>	Definite (7)	It is likely that total destruction of vegetation types will occur.	
<b>Nature</b>	Negative		
<b>Mitigation/ Management actions</b>			
<ul style="list-style-type: none"> <li>▪ Limit degradation and destruction of natural environment to designated RTSF project area by keeping the footprint of the disturbed areas to the minimum and within designated areas only, preferably the 1121 ha of cultivated land. Re-vegetate open areas to limit erosion, which will also aid in water infiltration and flood attenuation.</li> <li>▪ Avoid sensitive landscapes such as riparian and wetland areas that were encountered on and east of the site.</li> <li>▪ Manage nationally restricted alien invasive plant species by ensuring the removal of</li> </ul>			



Activity and Interaction (Construction of infrastructure (RTSF) require vegetation clearing)			
Dimension	Rating	Motivation	Significance
vegetation during construction and operation are controlled so that no open areas occur.			
<b>Post- mitigation</b>			
Duration	Permanent (7)	No mitigation possible.	Moderate (negative) – 77
Extent	Limited (2)	If contractors adhere to mitigation such as to limit the footprint of disturbance to only essential areas.	
Intensity x type of impact	Moderate (-2)	Dependent on sensitivity of the specific site.	
Probability	Definite (7)	This impact will occur	
Nature	Negative		

Activity and Interaction (Construction of infrastructure in areas of medium and high sensitivity (Pipelines and CPP) require vegetation clearing)			
Dimension	Rating	Motivation	Significance
<b>Impact Description: Direct loss of floral species/vegetation types and biodiversity</b>			
<b>Prior to mitigation/ management</b>			
Duration	Project Life (5)	Loss species/vegetation including 32 ha due to pipelines and 66 ha for the the CPP, this will definitely occur.	Moderate (negative) – 84
Extent	Limited (2)	Species/habitat loss will only occur within and immediately around the project site.	
Intensity x type of impact	High (5)	Sensitive sites occur throughout the pipeline and CPP, such as grasslands.	
Probability	Definite (7)	It is likely that destruction of vegetation types will occur without management measures.	
Nature	Negative		
<b>Mitigation/ Management actions</b>			
<ul style="list-style-type: none"> <li>▪ Limit degradation and destruction of natural environment to designated project areas by keeping the footprint of the disturbed areas to the minimum and within designated areas only. Re-vegetate open areas to limit erosion, which will also aid in water infiltration and flood attenuation.</li> <li>▪ Avoid known areas of faunal and floral SSC.</li> <li>▪ Avoid sensitive landscapes such as riparian and ridge areas that were encountered on site.</li> </ul>			



Activity and Interaction (Construction of infrastructure in areas of medium and high sensitivity (Pipelines and CPP) require vegetation clearing)			
Dimension	Rating	Motivation	Significance
<ul style="list-style-type: none"> <li>Manage nationally restricted alien invasive plant species by ensuring the removal of vegetation during construction and operation are controlled so that no open areas occur.</li> <li>Applications for permits for removal of certain plants, where required. If plant SSC are to be removed, they should be either translocated to a similar habitat to the donor site or relocated to a nursery.</li> </ul>			
<b>Post- mitigation</b>			
<b>Duration</b>	Medium term (3)	With vegetation management including rehabilitation, vegetation can recover in 1-5 years.	Negligible (negative) – 24
<b>Extent</b>	Limited (2)	If contractors adhere to mitigation such as to limit the footprint of disturbance to only essential areas.	
<b>Intensity x type of impact</b>	Moderate - (-3)	Dependent on sensitivity of the specific site.	
<b>Probability</b>	Unlikely (3)	It is unlikely that compaction will have an effect after rehabilitation	
<b>Nature</b>	Negative		

Activity and Interaction (Construction of infrastructure (Pipelines and CPP) require vegetation clearing)			
Dimension	Rating	Motivation	Significance
<b>Impact Description: Loss of species of special concern (protected species)</b>			
<b>Prior to mitigation/ management</b>			
<b>Duration</b>	Project Life (5)	Loss floral species/vegetation will occur within the footprints of infrastructure.	Minor (negative) – 72
<b>Extent</b>	Limited (2)	Species/habitat loss will only occur within the project site.	
<b>Intensity x type of impact</b>	High (-5)	Sensitive sites occur throughout the pipeline and CPP, such as ridges and grasslands.	
<b>Probability</b>	High (6)	It is likely that destruction of vegetation types will occur without management measures.	
<b>Nature</b>	Negative		



Activity and Interaction (Construction of infrastructure (Pipelines and CPP) require vegetation clearing)			
Dimension	Rating	Motivation	Significance
<b>Mitigation/ Management actions</b>			
<ul style="list-style-type: none"> <li>Limit degradation and destruction of natural environment to designated project areas by keeping the footprint of the disturbed areas to the minimum and within designated areas only. Re-vegetate open areas to limit erosion, which will also aid in water infiltration and flood attenuation.</li> <li>Avoid known areas of faunal and floral SSC.</li> <li>Avoid sensitive landscapes such as riparian and ridge areas that were encountered on site.</li> <li>Applications for permits for removal of certain plants, where required by provincial authorities. If plant SSC are to be removed, they should be either translocated to a similar habitat to the donor site or relocated to a nursery.</li> </ul>			
<b>Post management</b>			
<b>Duration</b>	Medium term (3)	With vegetation management including rehabilitation, vegetation can recover in 1-5 years.	Negligible (negative) – 24
<b>Extent</b>	Limited (2)	If contractors adhere to mitigation such as to limit the footprint of disturbance to only essential areas.	
<b>Intensity x type of impact</b>	Moderate negative (-3)	Dependent on sensitivity of the specific site.	
<b>Probability</b>	Unlikely (3)	It is unlikely that compaction will have an effect after rehabilitation	
<b>Nature</b>	Negative		

Activity and Interaction (Construction of infrastructure (Pipelines and CPP) require vegetation clearing)			
Dimension	Rating	Motivation	Significance
<b>Impact Description: Alien vegetation establishment</b>			
<b>Prior to mitigation/ management</b>			
<b>Duration</b>	Long term (4)	Alien vegetation will colonise any area that is available (open areas).	Minor (negative) – 48
<b>Extent</b>	Municipal area (4)	Such an infestation can easily spread to the entire municipal area, and infest water sources.	





<b>Activity and Interaction (Construction of infrastructure (Pipelines and CPP) require vegetation clearing)</b>			
<b>Dimension</b>	<b>Rating</b>	<b>Motivation</b>	<b>Significance</b>
<b>Intensity x type of impact</b>	Moderate - (-4)	Serious loss of sensitive habitats due to alien vegetation colonisation.	
<b>Probability</b>	Probable (4)	It is unlikely that without mitigation measures, alien vegetation will establish	
<b>Nature</b>	Negative		
<b>Mitigation/ Management actions</b>			
<ul style="list-style-type: none"> <li>Manage nationally restricted alien invasive plant species by ensuring the removal of vegetation during construction and operation are controlled so that no open areas occur.</li> <li>If alien vegetation is encountered, remove these plants, in the correct way and timeously. Alien plants should be removed as seedlings before they reach seed-bearing age. Alien plants can establish on a site after removal for up to 2-7 years, therefore appropriate monitoring must take place.</li> </ul>			
<b>Post management</b>			
<b>Duration</b>	Medium term (3)	Alien vegetation colonisation will be eradicated asap.	Negligible (negative) – 21
<b>Extent</b>	Limited (2)	An infestation will not be allowed to spread.	
<b>Intensity x type of impact</b>	Minor (-2)	Only limited areas will experience this for a short duration.	
<b>Probability</b>	Unlikely (3)	It is unlikely that alien vegetation will establish, if mitigation is adhered to.	
<b>Nature</b>	Negative		

### 9.1.3 Operational Phase

#### 9.1.3.1 Impact Description

During the operational phase of the CPP will be operational and will treat the sludge that is transported from Driefontein MRA, thereafter the tailings will be deposited on the RTSF. The tailings discussed here are fine particles that, if not covered with vegetation, have the ability to be mobilised through wind.

#### 9.1.3.2 Management Objectives

Management objectives during the operational phase will concentrate on preventing the loss of vegetation or habitat that surrounds the RTSF. This could occur through windblown tailings being deposited on plants, which then affects their functioning.



**9.1.3.3 Management Action and Targets**

The monitoring of the vegetation that surrounds the RTSF must be completed annually, the monitoring will involve recording the quality and quantity of vegetation that surrounds the RTSF. Any negative trends after the establishment of the RTSF will have to be noted and remedial action taken.

**Table 9-8: Impact Rating**

Activity and Interaction Operation of the RTSF			
Dimension	Rating	Motivation	Significance
<b>Impact Description: Loss of vegetation and habitat types due to windblown tailings particles degrading vegetation quality and quantity</b>			
<i>Prior to mitigation/ management</i>			
<b>Duration</b>	Permanent (7)	The RTSF will not be removed and this impact has the potential to occur as long as the RTSF is operational	Minor (negative) – 48
<b>Extent</b>	Limited (2)	Species/habitat loss will only occur within and immediately around the RTSF site.	
<b>Intensity x type of impact</b>	Moderate(3)	The vegetation surrounding the RTSF varies from disturbed (low sensitivity to wetlands with high sensitivity).	
<b>Probability</b>	Definite (4)	It is likely that certain plant species, downwind of the RTSF will be affected.	
<b>Nature</b>	Negative		
<i>Mitigation/ Management actions</i>			
<ul style="list-style-type: none"> <li>▪ Vegetate the RTSF as soon as possible during its operation</li> <li>▪ Monitor surrounding vegetation to assess the affect the RTSF has on it.</li> </ul>			
<i>Post- mitigation</i>			
<b>Duration</b>	Permanent (2)	With mitigation this impact can be greatly reduced.	Negligible) – 8
<b>Extent</b>	Very Limited (1)	If well vegetated the impact will not disturb surrounding vegetation.	
<b>Intensity x type of impact</b>	Minimal (-1)	Dependent on sensitivity of the specific site.	
<b>Probability</b>	Improbable (2)	This impact will occur	
<b>Nature</b>	Negative		



### 9.1.4 Closure Phase

Activity and Interaction (Closure of infrastructure (RTSF))			
Dimension	Rating	Motivation	Significance
<b>Impact Description: There are no impacts envisioned for this phase</b>			

## 9.2 Driefontein Mining Right Area Impact Assessment

The Driefontein MRA will include the mining of the Driefontein 3 and Driefontein 5 TSF's via hydraulic reclamation. The construction and operation of the WBT and the BWSF will also be within the Driefontein MRA as well as the series of pipelines containing slurry from Driefontein 3 and 5 TSFs to the WBT, water from the K10 water supply to the BWSF and the Driefontein 3 and 5 TSFs for the hydraulic reclamation process.

In addition, pipelines will be constructed from Driefontein 3 and Driefontein 5 to the WBT and a water pipeline will be constructed from the K10 water supply to the BWSF. The water pipeline will thereafter continue on to the Driefontein 3 and Driefontein 5 TSF's for the hydraulic reclamation process. These pipelines are following existing roads for the majority of the route, which will decrease the potential impact. From the WBT, there is a preferred and an alternative route to the CPP. Both routes follow existing roads for the majority of the route and cross over natural grassland and disturbed vegetation units.

### 9.2.1 No Go-Option and Current Impacts

The general vegetation and habitat types present have been impacted on by current and historical land uses, which include to a large extent mining and agriculture, the main impacts, are as a result of these land uses are discussed and rated below.

The impacts in this MRA arises from the cultivated/fallow/alien vegetation areas (61 ha) which on its own constitutes a disturbance for natural vegetation and habitat. However, such areas do provide food for seed eating birds (granivores) in agricultural areas, and can support small rodents and reptiles that feed on them. The transformed or alien vegetation encountered, mostly occurred in areas of previous disturbance or was utilised as wind breaks (surrounds of most TSF's) or for soil stabilisation. If the project is not pursued, these current impacts (rated below) will remain in perpetuity.

**Table 9-9: Current interaction and impacts to the fauna and flora in the Driefontein MRA**

Interaction	Impact
Mining which includes open pit and underground mining and resulting TSF's, road and pipeline infrastructure. Agriculture including cultivation of crops and cattle farming and associated infrastructure.	Loss of vegetation and habitat types and biodiversity. (Plants and animals)
	Alien vegetation recruitment.



**Table 9-10: Impact rating for the No-Go Option**

Activity and Interaction: Current and historical Mining and Agriculture			
Dimension	Rating	Motivation	Significance
<b>Impact Description:</b> Loss of vegetation and habitat types and biodiversity. (Plants and animals).			
<b>Duration</b>	Permanent (7)	Grassland, Ridges and Riparian/Wetland areas are continually being impacted on.	-112 "Major negative"
<b>Extent</b>	Local (3)	This impact occurs locally.	
<b>Intensity</b>	Irreplaceable loss (6)	Loss of the grassland vegetation and habitat is not being managed therefore no rehabilitation is being done.	
<b>Probability</b>	Definite (7)	This is a current impact	
<b>Nature</b>	Negative		
<b>Impact Description:</b> Alien vegetation recruitment			
<b>Duration</b>	Beyond 'Project' Life (6)	This impact will persist as long as activity persists	-105 "Moderate negative"
<b>Extent</b>	Municipal (4)	Alien plants can spread beyond the local area, as no management is in place to stop this.	
<b>Intensity</b>	Serious damage (5)	Alien vegetation by its nature outcompetes indigenous vegetation	
<b>Probability</b>	Definite (7)	This is a current impact	
<b>Nature</b>	Negative		

The current condition of the vegetation and habitat types in the project area and beyond have been impacted upon by activities emanating from agricultural and mining land use. It has been assessed in this report that the current state of these natural landscapes are in a relatively degraded state with many areas not resembling the historical descriptions of themselves.

## 9.2.2 Construction Phase

### 9.2.2.1 Project activity: Construction of surface infrastructure

The construction of various surface infrastructure components will mean the removal, partial or complete of vegetation/habitat types present.



**Table 9-11: Interactions and Impacts of Driefontein Infrastructure**

Interaction	Impact
Site clearing for infrastructure placement	Direct loss of floral species/vegetation types and biodiversity.
	Direct habitat loss and degradation.
	Loss of SSC (protected species).
	Alien vegetation recruitment.

### **9.2.2.2 Impact Description**

Vegetation and habitat types that were identified within the Driefontein MRA consists of 65.3 ha of grassland areas, 6.7 ha of wetlands, 7.4 ha ridges and 85 ha alien vegetation and agricultural areas. As per the impact assessment, the remaining natural areas in the footprint of the WBT (2.3 ha), which also coincides with a small pan, and the pipeline from this facility to the CPP (66.3 ha) crosses sensitive habitats. The grassland, wetland and ridges vegetation types will be directly impacted on to facilitate the construction of the pipeline to CPP, with the WBT impacting on the grassland only.

The Nationally protected plants *Boophone disticha* (Poison bulb) (Declining) was encountered throughout the grassland and ridges vegetation categories. The plant species *Hypoxis hemerocallidea* (Star Flower) (GDARD, Declining) were encountered in the grassland vegetation type. The protected species listed under 7.1.3.1, are expected to occur within the grassland habitat type and must be managed appropriately.

Mitigation measures when these plants are encountered include moving of infrastructure to ensure no impact occurs directly or obtaining permits and translocating these plants if encountered.

With the clearing of vegetation, open areas will occur, here indigenous vegetation will be replaced by fast growing alien and weed vegetation, thereby increasing the 85 ha of current alien vegetation. This impact can be greatly reduced with the correct implementation of alien vegetation management plan.

The WBT is located within 500m of a known Giant Bullfrog community during construction the following risks have been identified:

- possible mortality of buried bullfrogs during the construction phase;
- destruction of habitat used by bullfrogs for burrowing and foraging during the construction phase;
- possible degradation of terrestrial and/or breeding habitat from accidental contamination (assuming the tank may contain a hazardous substance) during operation.



The Giant bullfrog is protected according to The National Environmental Biodiversity Act (NEMBA), 2004 (Act 10 of 2004), Threatened and Protected Species (TOPS), and Vulnerable according to Gauteng Nature Conservation Ordinance. (1983). (Act No. 12 of 1983). As such the Provincial Gauteng government will have to be approached in order for the construction of the WBT to go ahead. Preliminary precautions will include that prior to construction, a walkthrough of the area is performed to identify any Bullfrogs that might be present. Furthermore, the location of the Bullfrog breeding site must be delineated and identified as a no go zone prior to any construction.

#### **9.2.2.2.1 Management Objectives**

Management objectives are to inform SGL where there are vegetation and habitat types interactions with the proposed activities during the construction of the WRTRP infrastructure in the Driefontein MRA.

Management objectives are to prevent the loss of important/protected species of vegetation (such as those with Red Data Status, National and Provincial), by firstly attempting to avoid destruction through not constructing in areas where these species are located thereafter applying for permits that will allow and prescribe relocation strategies.

The destruction of the vegetative cover must be limited, this can be achieved by restricting the removal and disturbance of vegetation to those areas absolutely essential for the infrastructure placements, such as 85 ha of alien vegetation and agriculture.

The ecosystem present must be preserved, this includes areas not directly affected by project activities, and can be achieved by limiting project activities to areas where they are essential. The risk of habitat fragmentation must be reduced through preservation of natural corridors. Rehabilitation plans must be initiated during construction to minimise disturbed areas. Habitat/vegetation degradation must be prevented through the implementation of an alien invasive plant management strategy.

#### **9.2.2.2.2 Management Actions and Targets**

Red Data Status plants located in areas of development (*Boophone disticha* (Poison bulb) and *Hypoxis hemerocallidea* (Star Flower) should be marked prior to construction and the necessary permits for relocations of these protected species must be obtained from the relevant government department, if destruction is imminent. The relocation strategy must be approved by relevant authorities (GDARD) prior to relocation to a safe place to avoid destruction and stipulations made by GDARD must be followed. A nursery should be developed on site for this purpose. No protected plant species can be disturbed without authorisation.

Three basic rules of conservation apply to populations of Red List Plant Species, as set out hereunder, according to Red List Plant Guidelines (2012).

- All populations of Near Threatened and Threatened plant taxa must be conserved *in situ*.



- All populations of Near Threatened and Threatened plant taxa must be protected with a buffer zone in accordance with guidelines.
- An Ecological Management Plan must be compiled in respect of all actions that affect populations of Red List Plant Species, and such Ecological Management Plans must conform with the Guidelines set out for buffer zone widths.

An alien plant management strategy must be implemented to preserve natural habitat and reduce current infestations, specifically the 85 ha that has been identified on site. Such a strategy will entail the identification of areas where such infestation occurs and what the extent of it is. Thereafter specific eradication measures can be prescribed for species present, all of whom are named in this report. The alien invasive plant strategy must reduce the number of these plant species that occur in the project area, this can be measured against the number of plants that were identified in this and previous studies as well as the size of the current infestation. The servitude is in close proximity to large infestation of alien invasive plant species, therefore a plan to eradicate the species must be priority.

Illegal waste dumping, including building waste and rubble, should be prohibited. Such illegal dumping sites are prone to alien vegetation recruitment. The environmental manager must ensure that after each building site is rehabilitated, there are no rubble piles remaining.

Training should be given to onsite staff on which plants and animals have red data status and how they may be identified. Thereafter the Environmental Officer must initiate the red data management plan. The incidence of plant or animal red data removal or death must be quantified and records kept, this will ensure that management actions are adapted if they are not successful.

Destruction of vegetation should be limited to the areas essential for the development; this includes specifically the CPP footprint and pipeline routes, if construction is finalised the environmental officer must ensure the construction areas are rehabilitated.

Rehabilitation of disturbed areas should take place within a week of construction, all bare patches of soil should be vegetated, preferably with pioneer species which will colonise open and disturbed areas relatively quickly, and prevent erosion and alien vegetation establishing.

Community awareness should be implemented as part of the stakeholder engagement procedure to create awareness of biodiversity and preservation of natural habitats.

**9.2.2.2.3 Impact Ratings**

**Table 9-12: Potential impacts of the construction of infrastructure**

Activity and Interaction (Construction of infrastructure in areas of medium and high sensitivity (Pipelines WBT, powerlines and BWS) require vegetation clearing)			
Dimension	Rating	Motivation	Significance
Impact Description: Direct loss of floral species/vegetation types and biodiversity			



<b>Activity and Interaction (Construction of infrastructure in areas of medium and high sensitivity (Pipelines WBT, powerlines and BWS) require vegetation clearing)</b>			
<b>Dimension</b>	<b>Rating</b>	<b>Motivation</b>	<b>Significance</b>
<b>Prior to mitigation/ management</b>			
<b>Duration</b>	Project Life (5)	Loss floral 66.3 ha of species/vegetation will occur on the WBT infrastructure footprint areas.	<b>Moderate (negative) – 78</b>
<b>Extent</b>	Local (3)	Species/habitat loss will only occur within and immediately around the project site.	
<b>Intensity x type of impact</b>	High (-5)	Sensitive sites occur throughout the pipeline and WBT, such as ridges and grasslands.	
<b>Probability</b>	High (6)	It is likely that destruction of vegetation types will occur without management measures.	
<b>Nature</b>	Negative		
<b>Mitigation/ Management actions</b>			
<ul style="list-style-type: none"> <li>▪ Limit degradation and destruction of natural environment (66.3 ha) (to designated project areas by keeping the footprint of the disturbed areas to the minimum and within designated areas only. Re-vegetate open areas to limit erosion.</li> <li>▪ Avoid known areas of faunal and floral SSC.</li> <li>▪ Avoid sensitive landscapes such as riparian and ridge areas that were encountered on site.</li> <li>▪ Manage nationally restricted alien invasive plant species by ensuring the removal of vegetation during construction and operation are controlled so that no open areas occur.</li> <li>▪ Applications for permits for removal of certain plants, where required.</li> </ul>			
<b>Post- mitigation</b>			
<b>Duration</b>	Medium term (3)	With vegetation management including rehabilitation, vegetation can recover in 1-5 years.	<b>Negligible (negative) – 21</b>
<b>Extent</b>	Limited (2)	If contractors adhere to mitigation such as to limit the footprint of disturbance to only essential areas.	
<b>Intensity x type of impact</b>	Moderate (-3)	If protected plant species are managed in accordance with prescribed mitigation measures.	
<b>Probability</b>	Unlikely (3)	It is unlikely that habitat/vegetation types will be unnecessarily lost.	
<b>Nature</b>	Negative		





Activity and Interaction (Construction of infrastructure in areas of medium and high sensitivity (Pipelines WBT, powerlines and BWS) require vegetation clearing)			
Dimension	Rating	Motivation	Significance

Activity and Interaction (Construction of infrastructure in areas of medium and high sensitivity (Pipelines WBT, powerlines and BWS) require vegetation clearing)			
Dimension	Rating	Motivation	Significance
<b>Impact Description: Loss of species of special concern (protected species)</b>			
<i>Prior to mitigation/ management</i>			
<b>Duration</b>	Long term (4)	Loss floral species/vegetation will occur.	Moderate (negative) - 72
<b>Extent</b>	Local (4)	Species/habitat loss will only occur within and immediately around the Project site.	
<b>Intensity x type of impact</b>	High (-5)	Sensitive sites occur throughout the pipeline and WBT, such as ridges and grasslands, all which have a high probability of containing SSC.	
<b>Probability</b>	High (6)	It is likely that destruction of vegetation types will occur without management measures.	
<b>Nature</b>	Negative		
<b>Mitigation/ Management actions</b>			
<ul style="list-style-type: none"> <li>▪ Limit degradation and destruction of natural environment to designated project areas by keeping the footprint of the disturbed areas to the minimum and within designated areas only. Re-vegetate open areas to limit erosion.</li> <li>▪ Avoid known areas of faunal and floral SSC.</li> <li>▪ Avoid sensitive landscapes such as riparian and ridge areas that were encountered on site.</li> <li>▪ Applications for permits for removal of certain plants, where required</li> </ul>			
<i>Post management</i>			
<b>Duration</b>	Medium term (3)	With vegetation management including rehabilitation, vegetation can recover in 1-5 years.	Negligible (negative) - 24
<b>Extent</b>	Limited (2)	If contractors adhere to mitigation such as to limit the footprint of disturbance to only essential areas.	
<b>Intensity x type of impact</b>	Moderate (-3)	No protected species will be lost.	



Activity and Interaction (Construction of infrastructure in areas of medium and high sensitivity (Pipelines WBT, powerlines and BWS) require vegetation clearing)			
Dimension	Rating	Motivation	Significance
Probability	Unlikely (3)	It is unlikely that compaction will have an effect after rehabilitation	
Nature	Negative		

Activity and Interaction (Construction of infrastructure in areas of medium and high sensitivity (Pipelines WBT, power lines and BWS) require vegetation clearing)			
Dimension	Rating	Motivation	Significance
<b>Impact Description: Alien vegetation establishment</b>			
<i>Prior to mitigation/ management</i>			
Duration	Long term (4)	Alien vegetation will colonise any area that is available.	Minor (negative) – 48
Extent	Municipal area (4)	Such an infestation can easily spread to the entire municipal area.	
Intensity x type of impact	Moderate (-4)	Serious loss of sensitive habitats due to alien vegetation colonisation.	
Probability	Probable (4)	It is unlikely that without mitigation measures, alien vegetation will establish.	
Nature	Negative		
<i>Mitigation/ Management actions</i>			
<ul style="list-style-type: none"> <li>▪ Manage nationally restricted alien invasive plant species by ensuring the removal of vegetation during construction and operation are controlled so that no open areas occur.</li> <li>▪ If alien vegetation is encountered, remove these plants, in the correct way and timeously</li> </ul>			
<i>Post management</i>			
Duration	Medium term (3)	Alien vegetation colonisation will be eradicated in accordance with the alien management plan.	Negligible (negative) – 24
Extent	Limited (2)	An infestation will not be allowed to spread beyond the site and its boundaries.	
Intensity x type of impact	Minor (-2)	Only limited areas will experience this for a short duration.	
Probability	Unlikely (3)	It is unlikely that alien vegetation will establish, if mitigation is adhered to.	



<b>Activity and Interaction (Construction of infrastructure in areas of medium and high sensitivity (Pipelines WBT, power lines and BWS) require vegetation clearing)</b>			
<b>Dimension</b>	<b>Rating</b>	<b>Motivation</b>	<b>Significance</b>
<b>Nature</b>	Negative		

### 9.2.3 Operational Phase Impacts

<b>Activity and Interaction (Operation of infrastructure in areas of medium and high sensitivity (Pipelines WBT, power lines and BWS))</b>			
<b>Dimension</b>	<b>Rating</b>	<b>Motivation</b>	<b>Significance</b>
<b>Impact Description: There are no impacts envisioned for this phase</b>			

### 9.2.1 Closure Phase Impacts

The decommissioning phase will involve the removal of the WBT and BWSF infrastructure and rehabilitation of their impacted footprints. The pipelines will be left in situ. This will also involve the rehabilitation of the reclaimed TSF footprints.



**Table 9-13: Interactions and Impacts of the WRTRP Driefontein MRA decommissioning phase**

Interaction	Impact
Rehabilitation of the infrastructure: including the WBT and BWSF footprints, as well as the series of pipelines	This will potentially have a positive impact on the vegetation and habitat types that could be restored over time.
Decommissioning of the reclaimed Driefontein 3 and 5 TSF footprints.	With rehabilitation of the footprints, this will have a positive impact to vegetation and habitat types present.

**9.2.1.1 Management objectives**

The objective for this phase will be to maximise the success of the rehabilitation that will happen after infrastructure is removed, and to furthermore reduce any impacts that may occur during this phase.

**9.2.1.2 Management Action and Targets**

Decommissioning of the WRTRP infrastructure in the Driefontein MRA will be predominantly a rehabilitation activity of footprint areas. In order for this to be a positive impact the removal of the infrastructure must be completed so as to not harm or negatively impact surrounding vegetation. Furthermore the rehabilitation must be conducted in such a manner to achieve aims for the process. These aims will be to ensure the footprint areas are vegetated and that erosion through runoff and wind does not occur. Efforts will be maximised if rehabo is completed in the before the first rains fall so as to make use of the rainfall to assist in plant recruitment.

**9.2.1.3 Impact Rating**

Activity and Interaction: Rehabilitation of infrastructure footprint areas			
Dimension	Rating	Motivation	Significance
<b>Impact Description:</b> Restoration of vegetation and habitat types.			
<b>Duration</b>	Short term (2)	If rehabilitation is not completed effectively it will not last .	18 "Small Positive"
<b>Extent</b>	Very Limited (1)	Only certain parts of the site will have revegetated cover.	
<b>Intensity</b>	Moderate (3)	The effectiveness of the rehab will determine the intensity	
<b>Probability</b>	Unlikely (3)	It's unlikely that the rehabilitation will be effective	
<b>Nature</b>	Positive		
<b>Impact Description:</b> Rehabilitation of infrastructure footprint areas			





Activity and Interaction: Rehabilitation of infrastructure footprint areas			
Dimension	Rating	Motivation	Significance
Duration	Permanent (7)	If rehabilitation is completed successfully this impact will be permanent	84 "Moderate positive"
Extent	Local (3)	The general area beyond the project site will be positively impacted on.	
Intensity	Positive (4)	Vegetation will be restored.	
Probability	Almost certain (6)	With correct implementation this impact has a high probability of occurring	
Nature	Positive		

### 9.3 Cooke Mining Right Area Impact Assessment

The Cooke MRA involves the hydraulic reclamation of the Cooke TSF and the Ezulwini South TSF as well as construction of the pipeline from the TSF to Ezulwini and the Cooke thickener.

#### 9.3.1 No Go-Option and Current Impacts

The general vegetation and habitat types present have been impacted on by current and historical land uses, which include to a large extent mining and agriculture, the main impacts, are as a result of these land uses are discussed and rated below.

The impacts in this MRA arises from the cultivated/fallow/alien vegetation areas (49 ha) which on its own constitutes a disturbance for natural vegetation and habitat. However, such areas do provide food for seed eating birds (granivores) in agricultural areas, and can support small rodents and reptiles that feed on them. The transformed or alien vegetation encountered mostly occurred in areas of previous disturbance or was utilised as wind breaks (surrounds of most TSF's) or for soil stabilisation. If the project is not pursued, these current impacts (rated below) will remain in perpetuity.

**Table 9-14: Current interaction and impacts to the fauna and flora in the Cooke MRA**

Interaction	Impact
Mining which includes open pit and underground mining and resulting TSF's, road and pipeline infrastructure. Agriculture including cultivation of crops and cattle farming and associated infrastructure.	Loss of vegetation and habitat types and biodiversity. (Plants and animals)
	Alien vegetation recruitment.



**Table 9-15: Impact rating for the No-Go Option**

Activity and Interaction: Current and historical Mining and Agriculture			
Dimension	Rating	Motivation	Significance
<b>Impact Description:</b> Loss of vegetation and habitat types and biodiversity. (Plants and animals).			
<b>Duration</b>	Permanent (7)	Grassland, Ridges and Riparian/Wetland areas are continually being impacted on.	-112 "Major negative"
<b>Extent</b>	Local (3)	This impact occurs locally.	
<b>Intensity</b>	Irreplaceable loss (6)	Loss of the grassland vegetation and habitat is not being managed therefore no rehabilitation is being done.	
<b>Probability</b>	Definite (7)	This is a current impact	
<b>Nature</b>	Negative		
<b>Impact Description:</b> Alien vegetation recruitment			
<b>Duration</b>	Beyond 'Project' Life (6)	This impact will persist as long as activity persists	-105 "Moderate negative"
<b>Extent</b>	Municipal (4)	Alien plants can spread beyond the local area, as no management is in place to stop this.	
<b>Intensity</b>	Serious damage (5)	Alien vegetation by its nature outcompetes indigenous vegetation	
<b>Probability</b>	Definite (7)	This is a current impact	
<b>Nature</b>	Negative		

The current condition of the vegetation and habitat types in the project area and beyond have been impacted upon by activities emanating from agricultural and mining land use. It has been assessed in this report that the current state of these natural landscapes are in a relatively degraded state with many areas not resembling the historical descriptions of themselves.

### 9.3.2 Construction Phase

#### 9.3.2.1 Project activity: Construction of surface infrastructure

The construction of various surface infrastructure components, specifically the pipeline will mean the removal, partial or complete of vegetation/habitat types present.

**Table 9-16: Interactions and Impacts of Cooke Infrastructure**

Interaction	Impact
Site clearing for infrastructure placement	Direct loss of floral species/vegetation types and biodiversity.
	Direct habitat loss and degradation.
	Loss of species of special concern (protected species).
	Alien vegetation recruitment

### **9.3.2.2 Impact Description**

The construction of surface infrastructure within the Cooke mining right area will take place in various areas which will affect the current habitat and vegetation types present. There are three main types of habitat found on this site, 49 ha of grassland areas, 1.3 ha of ridge areas, and 49 ha agricultural/alien vegetation. Of concern is the remaining natural areas (grassland) found in the pipeline servitude to Cooke 4 South. The existing vegetation (grassland, ridges and alien vegetation/agricultural areas) will be directly impacted on to facilitate the construction of the pipeline. This will remove the remaining habitat that the vegetation types present is currently providing.

The partial degradation of natural vegetation and habitat for animal life has already taken place within the surrounding environment due to current land use practices this mining and agriculture. The pipeline will affect 48ha of transformed vegetation habitat, and 16 ha of grassland, only 1.3 ha of ridge will be affected by the construction activities.

The Nationally protected plants *Boophane disticha* (Poison bulb) (Declining) was encountered throughout the grassland and ridges vegetation categories. The plant species *Hypoxis hemerocallidea* (Star Flower) (GDARD, Declining) was encountered in the grassland vegetation type. The protected species listed under 7.1.3.1, are expected to occur within the grassland habitat type and must be managed appropriately.

Mitigation measures include obtaining permits and translocating these plants if encountered.

With the clearing of vegetation, open areas will occur, here indigenous vegetation will be replaced by fast growing alien and weed vegetation. This impact can be greatly reduced with the correct implementation of alien vegetation management plan.

#### **9.3.2.2.1 Management Objectives**

Management objectives are to prevent the loss of important/protected species of vegetation (such as those with Red Data Status, National and Provincial), by firstly attempting to avoid destruction through not constructing in areas where these species are located thereafter applying for permits that will allow and prescribe relocation strategies.



The destruction of the vegetative cover must be limited, this can be achieved by restricting the removal and disturbance of vegetation to those areas absolutely essential for the infrastructure placements.

The ecosystem present must be preserved, this includes areas not directly affected by project activities, and can be achieved by limiting project activities to areas where they are essential. The risk of habitat fragmentation must be reduced through preservation of natural corridors. Rehabilitation plans must be initiated during construction to minimise disturbed areas. Habitat/vegetation degradation must be prevented through the implementation of an alien invasive plant management strategy.

#### **9.3.2.2.2 Management Actions and Targets**

Red Data Status plants located in areas of development (*Boophone disticha* (Poison bulb) and *Hypoxis hemerocallidea* (Star Flower) should be marked prior to construction of any infrastructure and the necessary permits for relocations of these protected species must be obtained from the relevant government department. The relocation strategy must be approved by relevant authorities (GDARD) prior to relocation to a safe place to avoid destruction and stipulations made by GDARD must be followed. A nursery should be developed on site for this purpose. No protected plant species can be disturbed without authorisation.

Three basic rules of conservation apply to populations of Red List Plant Species, as set out hereunder, according to Red List Plant Guidelines (2012).

- All populations of Near Threatened and Threatened plant taxa must be conserved *in situ*.
- All populations of Near Threatened and Threatened plant taxa must be protected with a buffer zone in accordance with guidelines.
- An Ecological Management Plan must be compiled in respect of all actions that affect populations of Red List Plant Species, and such Ecological Management Plans must conform with the Guidelines set out for buffer zone widths.

An alien plant management strategy must be implemented to preserve natural habitat. Such a strategy will entail the identification of areas where such infestation occurs and what the extent of it is. Thereafter specific eradication measures can be prescribed for species present. The alien invasive plant strategy must reduce the number and are size (49 ha) of these plant species that occur in the project area, this can be measured against the number of plants that were identified in this and previous studies.

Illegal waste dumping, including building waste and rubble, should be prohibited. Such illegal dumping sites are prone to alien vegetation recruitment. The environmental manager must ensure that after each building site is rehabilitated, there are no rubble piles remaining.

Training should be given to onsite staff on which plants and animals have red data status and how they may be identified. Thereafter the Environmental Officer must initiate the red





data management plan. The incidence of plant or animal red data removal or death must be quantified and records kept, this will ensure that management actions are adapted if they are not successful.

Destruction of vegetation should be limited to the areas essential for the development; this includes specifically the CPP, RTSF footprints and pipeline routes, if construction is finalised the environmental officer must ensure the construction areas are rehabilitated. Areas of erosion must be marked and attended to before the following wet season starts.

Rehabilitation of disturbed areas should take place within a week of construction, all bare patches of soil should be vegetated, preferably with pioneer species which will colonise open and disturbed areas relatively quickly, and prevent erosion and alien vegetation establishing.

Community awareness should be implemented as part of the stakeholder engagement procedure to create awareness of biodiversity and preservation of natural habitats.

**9.3.2.2.3 Impact Ratings**

**Table 9-17: Potential impacts of construction of infrastructure**

Activity and Interaction Construction of infrastructure in areas of medium and high sensitivity (pipelines) require vegetation clearing			
Dimension	Rating	Motivation	Significance
<b>Impact Description: Direct loss of floral species/vegetation types and biodiversity</b>			
<i>Prior to mitigation/ management</i>			
<b>Duration</b>	Long term (4)	Loss 17.2 ha of floral species/vegetation will occur.	Minor (negative) – 72
<b>Extent</b>	Local (3)	Species/habitat loss will only occur within and immediately around the Project site.	
<b>Intensity x type of impact</b>	High (-5)	Sensitive sites occur throughout the pipeline, such as ridges and grasslands.	
<b>Probability</b>	High (6)	It is likely that destruction of vegetation types will occur without management measures.	
<b>Nature</b>	Negative		
<b>Mitigation/ Management actions</b>			
<ul style="list-style-type: none"> <li>▪ Limit degradation and destruction of natural environment ridges and grassland, to designated project areas by keeping the footprint of the disturbed areas to the minimum and within designated areas only. Re-vegetate open areas to limit erosion.</li> <li>▪ Avoid known areas of faunal and floral SSC, specifically the ridges and grassland.</li> <li>▪ Avoid sensitive landscapes such as ridges and grassland areas that were encountered on site.</li> <li>▪ Manage nationally restricted alien invasive plant species by ensuring the removal of</li> </ul>			



<b>Activity and Interaction Construction of infrastructure in areas of medium and high sensitivity (pipelines) require vegetation clearing</b>			
<b>Dimension</b>	<b>Rating</b>	<b>Motivation</b>	<b>Significance</b>
vegetation during construction and operation are controlled so that no open areas occur. <ul style="list-style-type: none"> <li>Applications for permits for removal of certain plants, where required.</li> </ul>			
<b>Post- mitigation</b>			
<b>Duration</b>	Medium term (3)	With vegetation management including rehabilitation, vegetation can recover in 1-5 years.	Negligible (negative) – 21
<b>Extent</b>	Limited (2)	If contractors adhere to mitigation such as to limit the footprint of disturbance to only essential areas.	
<b>Intensity x type of impact</b>	Moderate (-3)	Vegetation types present are seen as sensitive, therefore limiting destruction is crucial.	
<b>Probability</b>	Unlikely (3)	It is unlikely that compaction will have an effect after rehabilitation.	
<b>Nature</b>	Negative		

<b>Activity and Interaction (Construction of infrastructure (pipelines and CPP) require vegetation clearing)</b>			
<b>Dimension</b>	<b>Rating</b>	<b>Motivation</b>	<b>Significance</b>
<b>Impact Description: Loss of species of special concern (protected species)</b>			
<b>Prior to mitigation/ management</b>			
<b>Duration</b>	Long term (4)	Loss floral species/vegetation will occur.	Minor (negative) – 72
<b>Extent</b>	Local (3)	Species/habitat loss will only occur within and immediately around the Project site.	
<b>Intensity x type of impact</b>	High (-5)	Sensitive sites occur throughout the pipeline and CPP, such as ridges and grasslands.	
<b>Probability</b>	High (6)	It is likely that destruction of vegetation types will occur without management measures.	
<b>Nature</b>	Negative		
<b>Mitigation/ Management actions</b>			
<ul style="list-style-type: none"> <li>Limit degradation and destruction of natural environment to designated project areas by</li> </ul>			



<b>Activity and Interaction (Construction of infrastructure (pipelines and CPP) require vegetation clearing)</b>			
<b>Dimension</b>	<b>Rating</b>	<b>Motivation</b>	<b>Significance</b>
keeping the footprint of the disturbed areas to the minimum and within designated areas only. Re-vegetate open areas to limit erosion. <ul style="list-style-type: none"> <li>▪ Avoid known areas of faunal and floral SSC.</li> <li>▪ Avoid sensitive landscapes such as riparian and ridge areas that were encountered on site.</li> <li>▪ Applications for permits for removal of certain plants, where required</li> </ul>			
<b>Post management</b>			
<b>Duration</b>	Medium term (3)	With vegetation management including rehabilitation, vegetation can recover in 1-5 years.	Negligible (negative) – 21
<b>Extent</b>	Limited (2)	If contractors adhere to mitigation such as to limit the footprint of disturbance to only essential areas.	
<b>Intensity x type of impact</b>	Moderate (-3)	Sensitive areas such as grassland, ridges and wetlands occur in the servitude of the pipeline. SSC is expected	
<b>Probability</b>	Unlikely (3)	It is unlikely that compaction will have an effect after rehabilitation	
<b>Nature</b>	Negative		

<b>Activity and Interaction (Construction of infrastructure (pipelines) require vegetation clearing)</b>			
<b>Dimension</b>	<b>Rating</b>	<b>Motivation</b>	<b>Significance</b>
<b>Impact Description: Alien vegetation establishment</b>			
<b>Prior to mitigation/ management</b>			
<b>Duration</b>	Long term (4)	Alien vegetation will colonise any area that is available.	Minor (negative) – 48
<b>Extent</b>	Municipal area (4)	Such an infestation can easily spread to the entire municipal area.	
<b>Intensity x type of impact</b>	Moderate (-4)	Serious loss of sensitive habitats due to alien vegetation colonisation.	
<b>Probability</b>	Probable (4)	It is unlikely that without mitigation measures, alien vegetation will establish.	
<b>Nature</b>	Negative		
<b>Mitigation/ Management actions</b>			



Activity and Interaction (Construction of infrastructure (pipelines) require vegetation clearing)			
Dimension	Rating	Motivation	Significance
<ul style="list-style-type: none"> <li>Manage nationally restricted alien invasive plant species by ensuring the removal of vegetation during construction and operation is controlled so that no open areas occur.</li> <li>If alien vegetation is encountered, remove these plants, in the correct way and timeously, following the alien management plan.</li> </ul>			
Post management			
Duration	Medium term (3)	Alien vegetation colonisation will be eradicated in accordance with the alien management plan.	Negligible (negative) – 24
Extent	Limited (2)	An infestation will not be allowed to spread beyond the site and its boundaries.	
Intensity x type of impact	Minor (-2)	Only limited areas will experience this for a short duration.	
Probability	Unlikely (3)	It is unlikely that alien vegetation will establish, if mitigation is adhered to.	
Nature	Negative		

### 9.3.3 Operation Phase Impacts

Operational activities will not lead to direct impacts to fauna and flora.

### 9.3.4 Closure Phase Impacts

The decommissioning phase will involve the removal of the Cooke TSF infrastructure and rehabilitation of its impacted footprint. The pipelines will be left in situ.

**Table 9-18: Interactions and Impacts of the WRTRP Cooke MRA decommissioning phase**

Interaction	Impact
Decommissioning of the reclaimed Cooke TSF and Cooke 4 TSF footprints.	With rehabilitation of the footprints, this will have a positive impact to vegetation and habitat types present.

#### 9.3.4.1 Management objectives

The objective for this phase will be to maximise the success of the rehabilitation that will happen after infrastructure is removed, and to furthermore reduce any impacts that may occur during this phase.





### 9.3.4.2 Management Action and Targets

Decommissioning of the WRTRP infrastructure in the Cooke MRA will be predominantly a rehabilitation activity of footprint area. In order for this to be a positive impact the removal of the infrastructure must be completed so as to not harm or negatively impact surrounding vegetation. Furthermore the rehabilitation must be conducted in such a manner to achieve aims for the process. These aims will be to ensure the footprint areas are vegetated and that erosion through runoff and wind does not occur. Efforts will be maximised if rehabilitation is completed in the before the first rains fall so as to make use of the rainfall to assist in plant recruitment.

### 9.3.4.3 Impact Rating

Activity and Interaction: Rehabilitation of infrastructure footprint areas			
Dimension	Rating	Motivation	Significance
<b>Impact Description:</b> Restoration of vegetation and habitat types.			
<b>Duration</b>	Short term (2)	If rehabilitation is not completed effectively it will not last .	18 "Small Positive"
<b>Extent</b>	Very Limited (1)	Only certain parts of the site will have revegetated cover.	
<b>Intensity</b>	Moderate (3)	The effectiveness of the rehab will determine the intensity	
<b>Probability</b>	Unlikely (3)	It's unlikely that the rehabilitation will be effective	
<b>Nature</b>	Positive		
<b>Impact Description:</b> Rehabilitation of infrastructure footprint areas			
<b>Duration</b>	Permanent (7)	If rehabilitation is completed successfully this impact will be permanent	84 "Moderate positive"
<b>Extent</b>	Local (3)	The general area beyond the project site will be positively impacted on.	
<b>Intensity</b>	Positive (4)	Vegetation will be restored.	
<b>Probability</b>	Almost certain (6)	With correct implementation this impact has a high probability of occurring	
<b>Nature</b>	Positive		

## 9.4 Ezulwini Mining Right Area Impact Assessment

The Ezulwini MRA will include the operation of the pipeline from the CPP to the Ezulwini plant containing uranium concentrate for recovery of uranium and residual gold.



### 9.4.1 No Go-Option and Current Impacts

The general vegetation and habitat types present have been impacted on by current and historical land uses, which include to a large extent mining and agriculture, the main impacts, are as a result of these land uses are discussed and rated below.

The impacts in this MRA arises from the cultivated/fallow/alien vegetation areas totalling 37 ha which on its own constitutes a disturbance for natural vegetation and habitat. However, such areas do provide food for seed eating birds (granivores) in agricultural areas, and can support small rodents and reptiles that feed on them. The transformed or alien vegetation encountered mostly occurred in areas of previous disturbance or was utilised as wind breaks (surrounds of most TSF's) or for soil stabilisation. If the project is not pursued, these current impacts (rated below) will remain in perpetuity.

**Table 9-19: Current interaction and impacts to the fauna and flora in the Ezulwini MRA**

Interaction	Impact
Mining which includes open pit and underground mining and resulting TSF's, road and pipeline infrastructure. Agriculture including cultivation of crops and cattle farming and associated infrastructure.	Loss of vegetation and habitat types and biodiversity. (Plants and animals)
	Alien vegetation recruitment.

**Table 9-20: Impact rating for the No-Go Option**

Activity and Interaction: Current and historical Mining and Agriculture			
Dimension	Rating	Motivation	Significance
<b>Impact Description:</b> Loss of vegetation and habitat types and biodiversity. (Plants and animals).			
<b>Duration</b>	Permanent (7)	Grassland, Ridges and Riparian/Wetland areas are continually being impacted on.	-112 "Major negative"
<b>Extent</b>	Local (3)	This impact occurs locally.	
<b>Intensity</b>	Irreplaceable loss (6)	Loss of the grassland vegetation and habitat is not being managed therefore no rehabilitation is being done.	
<b>Probability</b>	Definite (7)	This is a current impact	
<b>Nature</b>	Negative		
<b>Impact Description:</b> Alien vegetation recruitment			
<b>Duration</b>	Beyond 'Project' Life (6)	This impact will persist as long as activity persists	-105 "Moderate"



Activity and Interaction: Current and historical Mining and Agriculture			
Dimension	Rating	Motivation	Significance
Extent	Municipal (4)	Alien plants can spread beyond the local area, as no management is in place to stop this.	negative"
Intensity	Serious damage (5)	Alien vegetation by its nature outcompetes indigenous vegetation	
Probability	Definite (7)	This is a current impact	
Nature	Negative		

The current condition of the vegetation and habitat types in the project area and beyond have been impacted upon by activities emanating from agricultural and mining land use. It has been assessed in this report that the current state of these natural landscapes are in a relatively degraded state with many areas not resembling the historical descriptions of themselves.

## 9.4.2 Construction Phase

### 9.4.2.1 Project activity: Construction of surface infrastructure

The construction of various surface infrastructure components will mean the removal, partial or complete of vegetation/habitat types present.

**Table 9-21: Interactions and Impacts of Ezulwini Infrastructure**

Interaction	Impact
Site clearing for infrastructure placement	Direct loss of floral species/vegetation types and biodiversity.
	Direct habitat loss and degradation.
	Loss of species of special concern (protected species).
	Alien vegetation recruitment.

### 9.4.2.2 Impact Description

The construction of surface infrastructure within the Ezulwini mining right area will take place in various areas which will affect the current habitat and vegetation types present. There are four main types of habitat found on this site, 17 ha of grassland areas (of which 3 differentiations were encountered), 3.3 ha of ridge areas, 6 ha of wetland areas and 37 ha of agricultural/alien vegetation. Of concern is the remaining natural areas (6 ha) in the footprint of the pipeline servitude from Ezulwini to the CPP. The existing vegetation (Grassland, Ridges and Riparian areas) which will be directly impacted on to facilitate the construction of this pipeline.



The Nationally protected plants *Boophone disticha* (Poison bulb) (Declining) was encountered throughout the grassland and ridges vegetation categories, this included the footprint of this pipeline. The plant species *Hypoxis hemerocallidea* (Star Flower) (GDARD, Declining) was encountered in the grassland vegetation type in the region. The protected species listed under 7.1.3.1, are expected to occur within the grassland habitat type and must be managed appropriately.

Mitigation measures include obtaining permits and translocating these plants if encountered. With the clearing of vegetation, open areas will occur, here indigenous vegetation will be replaced by fast growing alien and weed vegetation. This impact can be greatly reduced with the correct implementation of alien vegetation management plan.

#### **9.4.2.2.1 Management Objectives**

Management objectives are to inform SGL where there are vegetation and habitat types interactions with the proposed activities during the construction of the WRTRP infrastructure in the Ezulwini MRA.

Management objectives are to prevent the loss of important/protected species of vegetation (such as those with Red Data Status, National and Provincial), by firstly attempting to avoid destruction through not constructing in areas where these species are located thereafter applying for permits that will allow and prescribe relocation strategies.

The destruction of the vegetative cover must be limited, this can be achieved by restricting the removal and disturbance of vegetation to those areas absolutely essential for the infrastructure placements.

The ecosystem present must be preserved, this includes areas not directly affected by project activities, and can be achieved by limiting project activities to areas where they are essential. The risk of habitat fragmentation must be reduced through preservation of natural corridors. Rehabilitation plans must be initiated during construction to minimise disturbed areas. Habitat/vegetation degradation must be prevented through the implementation of an alien invasive plant management strategy.

#### **9.4.2.2.2 Management Actions and Targets**

Red Data Status plants located in areas of development (*Boophone disticha* (Poison bulb) and *Hypoxis hemerocallidea* (Star Flower) should be marked prior to construction and the necessary permits for relocations of these protected species must be obtained from the relevant government department. The relocation strategy must be approved by relevant authorities (GDARD) prior to relocation to a safe place to avoid destruction and stipulations made by GDARD must be followed. A nursery should be developed on site for this purpose. No protected plant species can be disturbed without authorisation.



Three basic rules of conservation apply to populations of Red List Plant Species, as set out hereunder, according to Red List Plant Guidelines (2012):

- All populations of Near Threatened and Threatened plant taxa must be conserved *in situ*.
- All populations of Near Threatened and Threatened plant taxa must be protected with a buffer zone in accordance with guidelines.
- An Ecological Management Plan must be compiled in respect of all actions that affect populations of Red List Plant Species, and such Ecological Management Plans must conform with the Guidelines set out for buffer zone widths.

An alien plant management strategy must be implemented to preserve natural habitat. Such a strategy will entail the identification of areas where such infestation occurs and what the extent of it is. Thereafter specific eradication measures can be prescribed for species present.

Illegal waste dumping should be prohibited, this included building waste and rubble, these areas are prone to alien vegetation recruitment.

Training should be given to onsite staff on which plants have Red Data Status and how to identify them, thereafter the environmental officer must initiate the red data management plan.

Destruction of vegetation should be limited to the areas essential for the development, this includes specifically the CPP footprint and pipeline routes.

Rehabilitation of disturbed areas should take place as soon as possible, all bare patches of soil should be vegetated, preferably with pioneer species which will colonise open and disturbed areas relatively quickly, and prevent erosion and alien vegetation establishing.

Community awareness should be implemented as part of the stakeholder engagement procedure to create awareness of biodiversity and preservation of natural habitats.

#### 9.4.2.2.3 Impact Ratings

**Table 9-22: Potential impacts of Construction of infrastructure**

Activity and Interaction Construction of infrastructure in areas of medium and high sensitivity (pipeline) require vegetation clearing			
Dimension	Rating	Motivation	Significance
<b>Impact Description: Direct loss of floral species/vegetation types and biodiversity</b>			
<i>Prior to mitigation/ management</i>			
<b>Duration</b>	Long term (4)	Loss of 26 ha of floral species/vegetation will occur.	Minor (negative) – 72
<b>Extent</b>	Local (3)	Species/habitat loss will only occur within	





<b>Activity and Interaction Construction of infrastructure in areas of medium and high sensitivity (pipeline) require vegetation clearing</b>			
<b>Dimension</b>	<b>Rating</b>	<b>Motivation</b>	<b>Significance</b>
		and immediately around the Project site.	
<b>Intensity x type of impact</b>	High (-5)	Sensitive sites occur throughout the pipeline, such as ridges wetlands and grasslands.	
<b>Probability</b>	High (6)	It is likely that destruction of vegetation types will occur without management measures.	
<b>Nature</b>	Negative		
<b>Mitigation/ Management actions</b>			
<ul style="list-style-type: none"> <li>▪ Limit degradation and destruction of natural environment to designated project areas by keeping the footprint of the disturbed areas to the minimum and within designated areas only. Re-vegetate open areas to limit erosion.</li> <li>▪ Avoid known areas of faunal and floral SSC.</li> <li>▪ Avoid sensitive landscapes such as riparian and ridge areas that were encountered on site.</li> <li>▪ Manage nationally restricted alien invasive plant species by ensuring the removal of vegetation during construction and operation are controlled so that no open areas occur.</li> <li>▪ Applications for permits for removal of certain plants, where required</li> </ul>			
<b>Post- mitigation</b>			
<b>Duration</b>	Medium term (3)	With vegetation management including rehabilitation, vegetation can recover in 1-5 years.	Negligible (negative) – 21
<b>Extent</b>	Limited (2)	If contractors adhere to mitigation such as to limit the footprint of disturbance to only essential pipeline areas.	
<b>Intensity x type of impact</b>	Moderate (-3)	Certain habitats of concern is be present such as the grassland and ridges vegetation types.	
<b>Probability</b>	Unlikely (3)	Loss of vegetation will only occur in areas where it is completely necessary.	
<b>Nature</b>	Negative		



<b>Activity and Interaction (Construction of infrastructure (pipelines) require vegetation clearing)</b>			
<b>Dimension</b>	<b>Rating</b>	<b>Motivation</b>	<b>Significance</b>
<b>Impact Description: Loss of species of special concern (protected species)</b>			
<b><i>Prior to mitigation/ management</i></b>			
<b>Duration</b>	Long term (4)	Loss floral species/vegetation will occur.	<b>Minor (negative) – 72</b>
<b>Extent</b>	Local (3)	Species/habitat loss will only occur within and immediately around the Project site.	
<b>Intensity x type of impact</b>	High (-5)	Sensitive sites occur throughout the pipeline, such as ridges, wetlands and grasslands.	
<b>Probability</b>	High (6)	It is likely that destruction of vegetation types will occur without management measures.	
<b>Nature</b>	Negative		
<b><i>Mitigation/ Management actions</i></b>			
<ul style="list-style-type: none"> <li>▪ Limit degradation and destruction of natural environment to designated project areas by keeping the footprint of the disturbed areas to the minimum and within designated areas only. Re-vegetate open areas to limit erosion.</li> <li>▪ Avoid known areas of faunal and floral SSC.</li> <li>▪ Avoid sensitive landscapes such as riparian and ridge areas that were encountered on site.</li> <li>▪ Applications for permits for removal of certain plants, where required</li> </ul>			
<b><i>Post management</i></b>			
<b>Duration</b>	Medium term (3)	With vegetation management including rehabilitation, vegetation can recover in 1-5 years.	<b>Negligible (negative) – 21</b>
<b>Extent</b>	Limited (2)	If contractors adhere to mitigation such as to limit the footprint of disturbance to only essential areas.	
<b>Intensity x type of impact</b>	Moderate (-3)	Sensitive species are expected on site within grasslands, ridges and wetlands	
<b>Probability</b>	Unlikely (3)	It is unlikely that compaction will have an effect after rehabilitation	
<b>Nature</b>	Negative		



Activity and Interaction (Construction of infrastructure (pipelines and CPP) require vegetation clearing)			
Dimension	Rating	Motivation	Significance
<b>Impact Description: Alien vegetation establishment</b>			
<i>Prior to mitigation/ management</i>			
<b>Duration</b>	Long term (4)	Alien vegetation will colonise any area that is available.	Minor (negative) – 48
<b>Extent</b>	Municipal area (4)	Such an infestation can easily spread to the entire municipal area.	
<b>Intensity x type of impact</b>	Moderate (-4)	Serious loss of sensitive habitats due to alien vegetation colonisation.	
<b>Probability</b>	Probable (4)	It is unlikely that without mitigation measures, alien vegetation will establish	
<b>Nature</b>	Negative		
<i>Mitigation/ Management actions</i>			
<ul style="list-style-type: none"> <li>Manage nationally restricted alien invasive plant species by ensuring the removal of vegetation during construction and operation are controlled so that no open areas occur.</li> <li>If alien vegetation is encountered, remove these plants, in the correct way and timeously</li> </ul>			
<i>Post management</i>			
<b>Duration</b>	Medium term (3)	Alien vegetation colonisation will be eradicated asap.	Negligible (negative) – 21
<b>Extent</b>	Limited (2)	An infestation will not be allowed to spread.	
<b>Intensity x type of impact</b>	Minor (-2)	Only limited areas will experience this for a short duration.	
<b>Probability</b>	Unlikely (3)	It is unlikely that alien vegetation will establish, if mitigation is adhered to.	
<b>Nature</b>	Negative		

### 9.4.3 Operational Activities

Operational activities will not lead to direct impacts to fauna and flora.

### 9.4.4 Closure Phase Impacts

The decommissioning phase will involve the removal of the Ezulwini TSF infrastructure and rehabilitation of its impacted footprint. The pipelines will be left in situ.



**Table 9-23: Interactions and Impacts of the WRTRP Cooke MRA decommissioning phase**

Interaction	Impact
Decommissioning of the reclaimed Ezulwini TSF footprint.	With rehabilitation of the footprints, this will have a positive impact to vegetation and habitat types present.

**9.4.4.1 Management objectives**

The objective for this phase will be to maximise the success of the rehabilitation that will happen after infrastructure is removed, and to furthermore reduce any impacts that may occur during this phase.

**9.4.4.2 Management Action and Targets**

Decommissioning of the WRTRP infrastructure in the Ezulwini MRA will be predominantly a rehabilitation activity of footprint area. In order for this to be a positive impact the removal of the infrastructure must be completed so as to not harm or negatively impact surrounding vegetation. Furthermore the rehabilitation must be conducted in such a manner to achieve aims for the process. These aims will be to ensure the footprint areas are vegetated and that erosion through runoff and wind does not occur. Efforts will be maximised if rehabilitation is completed in the before the first rains fall so as to make use of the rainfall to assist in plant recruitment.

**9.4.4.3 Impact Rating**

Activity and Interaction: Rehabilitation of infrastructure footprint areas			
Dimension	Rating	Motivation	Significance
<b>Impact Description:</b> Restoration of vegetation and habitat types.			
<b>Duration</b>	Short term (2)	If rehabilitation is not completed effectively it will not last .	18 "Small Positive"
<b>Extent</b>	Very Limited (1)	Only certain parts of the site will have revegetated cover.	
<b>Intensity</b>	Moderate (3)	The effectiveness of the rehab will determine the intensity	
<b>Probability</b>	Unlikely (3)	It's unlikely that the rehabilitation will be effective	
<b>Nature</b>	Positive		
<b>Impact Description:</b> Rehabilitation of infrastructure footprint areas			
<b>Duration</b>	Permanent (7)	If rehabilitation is completed successfully this impact will be permanent	84 "Moderate"



Activity and Interaction: Rehabilitation of infrastructure footprint areas			
Dimension	Rating	Motivation	Significance
Extent	Local (3)	The general area beyond the project site will be positively impacted on.	positive"
Intensity	Positive (4)	Vegetation will be restored.	
Probability	Almost certain (6)	With correct implementation this impact has a high probability of occurring	
Nature	Positive		

## 10 Cumulative Impacts

### 10.1 Kloof MRA

The only construction and subsequent removal of vegetation that will occur is within the footprint of the CPP and the RTSF, with negligible (after mitigation) impacts occurring from the pipeline. These two pose the greatest cumulative impacts to the general area. It is expected that 346 ha of natural grassland and 12 ha of wetlands will be removed to facilitate construction. Total cumulative will be 358 ha.

### 10.2 Driefontein MRA

The pipeline to the CPP, through this MRA includes the construction of the WBT, which are the only two activities that will remove vegetation and habitat types.

If rehabilitation and remediation of the Driefontein TSF's are done, the MRA will see a positive impact to the vegetation and habitat types present. It is expected that 65.3 ha of natural grassland and 6.7 ha of wetlands and 7.4 ha of ridge will be removed to facilitate construction. Total cumulative will be 79.4 ha.

### 10.3 Cooke MRA

The only disturbance to vegetation and habitat types is the construction of the pipeline, which is not a significant impact.

If rehabilitation and remediation of the Cooke TSF is done, the MRA will see a positive impact to the vegetation and habitat types present. It is expected that 16.7 ha of natural grassland, 6 ha of wetland and 3.3 ha of ridge are will be removed to facilitate construction. Total cumulative will be 26 ha.

### 10.4 Ezulwini MRA

The activities within this MRA have the potential to directly contribute to the cumulative negative impacts to wetlands of the local area, municipality and province. The contents of the pipeline represent a significant threat to the wetlands and water resources of the catchment as it is uranium rich. This is captured in the unplanned events section below.





If rehabilitation and remediation of the Ezulwini South TSF is done, the MRA will see a positive impact to the vegetation and habitat types present. Total cumulative will be 17.3.

## 11 Unplanned Events and Low Risks

### 11.1 Kloof MRA

The activities taking place in the Kloof MRA have the potential to result in unplanned events that may have significant impacts to the natural vegetation and habitat types of the area. These are described in Table 11-1.

**Table 11-1: Unplanned events and impacts to fauna and flora in the Kloof MRA**

Unplanned event	Potential impact	Mitigation/ Management/ Monitoring
<b>Hydrocarbon spillage</b>	Natural vegetation and habitat types will be adversely affected.	Vehicles must only be serviced within designated service bays. Hydrocarbon spill kits must be available on site at all locations where hydrocarbon spills could occur.
<b>Tailings slurry pipeline burst.</b>	Natural vegetation and habitat types will be adversely affected.	Install emergency shut off valves to help in the case of pipe bursts.
<b>RTSF overflow</b>	Natural vegetation and habitat types will be adversely affected.	Engineering design of the RTSF and PCD must consider the prevention of any spillage from entering natural vegetation or habitats. This will include catering for the 1:100 year floods, designing an overflow catchment dam

### 11.2 Driefontein MRA

The activities taking place in the Driefontein MRA have the potential to result in unplanned events that may have significant impacts to the wetlands of the area and catchment. These are described in the table below.

**Table 11-2: Unplanned events and impacts to fauna and flora of the Driefontein MRA**

Unplanned event	Potential impact	Mitigation/ Management/ Monitoring
Hydrocarbon spillage	Natural vegetation and habitat types will be adversely affected, including wetlands.	Vehicles must only be serviced within designated service bays. Hydrocarbon spill kits must be available on site at all locations where hydrocarbon spills could take place.



Unplanned event	Potential impact	Mitigation/ Management/ Monitoring
Tailings slurry spill due to a pipeline burst or during hydraulic reclamation of the TSF's.	This will result in contamination of the vegetation and habitat types.	Monitoring of the pipeline and its pressure must be a continuous mitigation effort prevent a leak or burst or to identify a burst as soon as possible. Should it occur, emergency valves need to be shut down to prevent spillage of hazardous material.

### 11.3 Cooke MRA

The mining of the Cooke TSF in the Cooke MRA has the potential to result in unplanned events that will have significant impacts to the vegetation and habitat types of the area. These are described in the table below.

**Table 11-3: Unplanned events and impacts to the vegetation and habitat types of the Cooke MRA**

Unplanned event	Potential impact	Mitigation/ Management/ Monitoring
Hydrocarbon spillage	Natural vegetation and habitat types will be adversely affected, including wetlands.	Vehicles must only be serviced within designated service bays. Hydrocarbon spill kits must be available on site at all locations where hydrocarbon spills could take place.
Tailings slurry spill due to a pipeline burst or during hydraulic reclamation of the TSF's.	This will result in contamination of the vegetation and habitat types.	Monitoring of the pipeline and its pressure must be a continuous mitigation effort prevent a leak or burst or to identify a burst as soon as possible. Should it occur, emergency valves need to be shut down to prevent spillage of hazardous material.

### 11.4 Ezulwini MRA

The mining of the Ezulwini South TSF in the Ezulwini MRA has the potential to result in unplanned events that will have impacts on the vegetation and habitat types of the area. These are described in the table below.



**Table 11-4: Unplanned events and impacts to vegetation and habitat in the Ezulwini MRA**

Unplanned event	Potential impact	Mitigation/ Management/ Monitoring
Hydrocarbon spillage	Natural vegetation and habitat types will be adversely affected, including wetlands.	Vehicles must only be serviced within designated service bays. Hydrocarbon spill kits must be available on site at all locations where hydrocarbon spills could take place.
Tailings slurry spill due to a pipeline burst or during hydraulic reclamation of the TSF's.	This will result in contamination of the vegetation and habitat types.	Monitoring of the pipeline and its pressure must be a continuous mitigation effort prevent a leak or burst or to identify a burst as soon as possible. Should it occur, emergency valves need to be shut down to prevent spillage of hazardous material.

## 12 Environmental Management Plan

The objective of an Environmental Management Plan (EMP) is to present mitigation and (a) to manage undue or reasonably avoidable adverse impacts associated with the development of a project, and (b) to enhance potential positive impacts.

Mitigation measures will be built into the base of a project and should be considered as part of the “pre-mitigation” scenario; additional mitigation must be recommended if the impact assessment indicates it is necessary.

The key objectives of environmental and social management plans are to give S.M.A.R.T. mitigation measures to:

- Identify the actual environmental, socio-economic and public health impacts of the project and check if the observed impacts are within the levels predicted in the EMP;
- Determine that mitigation measures or other conditions attached to project approval (e.g. by legislation) are properly implemented and work effectively;
- Adapt the measures and conditions attached to project approval in the light of new information or take action to manage unanticipated impacts if necessary;
- Gauge if predicted benefits of the project are being achieved and maximized; and
- Gain information for improving similar projects and ESIA practice in the future.



## 12.1 Project Activities with Potentially Significant Impacts

Give a short introduction and then list the activities with potentially significant impacts (relevant to your specialist field), that require mitigation or management:

**Table 12-1: Potentially Significant Impacts of the Pipelines and Associated Infrastructure Development**

Aspects	Potential Significant impacts
<b>Kloof Mining Right Area</b>	
Placement of the CPP and RTSF in grassland habitat type	Permanent loss of vegetation and habitat.
<b>Driefontein Mining Right Area</b>	
Placement of the WBT and BWSF in grassland habitat type	Permanent loss of vegetation and habitat.
<b>Cooke Mining Right Area</b>	
Placement of pipeline and Cooke thickener within grassland and ridge vegetation types	This will result in the partial removal of vegetation and therefore habitat.
<b>Ezulwini Mining Right Area</b>	
Placement of pipeline within grassland, wetland and ridge vegetation types	This will result in the partial removal vegetation and therefore habitat.

## 12.2 Summary of Mitigation and Management

This section provides a description of the mitigation and management options for the environmental impacts anticipated during the construction, operational and decommissioning and closure phases. Table 12-2 to Table 12-4 provide a summary of the proposed project activities, environmental aspects and impacts on the receiving environment. Information on the frequency of mitigation, relevant legal requirements, recommended management plans, timing of implementation, and roles / responsibilities of persons implementing the EMP.

**Table 12-2: Impacts**

Activities	Phase	Size and scale of disturbance	Mitigation Measures	Compliance with standards	Time period for implementation
<b>Kloof Mining Right Area</b>					
Construction of pipelines, CPP and RTSF around natural areas	Pre-construction and construction		<p>Red Data Status plants located in areas of development should be marked prior to construction and the necessary permits for relocations of protected species must be obtained from the relevant government department. The relocation strategy must be approved by relevant authorities prior to relocation to a safe place to avoid destruction. A nursery should be developed on site for this purpose</p> <p>Illegal waste dumping should be prohibited</p> <p>Training should be given to onsite staff on which plants have Red Data Status and how to identify them</p> <p>Destruction of vegetation should be</p>	<p>South African National Biodiversity Institute (SANBI) Red List of South African plants version 2012.1</p> <p>National Environmental Management Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA) listed species;</p> <p>National Forests Act, 1998 (Act No. 84 of 1998) Protected Trees;</p> <p>Gauteng Protected Plants.</p>	Continually, specifically construction



Activities	Phase	Size and scale of disturbance	Mitigation Measures	Compliance with standards	Time period for implementation
			<p>limited to the areas essential for the development</p> <p>All bare patches of soil should be vegetated, preferably with pioneer species which will colonise open and disturbed areas relatively quickly</p> <p>Community awareness should be implemented as part of the stakeholder engagement procedure to create awareness of biodiversity and preservation of natural habitats</p> <p>Rehabilitation of disturbed areas should take place as soon as possible</p>		
<b>Driefontein Mining Right Area</b>					
Construction of the WBT and BWSF within grassland habitat type	Pre-construction and construction		Red Data Status plants located in areas of development should be marked prior to construction and the necessary permits for relocations of protected species must be obtained from the relevant government	South African National Biodiversity Institute (SANBI) Red List of South African plants version 2012.1 National Environmental Management Biodiversity Act,	Continually, specifically construction

Activities	Phase	Size and scale of disturbance	Mitigation Measures	Compliance with standards	Time period for implementation
			<p>department. The relocation strategy must be approved by relevant authorities prior to relocation to a safe place to avoid destruction. A nursery should be developed on site for this purpose</p> <p>Illegal waste dumping should be prohibited</p> <p>Training should be given to onsite staff on which plants have Red Data Status and how to identify them</p> <p>Destruction of vegetation should be limited to the areas essential for the development</p> <p>All bare patches of soil should be vegetated, preferably with pioneer species which will colonise open and disturbed areas relatively quickly</p> <p>Community awareness should be implemented as part of the stakeholder engagement procedure to create awareness of biodiversity and preservation of natural habitats</p> <p>Rehabilitation of disturbed areas</p>	<p>2004 (Act No. 10 of 2004) (NEMBA) listed species;</p> <p>National Forests Act, 1998 (Act No. 84 of 1998) Protected Trees; and</p> <p>Gauteng Protected Plants.</p>	

Activities	Phase	Size and scale of disturbance	Mitigation Measures	Compliance with standards	Time period for implementation
			should take place as soon as possible		
Decommissioning of Infrastructure	Decommissioning Phase	All footprints of areas that are going to be rehabilitated including Driefontein TSF 3 and 5	Ensure areas are rehabilitated with correct grass seed mix. Ensure areas that are to be rehabilitated are prepared beforehand, this includes correct slopes, correct soil placement, correct machinery is available for the task. (Please refer to Digby Wells Rehabilitation report 2015)	Please refer to Digby Wells Rehabilitation report 2015	Please refer to Digby Wells Rehabilitation report 2015
<b>Cooke Mining Right Area</b>					
Construction of the pipeline within grassland habitat type	Pre-construction and construction		Red Data Status plants located in areas of development should be marked prior to construction and the necessary permits for relocations of protected species must be obtained from the relevant government department. The relocation strategy must be approved by relevant authorities prior to relocation to a safe place to avoid destruction. A nursery should be developed on site for this	South African National Biodiversity Institute (SANBI) Red List of South African plants version 2012.1 National Environmental Management Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA) listed species; National Forests Act, 1998 (Act No. 84 of 1998) Protected Trees; and	Continually, specifically construction.

Activities	Phase	Size and scale of disturbance	Mitigation Measures	Compliance with standards	Time period for implementation
			<p>purpose</p> <p>Illegal waste dumping should be prohibited</p> <p>Training should be given to onsite staff on which plants have Red Data Status and how to identify them</p> <p>Destruction of vegetation should be limited to the areas essential for the development</p> <p>All bare patches of soil should be vegetated, preferably with pioneer species which will colonise open and disturbed areas relatively quickly</p> <p>Community awareness should be implemented as part of the stakeholder engagement procedure to create awareness of biodiversity and preservation of natural habitats</p> <p>Rehabilitation of disturbed areas should take place as soon as possible</p>	<p>Gauteng Protected Plants.</p>	

Activities	Phase	Size and scale of disturbance	Mitigation Measures	Compliance with standards	Time period for implementation
Decommissioning of Infrastructure	Decommissioning Phase	All footprints of areas that are going to be rehabilitated including Driefontein TSF 3 and 5	Ensure areas are rehabilitated with correct grass seed mix. Ensure areas that are to be rehabilitated are prepared beforehand, this includes correct slopes, correct soil placement, correct machinery is available for the task. (Please refer to Digby Wells Rehabilitation report 2015)	Please refer to Digby Wells Rehabilitation report 2015	Please refer to Digby Wells Rehabilitation report 2015
<b>Ezulwini Mining Right Area</b>					
Construction of the pipeline within grassland, ridges and wetland habitat types	Pre-construction and construction		Red Data Status plants located in areas of development should be marked prior to construction and the necessary permits for relocations of protected species must be obtained from the relevant government department. The relocation strategy must be approved by relevant authorities prior to relocation to a safe place to avoid destruction. A nursery should be developed on site for this purpose Illegal waste dumping should be	South African National Biodiversity Institute (SANBI) Red List of South African plants version 2012.1 National Environmental Management Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA) listed species; National Forests Act, 1998 (Act No. 84 of 1998) Protected Trees; and Gauteng Protected Plants.	Continually, specifically construction



Activities	Phase	Size and scale of disturbance	Mitigation Measures	Compliance with standards	Time period for implementation
			<p>prohibited</p> <p>Training should be given to onsite staff on which plants have Red Data Status and how to identify them</p> <p>Destruction of vegetation should be limited to the areas essential for the development</p> <p>All bare patches of soil should be vegetated, preferably with pioneer species which will colonise open and disturbed areas relatively quickly</p> <p>Community awareness should be implemented as part of the stakeholder engagement procedure to create awareness of biodiversity and preservation of natural habitats</p> <p>Rehabilitation of disturbed areas should take place as soon as possible</p>		

Activities	Phase	Size and scale of disturbance	Mitigation Measures	Compliance with standards	Time period for implementation
Decommissioning of Infrastructure	Decommissioning Phase	All footprints of areas that are going to be rehabilitated including Driefontein TSF 3 and 5	Ensure areas are rehabilitated with correct grass seed mix. Ensure areas that are to be rehabilitated are prepared beforehand, this includes correct slopes, correct soil placement, correct machinery is available for the task. (Please refer to Digby Wells Rehabilitation report 2015)	Please refer to Digby Wells Rehabilitation report 2015	Please refer to Digby Wells Rehabilitation report 2015

**Table 12-3: Objectives and Outcomes of the EMP**

Activities	Potential impacts	Aspects affected	Phase	Mitigation	Standard to be achieved/objective
<b>Kloof Mining Right Area</b>					
Construction of pipelines, CPP and RTSF around natural areas	Removal of vegetation and habitat.	Flora and Fauna	Pre-construction and construction	Red Data Status plants located in areas of development should be marked prior to construction and the necessary permits for relocations of protected species must be obtained from the relevant government department. The relocation strategy must be approved by relevant	South African National Biodiversity Institute (SANBI) Red List of South African plants version 2012.1  National Environmental

Activities	Potential impacts	Aspects affected	Phase	Mitigation	Standard to be achieved/objective
				<p>authorities prior to relocation to a safe place to avoid destruction. A nursery should be developed on site for this purpose</p> <p>Illegal waste dumping should be prohibited</p> <p>Training should be given to onsite staff on which plants have Red Data Status and how to identify them</p> <p>Destruction of vegetation should be limited to the areas essential for the development</p> <p>All bare patches of soil should be vegetated, preferably with pioneer species which will colonise open and disturbed areas relatively quickly</p> <p>Community awareness should be implemented as part of the stakeholder engagement procedure to create awareness of biodiversity and preservation of natural habitats</p> <p>Rehabilitation of disturbed areas should take place as soon as possible</p>	<p>Management Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA) listed species;</p> <p>National Forests Act, 1998 (Act No. 84 of 1998) Protected Trees;</p> <p>Gauteng Protected Plants.</p>

Activities	Potential impacts	Aspects affected	Phase	Mitigation	Standard to be achieved/objective
<b>Driefontein Mining Right Area</b>					
Construction of the WBT and BWSF within grassland habitat type	Removal of vegetation and habitat.	Flora and Fauna	Pre-construction and construction	<p>Red Data Status plants located in areas of development should be marked prior to construction and the necessary permits for relocations of protected species must be obtained from the relevant government department. The relocation strategy must be approved by relevant authorities prior to relocation to a safe place to avoid destruction. A nursery should be developed on site for this purpose</p> <p>Illegal waste dumping should be prohibited</p> <p>Training should be given to onsite staff on which plants have Red Data Status and how to identify them</p> <p>Destruction of vegetation should be limited to the areas essential for the development</p> <p>All bare patches of soil should be vegetated, preferably with pioneer species which will colonise open and disturbed areas relatively quickly</p>	<p>South African National Biodiversity Institute (SANBI) Red List of South African plants version 2012.1</p> <p>National Environmental Management Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA) listed species;</p> <p>National Forests Act, 1998 (Act No. 84 of 1998) Protected Trees; and</p> <p>Gauteng Protected Plants.</p>

Activities	Potential impacts	Aspects affected	Phase	Mitigation	Standard to be achieved/objective
				Community awareness should be implemented as part of the stakeholder engagement procedure to create awareness of biodiversity and preservation of natural habitats  Rehabilitation of disturbed areas should take place as soon as possible.	
Construction of the WBT and BWSF within grassland habitat type	Introduction of alien invasive species	Flora	Pre-construction and construction	Review of the monitoring programme to determine the spread of invasive species and if this has occurred, to action the removal and eradication  All alien invasive species within the project area should be eradicated and their reintroduction controlled	Alien and Invasive Species Lists, 2014 (GN R599 in GG 37886 of 1 August 2014) of the NEMBA (Act 10 of 2004).
Decommissioning of Infrastructure	Decommissioning Phase	All footprints of areas that are going to be rehabilitated including	Ensure areas are rehabilitated with correct grass seed mix.  Ensure areas that are to be rehabilitated are prepared beforehand, this includes correct slopes, correct soil placement, correct machinery is available	Please refer to Digby Wells Rehabilitation report 2015	Please refer to Digby Wells Rehabilitation report 2015



Activities	Potential impacts	Aspects affected	Phase	Mitigation	Standard to be achieved/objective
			for the task. (Please refer to Digby Wells Rehabilitation report 2015)		
<b>Cooke Mining Right Area</b>					
Construction of the pipeline within grassland habitat type	Removal of vegetation and habitat	Flora and Fauna	Pre-construction and construction	<p>Red Data Status plants located in areas of development should be marked prior to construction and the necessary permits for relocations of protected species must be obtained from the relevant government department. The relocation strategy must be approved by relevant authorities prior to relocation to a safe place to avoid destruction. A nursery should be developed on site for this purpose</p> <p>Illegal waste dumping should be prohibited</p> <p>Training should be given to onsite staff on which plants have Red Data Status and how to identify them</p> <p>Destruction of vegetation should be limited to the areas essential for the</p>	

Activities	Potential impacts	Aspects affected	Phase	Mitigation	Standard to be achieved/objective
				development All bare patches of soil should be vegetated, preferably with pioneer species which will colonise open and disturbed areas relatively quickly Community awareness should be implemented as part of the stakeholder engagement procedure to create awareness of biodiversity and preservation of natural habitats Rehabilitation of disturbed areas should take place as soon as possible	
Construction of the pipeline within grassland habitat type	Introduction of alien invasive species	Flora	Pre-construction and construction	Review of the monitoring programme to determine the spread of invasive species and if this has occurred, to action the removal and eradication All alien invasive species within the project area should be eradicated and their reintroduction controlled	Alien and Invasive Species Lists, 2014 (GN R599 in GG 37886 of 1 August 2014) of the NEMBA (Act 10 of 2004).

Activities	Potential impacts	Aspects affected	Phase	Mitigation	Standard to be achieved/objective
Decommissioning of Infrastructure	Decommissioning Phase	All footprints of areas that are going to be rehabilitated	<p>Ensure areas are rehabilitated with correct grass seed mix.</p> <p>Ensure areas that are to be rehabilitated are prepared beforehand, this includes correct slopes, correct soil placement, correct machinery is available for the task.</p> <p>(Please refer to Digby Wells Rehabilitation report 2015)</p>	Please refer to Digby Wells Rehabilitation report 2015	Please refer to Digby Wells Rehabilitation report 2015
<b>Ezulwini Mining Right Area</b>					
Construction of the pipeline within grassland, ridges and wetland habitat types	Removal of vegetation and habitat	Flora and Fauna	Pre-construction and construction	Red Data Status plants located in areas of development should be marked prior to construction and the necessary permits for relocations of protected species must be obtained from the relevant government department. The relocation strategy must be approved by relevant authorities prior to relocation to a safe place to avoid destruction. A	<p>South African National Biodiversity Institute (SANBI) Red List of South African plants version 2012.1</p> <p>National Environmental Management Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA) listed</p>

Activities	Potential impacts	Aspects affected	Phase	Mitigation	Standard to be achieved/objective
				<p>nursery should be developed on site for this purpose</p> <p>Illegal waste dumping should be prohibited</p> <p>Training should be given to onsite staff on which plants have Red Data Status and how to identify them</p> <p>Destruction of vegetation should be limited to the areas essential for the development</p> <p>All bare patches of soil should be vegetated, preferably with pioneer species which will colonise open and disturbed areas relatively quickly</p> <p>Community awareness should be implemented as part of the stakeholder engagement procedure to create awareness of biodiversity and preservation of natural habitats</p> <p>Rehabilitation of disturbed areas should take place as soon as possible</p>	<p>species;</p> <p>National Forests Act, 1998 (Act No. 84 of 1998)</p> <p>Protected Trees; and</p> <p>Gauteng Protected Plants.</p>

Activities	Potential impacts	Aspects affected	Phase	Mitigation	Standard to be achieved/objective
Construction of the pipeline within grassland, ridges and wetland habitat types	Introduction of alien invasive species	Flora	Pre-construction and construction	Review of the monitoring programme to determine the spread of invasive species and if this has occurred, to action the removal and eradication  All alien invasive species within the project area should be eradicated and their reintroduction controlled	Alien and Invasive Species Lists, 2014 (GN R599 in GG 37886 of 1 August 2014) of the NEMBA (Act 10 of 2004).
Decommissioning of Infrastructure	Decommissioning Phase	All footprints of areas that are going to be rehabilitated including	Ensure areas are rehabilitated with correct grass seed mix.  Ensure areas that are to be rehabilitated are prepared beforehand, this includes correct slopes, correct soil placement, correct machinery is available for the task.  (Please refer to Digby Wells Rehabilitation report 2015)	Please refer to Digby Wells Rehabilitation report 2015	Please refer to Digby Wells Rehabilitation report 2015

**Table 12-4: Mitigation**

Activities	Potential impacts	Aspects affected	Mitigation type	Time period for implementation	Compliance with standards
<b>Kloof Mining Right Area</b>					
Placement of the CPP and RTSF within natural grassland	Removal of vegetation and habitat	Fauna and Flora	<p>Red Data Status plants located in areas of development should be marked prior to construction and the necessary permits for relocations of protected species must be obtained from the relevant government department. The relocation strategy must be approved by relevant authorities prior to relocation to a safe place to avoid destruction. A nursery should be developed on site for this purpose</p> <p>Illegal waste dumping should be prohibited</p> <p>Training should be given to onsite staff on which plants have Red Data Status and how to identify them</p> <p>Destruction of vegetation should be limited to the areas essential for the development</p> <p>All bare patches of soil should be vegetated, preferably with pioneer species which will colonise open and disturbed areas relatively quickly</p> <p>Community awareness should be implemented as part of the stakeholder engagement procedure to create awareness of biodiversity and preservation of natural habitats</p> <p>Rehabilitation of disturbed areas should take place as soon as possible</p>	Life of project	<p>South African National Biodiversity Institute (SANBI) Red List of South African plants version 2012.1</p> <p>National Environmental Management Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA) listed species;</p> <p>National Forests Act, 1998 (Act No. 84 of 1998) Protected Trees; and</p> <p>Gauteng Protected Plants.</p>



Activities	Potential impacts	Aspects affected	Mitigation type	Time period for implementation	Compliance with standards
Rehabilitation of the RTSF; this is to remain in perpetuity.	Removal of vegetation and habitat	Fauna and Flora	<p>Red Data Status plants located in areas of development should be marked prior to construction and the necessary permits for relocations of protected species must be obtained from the relevant government department. The relocation strategy must be approved by relevant authorities prior to relocation to a safe place to avoid destruction. A nursery should be developed on site for this purpose</p> <p>Illegal waste dumping should be prohibited</p> <p>Training should be given to onsite staff on which plants have Red Data Status and how to identify them</p> <p>Destruction of vegetation should be limited to the areas essential for the development</p> <p>All bare patches of soil should be vegetated, preferably with pioneer species which will colonise open and disturbed areas relatively quickly</p> <p>Community awareness should be implemented as part of the stakeholder engagement procedure to create awareness of biodiversity and preservation of natural habitats</p> <p>Rehabilitation of disturbed areas should take place as soon as possible</p>	-	<p>South African National Biodiversity Institute (SANBI) Red List of South African plants version 2012.1</p> <p>National Environmental Management Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA) listed species;</p> <p>National Forests Act, 1998 (Act No. 84 of 1998) Protected Trees; and</p> <p>Gauteng Protected Plants.</p>

Activities	Potential impacts	Aspects affected	Mitigation type	Time period for implementation	Compliance with standards
<b>Driefontein Mining Right Area</b>					
Placement of the WBT and BWSF in natural vegetation	Removal of vegetation and habitat	Fauna and Flora	<p>Red Data Status plants located in areas of development should be marked prior to construction and the necessary permits for relocations of protected species must be obtained from the relevant government department. The relocation strategy must be approved by relevant authorities prior to relocation to a safe place to avoid destruction. A nursery should be developed on site for this purpose</p> <p>Illegal waste dumping should be prohibited</p> <p>Training should be given to onsite staff on which plants have Red Data Status and how to identify them</p> <p>Destruction of vegetation should be limited to the areas essential for the development</p> <p>All bare patches of soil should be vegetated, preferably with pioneer species which will colonise open and disturbed areas relatively quickly</p> <p>Community awareness should be implemented as part of the stakeholder engagement procedure to create awareness of biodiversity and preservation of natural habitats</p> <p>Rehabilitation of disturbed areas should take place as soon as possible</p>	An offset strategy will need to be compiled prior to any construction.	<p>South African National Biodiversity Institute (SANBI) Red List of South African plants version 2012.1</p> <p>National Environmental Management Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA) listed species;</p> <p>National Forests Act, 1998 (Act No. 84 of 1998) Protected Trees; and</p> <p>Gauteng Protected Plants.</p>

**Table 12-5: Prescribed environmental management standards, practice, guideline, policy or law**

Specialist field	Applicable standard, practice, guideline, policy or law			
Fauna and flora	South African National Biodiversity Institute (SANBI) Red List of South African plants version 2012.1	National Environmental Management Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA) listed species	National Forests Act, 1998 (Act No. 84 of 1998) Protected Trees;	Gauteng Protected Plants.



## 12.3 Monitoring Plan

The fauna and flora monitoring programme should be initiated pre-construction and continue through construction thereafter conducted annually during the growing season (December to March) as close to the same time of year as possible. Should the monitoring results indicate the additional presence of red data species, or threatened species, this may necessitate the need to undergo monitoring for that particular species more frequently, especially during the breeding season and birthing season for that species.

Monitoring will include sites in the undisturbed vegetation which will act as control plots, plots within the disturbed infrastructure areas which will have baseline data and then be monitored during the rehabilitation phase. The same plots will be monitored with each survey so as to ensure collected data is comparable and trends are identified.

Where rehabilitation is conducted, additional plots will be included to monitor the efficacy of the re-vegetation.

Aspects that will be monitored in the annual surveys will include, species richness, vegetation composition i.e. proportion grasses, forbs and woody species, canopy height, cover percentage, presence of Red Data or protected species, and presence of alien invasive species.

### 12.3.1 Flora

#### 12.3.1.1 Vegetation Cover Monitoring

The vegetation cover established on the disturbed areas needs to be monitored annually for the first five years after rehabilitation has been carried out, to ensure that the rehabilitation work has been successful in terms of stabilising the newly formed surfaces (preventing air and water erosion from affecting those surfaces), and that the newly established vegetation cover is trending towards convergence with the original vegetation cover found on the areas prior to disturbance (and on adjacent undisturbed areas) (Dawson, 2007).

Various parameters need to be measured, both on the rehabilitation sites and in the adjacent undisturbed areas, to determine the success or otherwise of the establishment of the rehabilitation vegetation cover, and how this compares with the undisturbed vegetation in the area.

These parameters include (Dawson, 2007):

- Plant species presence / absence
- Presence / absence of weed species in the rehabilitation cover
- The number of individuals of a species in a given area ("density")
- The number of times a species is recorded in a given number of sample points ("frequency")
- The area covered by vegetation at ground level ("basal cover")



- The “biomass” of representative sample plots, giving an indication of the mass of living material present above the surface
- An assessment of the vitality or “vigour” of the various species present. This can be assessed by measuring factors such as the amount of inflorescences (flowering heads) or seed produced, and the proportion of senescent (dead) material present within the vegetation cover.
- Photographic recording of vegetation appearance, at fixed points, to provide a visual record of appearance and changes over time.
- Potential climatic influences on local biodiversity, which will be apparent with inclusion of control plots.

This assessment needs to be undertaken by a botanist / environmental scientist trained and experienced in vegetation assessments of this nature (Dawson, 2007).

Vegetation cover of rehabilitated areas should be assessed during the summer growing season, at least a month after rain has fallen (so that there has been an opportunity for fresh plant growth to have occurred). It is recommended that this should be done annually for the first five years. Thereafter, visual spot-checking with photographic recording by an experienced field botanist / rehabilitation practitioner every three years will suffice, depending on results found. Remote sensing information and aerial photos will also be used to determine impacts and management plans. A detailed botanical study should again be undertaken, comparing plots on the rehabilitated areas with plots in the undisturbed adjacent vegetation, 20 years post rehabilitation (Dawson, 2007)

The environmental indicators which will demonstrate whether the rehabilitation has been successful or not include:

- Increasing similarity between rehabilitated and undisturbed areas in terms of species composition and vegetation structure;
- Increasing species diversity of desired (local) species in rehabilitation cover over time;
- Reduction in presence of weed species over time;
- Increase in woody plant growth, and achievement of reproductive status and production of reproductive propagules (seed);
- Ability of the rehabilitation species populations to reproduce, indicated by the presence of seedlings of the rehabilitation species once the original generation has reached sexual maturity (“population recruitment”);
- Increase in vegetation basal cover and biomass;
- Increase in soil organic matter.



In the event that the vegetation cover remains static, or should deteriorate; additional seeding, with locally harvested species, and possibly fertilisation would be required as a mitigation measure.

#### **12.3.1.2 Alien Vegetation Monitoring**

During vegetation monitoring, the presence of alien species should also be detected. An active programme of weed management, to control the presence and spread of invasive weeds, will need to be instituted so that any weeds encroaching because of the disturbed conditions are controlled by means appropriate to the species.

Species likely to be problematic include those identified during the fauna and flora study of the site, namely *Datura stramonium* and *D. ferox* and *Opuntia ficus-indica*.

The environmental indicator assessed in this instance is the reduction in presence of weed species over time, to the point where no invasive weed species are present and no further population recruitment occurs.

### **12.3.2 Fauna**

The fauna monitoring will be closely linked to the flora monitoring to enable solid scientific conclusions and comparisons; also, the strong ecological link between vegetation and animals can only be measured if monitoring is similar (e.g. in terms of monitoring points) for both disciplines.

To successfully monitor faunal and floral biodiversity, a solid baseline (pre-construction) will be established through the first round of monitoring. This needs to be supplemented with regular repeats to compile a reasonable comparison between the pre-construction faunal communities present and faunal communities found in the same areas during various stages of construction and operation of the proposed project.

#### **12.3.2.1.1 Mammals**

Small mammals will be surveyed by using small mammal live traps – line transects will be used to gather repeatable quantitative data with regards to species richness and population dynamics. Tracks and ecological indicators will be used to assess the presence of larger free-roaming mammals – frequencies of such observations will be used for quantitative comparisons. The nesting sites, burrows and possible home ranges of these species will be recorded, marked, monitored and actively avoided.

All wetland and riverine habitats must be continuously surveyed for the following mammal species: Rough-haired golden moles (*Chrysospalax villosus*), Spotted-necked otter (*Lutra maculicollis*), African marsh rat (*Dasymys incomtus*). This must also include any other SSC that has been identified on or near the project area.





### ***12.3.2.1.2 Birds***

Line transects will be used to compile quantitative lists of birds present in the areas surveyed; both sounds and visual observations will be used. Nesting sites of threatened birds, will be marked and the area preserved with an adequate buffer zone. The authorities will be informed of any sites found and Sibanye will abide by their recommendations. It is recommended that the more detailed avifaunal monitoring is conducted in the breeding season between October and January.

Surveys for terrestrial birds must be conducted in summer, but only once the vegetation layer has recovered sufficiently from winter fires to allow for assessment of available habitat.

Surveys for aquatic birds must also be conducted in summer. For species associated with rivers, the assessment must coincide with average flow conditions (i.e. not dry and not in flood) and preferably within the breeding season. For species associated with wetlands, the assessment must follow good summer rains i.e. standing water must be present and the vegetation must have recovered sufficiently from winter fires to allow for assessment of available habitat.

### ***12.3.2.1.3 Reptiles & Amphibians***

Active searches for both reptiles and amphibians will be used to assess species richness of these groups in the area; due to the difficulty in recording occurrence of these groups data gathering will be limited to species counts.

### ***12.3.2.1.4 Invertebrates***

Invertebrate biodiversity will be measured by using pitfall trap lines. This method concentrates on ground-living invertebrates – the groups found in pitfall traps are good indicator groups for general biodiversity. Pitfall traps can be repeated exactly and works well in areas where vegetation cover at ground level is low (open habitat) as is found in the study area. In addition sweep net sampling will be conducted to provide an indication of airborne and canopy dwelling species.

## **13 Consultation Undertaken**

Through this process, stakeholders have the opportunity to comment on all aspects of the project and specialist studies. Consultation was undertaken with farm owners/occupiers to gain access to farm portions where specialist fauna and flora investigation were required. Consultation was undertaken with the owner of the farm portions associated with the RTSF boundary.

## 14 Comments and Responses

### 14.1 Ecology

Emily Taylor Endangered Wildlife Trust	NGOs Focus Group Meeting	What species have been identified? EWT would like to be involved and assist with information where possible.	Thank you for your comment, the wet and dry season field work studies have been completed and the full species list (both fauna and flora) is in the F&F report heading no.7. EWT did not accompany the team during the dry season site visit due to short time frames. However the report will also be made available to EWT for review.
Tom McGhee	Written Comment	In the Environmental Management Framework (EMF) for the West Rand District Municipality (WRDM) by BKS (Pty) Ltd, the Eco status area of the proposed RTFS is considered to be Endangered (map 18 of the report). Surely this means that the construction of such a large polluting facility should not be allowed. Furthermore, the ridges over which the proposed slimes pipelines will be running are considered to be class 1 and class 2 ridges (Map 8). Reading the report in its entirety suggests that the positioning of the RTFS is inadvisable in the least.	Thank you for the comment, according to the Digby Wells Fauna and Flora surveys the RTSF will only disturb 260 ha of transformed grassland and a further 1121 ha of agricultural areas, this area is therefore not considered endangered, after fine scale field work assessments. All pipeline areas that cross ridges are marked as highly sensitive, and the prescribed mitigation measures are deemed sufficient to negate this impact.
Mark Gietzmann	Written Comment	You must be aware of the wetlands and ground pools with the bullfrogs and the little wild Steenbok and duiker in the area.	Thank you for the comment. All protected and endangered species according to legislation and frameworks listed in Tabel 3.1 in the fauna and flora report were consulted. All efforts are prescribed to not disturb or affect any protected species habitat or individual. All efforts are made not to disturb any natural fauna and flora.

## 14.2 Fauna

<p>Peet Bornman Landowner</p>	<p>Landowners Focus Group Meeting</p>	<p>The waste dump is right next to my cattle kraal and meat derived from my cattle will be contaminated as a result. Barry's wife is sick because of drinking the borehole water which is contaminated.</p>	<p>The impact assessment phase will assess the current status of the boreholes and other pathways and assess the potential contamination zones from the facility. Fauna and Flora cannot comment on this issue</p>
<p>Judith Taylor Earthlife Africa</p>	<p>NGOs Focus Group Meeting</p>	<p>Bullfrogs need to be considered as part of the specialist studies. Digby Wells can involve us with site visits.</p>	<p>Thank you for the comment, The F&amp;F team only had a dry season site visit left at the time of this comment and Bullfrogs were not expected in this season. Bullfrogs were taken into account during both studies..</p>
<p>Hermann Heunis Landowner</p>	<p>Written Comment</p>	<p>The precipitation of toxic substances through dust sifting down on the environment (in the immediate vicinity of the tailings facility) will have a negative impact on a breeding project of Nyalas.</p>	<p>Thank you for the comment - Through the F&amp;F field surveys suitable natural habitat was not encountered for Nyala, around the TSF. The habitat requirements of Nyala's are dense shrubs to thickets/forests and occasional floodplains, they only access open grassland within their range during the night to graze, adjacent to the TSF there are very few open grassland areas, with agriculture dominating the landscape, the exact conditions of the breeding project is not known, however the habitat must contain a minimum of 15% thicket and must be an absolute minimum of 60 ha in size. The less the thicket component of the habitat, the more nocturnal the nyala become. The grass layer must consist of short to medium sweet grass species 4-23 cm high. Nyala cannot survive in areas with a rainfall of &lt;300 mm or at temperatures below -2°C. It is assumed that the animals are kept under controlled conditions and are supplementary fed, this will negate the effect of precipitation of toxic substances.</p>

Ezekiel Khunou Bekkersdal Care for the Aged	Written Comment	Animals such as cows that graze grass will be impacted by the project. Aquatic animals can also be affected.	The impact of the project on availability of grazing conditions will be minimal as the majority of the footprint of the TSF and pipelines traverse disturbed areas such as agricultural areas and existing corridors. Aquatic animals will only be affected at wetland and river crossings, this impact is negated through strict EMP conditions.
Jean Coetzer & Maria Coetzer Landowner	Written Comment	There are "duikers" in the area they are considered endangered by the IUCN red list of threatened species.	Thank you for the comment - the only two species of Duiker that could occur in the area of interest are the Blue Duiker and the Common Duiker, both of which are LC according to IUCN red list ver 2015-4, accessed 15/01/2016
Nicci Simpson Landowner	Written Comment	Animal fodder can be found at 365IQ.	Thank you for the comment.
Louis Nel Landowner	Open House	Stolen cattle are also being hidden in the cattle herds kept on Sibanye Gold grounds.	Thank you your comments. This will be noted for our Protection Services. Fauna and Flora cannot comment on this
Louis Nel Landowner	Open House	Cattle are also abused by thieves and the SPCA can't keep up with associated cases.	A process has been started to remove all illegal cattle from mine property. Fauna and Flora cannot comment on this
Mr & Mrs Rudman Landowners	Written Comment	We have a variety of game and bullfrogs that which are endangered species for example Steenbok, Duikerkies and Bullfrogs.	Thank you for the comment. All protected and endangered species according to legislation and frameworks listed in Tabel 3.1 in the fauna and flora report were consulted. All efforts are prescribed to not disturb or affect any protected species habitat or individual.
Mr & Mrs Notnagel Landowners	Written Comment	There is environmental features like protected wildlife for example Steenbok, Duikerkies, Hyena and the big Bullfrogs and Hedgehogs: these are just a few and there are many more.	Thank you for the comment. All protected and endangered species according to legislation and frameworks listed in Tabel 3.1 in the fauna and flora report were consulted. All efforts are prescribed to not disturb or affect any protected species habitat or individual.

Dr J.A Olivier Landowner	Written Comment	There is a fountain on my farm that will be polluted, including underground water. There is also big green bullfrogs that stays at the fountain.	Thank you for the comment. All protected and endangred species according to legislation and frameworks listed in Tabel 3.1 in the fauna and flora report were consulted. All efforts are prescribed to not disturb of affect any protected species habitat or individual. All efforts are made not to contaminate groundwater and thereby disturb the Bullfrogs.
Dr J.A Olivier Landowner	Written Comment	Diseases will cause green bullfrogs located at the fountain will die if the dam is built close to my farm.	Thank you for the comment. All protected and endangred species according to legislation and frameworks listed in Tabel 3.1 in the fauna and flora report were consulted. All efforts are prescribed to not disturb of affect any protected species habitat or individual. All efforts are made not to contaminate groundwater and thereby disturb the Bullfrogs.

### 14.3 Flora

Jaco Taute Landowner	Written Comment	There are environmental features such as Kiepersol plants, and they can be found at 4 shaft.	Thank you for the comment. All protected and endangered species according to legislation and frameworks listed in Tabel 3.1 in the fauna and flora report were consulted. All efforts are prescribed to not disturb of affect any protected species habitat or individual. All efforts are made not to disturb these trees and a relocation program will be instituted if these plants are going to be disturbed with the help of GDARD
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Pulane Malebo Land Occupier	Written Comment	There are environmental features such as Kiepersol plants, and they can be found at 4 shaft.	Thank you for the comment. All protected and endangered species according to legislation and frameworks listed in Tabel 3.1 in the fauna and flora report were consulted. All efforts are prescribed to not disturb or affect any protected species habitat or individual. All efforts are made not to disturb these trees and a relocation program will be instituted if these plants are going to be disturbed with the help of GDARD
Petrus Bornman Landowner	Written Comment	There are environmental features such as Kiepersol plants, and they can be found at 4 shaft.	Thank you for the comment. All protected and endangered species according to legislation and frameworks listed in Tabel 3.1 in the fauna and flora report were consulted. All efforts are prescribed to not disturb or affect any protected species habitat or individual. All efforts are made not to disturb these trees and a relocation program will be instituted if these plants are going to be disturbed with the help of GDARD
Susan Taute Landowner	Written Comment	There are environmental features such as Kiepersol plants, and they can be found at 4 shaft.	Thank you for the comment. All protected and endangered species according to legislation and frameworks listed in Tabel 3.1 in the fauna and flora report were consulted. All efforts are prescribed to not disturb or affect any protected species habitat or individual. All efforts are made not to disturb these trees and a relocation program will be instituted if these plants are going to be disturbed with the help of GDARD
Lanet Taute Landowner	Written Comment	There are environmental features such as Kiepersol plants, and they can be found at 4 shaft.	Thank you for the comment. All protected and endangered species according to legislation and frameworks listed in Tabel 3.1 in the fauna and flora report were consulted. All efforts are prescribed to not disturb or affect any protected species habitat or individual. All efforts are made not to disturb these trees and a relocation program will be instituted if these plants are going to be disturbed with the help of GDARD



AdriaanTaute Landowner	Written Comment	There are environmental features such as Kiepersol plants, and they can be found at 4 shaft.	Thank you for the comment. All protected and endangered species according to legislation and frameworks listed in Tabel 3.1 in the fauna and flora report were consulted. All efforts are prescribed to not disturb or affect any protected species habitat or individual. All efforts are made not to disturb these trees and a relocation program will be instituted if these plants are going to be disturbed with the help of GDARD.
H.N Thorold Landowner	Written Comment	There are environmental features such as Kiepersol plants, and they can be found at 4 shaft.	Thank you for the comment. All protected and endangered species according to legislation and frameworks listed in Tabel 3.1 in the fauna and flora report were consulted. All efforts are prescribed to not disturb or affect any protected species habitat or individual. All efforts are made not to disturb these trees and a relocation program will be instituted if these plants are going to be disturbed with the help of GDARD
Victor Siqongana Land Occupier	Written Comment	There are environmental features such as Kiepersol plants, and they can be found at 4 shaft.	Thank you for the comment. All protected and endangered species according to legislation and frameworks listed in Tabel 3.1 in the fauna and flora report were consulted. All efforts are prescribed to not disturb or affect any protected species habitat or individual. All efforts are made not to disturb these trees and a relocation program will be instituted if these plants are going to be disturbed with the help of GDARD
Shanique Marais Land Occupier	Written Comment	There are environmental features such as Kiepersol plants, and they can be found at 4 shaft.	Thank you for the comment. All protected and endangered species according to legislation and frameworks listed in Tabel 3.1 in the fauna and flora report were consulted. All efforts are prescribed to not disturb or affect any protected species habitat or individual. All efforts are made not to disturb these trees and a relocation program will be instituted if these plants are going to be disturbed with the help of GDARD

<p>Patricia August Land Occupier</p>	<p>Written Comment</p>	<p>There are environmental features such as Kiepersol plants, and they can be found at 4 shaft.</p>	<p>Thank you for the comment. All protected and endangered species according to legislation and frameworks listed in Tabel 3.1 in the fauna and flora report were consulted. All efforts are prescribed to not disturb of affect any protected species habitat or individual. All efforts are made not to disturb these trees and a relocation program will be instituted if these plants are going to be disturbed with the help of GDARD</p>
<p>Jaco Taute Landowner</p>	<p>Written Comment</p>	<p>There are environmental features such as Kiepersol plants, and they can be found at 4 shaft.</p>	<p>Thank you for the comment. All protected and endangered species according to legislation and frameworks listed in Tabel 3.1 in the fauna and flora report were consulted. All efforts are prescribed to not disturb of affect any protected species habitat or individual. All efforts are made not to disturb these trees and a relocation program will be instituted if these plants are going to be disturbed with the help of GDARD</p>



## 15 Conclusion and Recommendation

The study area is under pressure from current land use, most notably, livestock utilisation and mining. Despite current threats, the habitat found in the project area provides an ecological service to the plant and animal species encountered (including plant SSC). It possibly also provides this service to the plant and animal species identified during the desktop survey. The only project activities that will have a considerable impact on the vegetation and associated habitat types present is the Driefontein MRA's WBT and BWS, Kloof MRA's RTSF and CPP.

The Sibanye WRTRP project offers moderate to high Biodiversity Value owing to the presence of intact grassland, ridge and wetland habitat as well ephemeral pan habitat.

Loss of these components will result in significant loss of biodiversity for the area. The opportunity exists however, for the proposed project to contribute significantly to conservation of biodiversity within the grassland region.

Conservation of as much of the natural land in the area within the site as possible, and the creation of corridors linking other natural areas would aid in conservation of ecosystems, flora and fauna.

If efforts are made to initiate conservation of this habitat, and conservation is maintained after the decommissioning of the TSF's, the net impacts on biodiversity may be positive.

From a faunal perspective the most sensitive microhabitats are the pan systems and the riparian system along the rivers and streams present. The numbers of faunal Species of Special Concern are high, with the faunal assemblages making full use of the variety of habitat available on the study site.

The area is either transformed or degraded, but open grassland areas, ridges and wetlands form important process and habitat areas that still exist. As mentioned previously, open grasslands, ridges and wetlands also support certain SSC and are protected by legislation. This protection must be communicated to all involved with construction, as well as the consequence of not adhering to legislation.

From a vegetation perspective the impacts, if mitigation is followed, will be acceptable and, vegetation will recover from these impacts



It is the opinion of the specialist that should the Sibanye project go ahead then the following conditions must be in place for all activities:

- Any surface infrastructure, this includes the RTSF, CPP and ancillary activities such as roads, power lines and fences, should be located in areas of low sensitivity;
- All mitigation measures and targets prescribed in this report will be strictly adhered to;
- Livestock should be excluded from rehabilitated areas, in line with veld management principles and invasive and problem plants actively controlled. Restoration of these areas should also be undertaken;
- The monitoring of vegetation and fauna, as described in this document must be conducted biannually;
- A Biodiversity Land Management plan is suggested, this will encapsulate the biodiversity management within this project.



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## Appendix A: Curriculum Vitae

## **Mr. Rudolph Greffrath**

Senior Fauna and Flora Specialist

Biophysical Department

Digby Wells Environmental

### **Education**

- 2005: B-tech Degree in Nature Conservation, Nelson Mandela Metropolitan University (NMMU).
- 2001- 2004: National Diploma in Nature Conservation, Nelson Mandela Metropolitan University (NMMU).

### **Professional Registration**

- South African Council for Natural Scientific Professions (Membership No. 200245/13).
- IAIA, International Association for Impact assessments;
- Botanical Society of South Africa.

### **Employment**

- 2006 – Present: Digby Wells Environmental, Johannesburg, South Africa.
- 2002 - 2003: Shamwari Game Reserve, Eastern Cape, South Africa.
- 2001: Kop-Kop Geotechnical instrumentation specialists, Johannesburg, South Africa.

### **Experience**

Rudi's current role is that of a fauna and flora specialist, in this capacity he is responsible for planning and conducting fauna and flora surveys/studies that are either completed in support of environmental authorisations or are focused specialist studies which meet local and international standards. In addition to this, Rudi is responsible for compiling Biodiversity Land Management Programs where different specialist studies are collated into a working document for clients to aid in pre or post mining management. He is also involved in rehabilitation studies which entail the planning, implementation and monitoring of vegetative rehabilitation in designated areas on mines. Rudi also fulfils the role of project manager for selected projects; here he manages national and international projects across Africa, specifically west, central and southern Africa, managing a multi-disciplinary team of specialists.

Rudi is also involved in the acquisition of permits for mines, this includes the planning of relocation strategies for protected and endangered plant species in areas where mines are to be established. This involves the planning and execution of data gathering surveys, thereafter he manages the process involving relevant provincial and National authorities to obtain the specific permit that allows for a development to continue.

Information pertaining to the technical expertise of Rudi includes the following:

- Environmental Impact Assessments (EIAs), Basic Assessments and Environmental Management Plans (EMPs) for environmental authorisations in terms of the South African National Environmental Management Act (NEMA), 1998 (Act 107 of 1998);
- Environmental pre-feasibility studies for gold tailings reclamation and iron ore mining projects;
- Biodiversity Assessments including Mammalia, Avifauna, Herpetofauna and Arthropoda;
- Impact assessments based on the terrestrial environment;
- Biodiversity and Land Management Programs;
- Protected plant species management strategies planning and implementation;
- Monitoring of rehabilitation success through vegetation establishment;
- Rehabilitation planning;
- Environmental auditing of rehabilitated areas;
- Project management of ecological specialist studies;
- Planning and design of Rehabilitation off-set strategies.

### Training

- Measurements of Biodiversity at the University of the Free State, led by Prof. M. T. Seaman. September 2008.
- Bird Identification course led by Ettiene Maraise November 2009.
- Introduction to VEGRAI and Eco-classification led by Dr. James Mackenzie December 2009.
- Dangerous snake handling and snake bite treatment with Mike Perry 2011.
- Rehabilitation of Mine impacted areas, with Fritz van Oudshoorn, Dr Wayne Truter and Gustav le Roux 2011.



## Projects

The following project list is indicative of Rudi's experience, providing insight into the various projects, roles and locations he has worked in.

Project	Location	Client	Main project features	Positions held	Activities performed
Mmamabula Energy Project (MEP).	Botswana	CIC energy	Construction of a railway, opencast mine, wellfield, conveyors, addits, housing.	Ecologist	Fauna and Flora surveys for the project features, including impact assessments, management plans. Alien eradication plans.
Tongan Biodiversity Land Management Plan	Ivory Coast	Randgold	Design, compilation and implementation of the BLMP	Ecologist, Project Manager	Fauna and Flora surveys for the BLMP, compilation of BLMP. Alien eradication plans.
Kibali Gold mine	DRC Congo	Randgold	Gold mine infrastructure	Ecologist	Fauna and Flora surveys for the project features, including impact assessments, management plans.
Nzoro Hydroelectric station	DRC Congo	Randgold	Hydroelectric plant	Ecologist	Fauna and Flora surveys for the project features, including impact assessments, management plans.
Loulo Biodiversity Land Management Plan	Mali	Randgold	Design, compilation and implementation of the BLMP	Ecologist, Project Manager	Fauna and Flora surveys for the project features, compilation of BLMP.
Koidu Diamond Mine	Sierra Leone	Koidu Resources	Construction of new open pit	Ecologist	Fauna and Flora surveys for the project features,



Project	Location	Client	Main project features	Positions held	Activities performed
					including impact assessments, management plans. Alien eradication plan.
Resource Generation	South Africa	Temo Coal	Coal mine/Railway Line	Ecologist	Fauna and Flora surveys, Protected plant species management plans, Permitting and Rehabilitation design.
Impunzi Rehabilitation monitoring	South Africa	Glencore	Monitoring of rehabilitation success and suggested management measures	Flora specialist, Project manager	Vegetation surveys, rehabilitation monitoring. Alien eradication plan.

### Publications

Biodiversity Action Plans for faunal habitat maintenance and expansion in mining. Poster presented at the 48th Annual Grassland Society of Southern Africa (GSSA) conference.



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## Appendix B: Plant Species List

Scientific Name	Common Name	Ecological Status	G1	G2	G3	R	W	T
<i>Acacia baileyana</i>	Baileys Wattle	Alien Invasive 3	X					X
<i>Acacia burkei</i>	Black monkey thorn		X					
<i>Acacia caffra</i>	Common Hook thorn			X		X		X
<i>Acacia cyclops</i>	Redeye	Alien Invasive 1b						X
<i>Acacia dealbata</i>	Silver wattle	Alien Invasive 2	X					X
<i>Acacia karoo</i>	Sweet thorn	Medicinal				X		
<i>Acacia mearnsii</i>	Black wattle	Alien Invasive 2				x		X
<i>Aloe greatheadii</i>	Spotted aloe	Medicinal				X		
<i>Aloe maculata</i>	Soap Aloe		X			X		
<i>Aloe marlothi</i>	Mountain Aoe	Medicinal				X		
<i>Alternanthera pungens</i>	Khaki burweed	Alien invasive		X			X	X
<i>Amaranthus hybridus</i>	Common pigweed	Alien invasive					X	X
<i>Amaranthus viridis</i>	Slender amaranth	Alien invasive					X	X
<i>Andropogon appendiculatus</i>	Vlei bluestem			X				
<i>Andropogon eucomus</i>	Snowflake grass	Increaser 2 - Subclimax	X					
<i>Araujia sericifera</i>	Moth catcher	Alien invasive 1b		X	x			X
<i>Aristida aequiglumis</i>				X	x			
<i>Aristida bipartita</i>	Rolling grass	Increaser 3 - Subclimax				X		

Scientific Name	Common Name	Ecological Status	G1	G2	G3	R	W	T
<i>Aristida congesta congesta</i>	Tassel Tree-awn	Increaser 2 - Pioneer	X	X		X		
<i>Aristida junciformis</i>	Ngongoni Three-awn	Invasive	X					
<i>Arundo donax</i>	Spanish Reed	Alien invasive 1b						X
<i>Asclepias fruticosa</i>	Shrubby milkweed	Alien invasive	X					X
<i>Asparagus laricinus</i>	Wild asparagus		X	X	X	X	X	X
<i>Asparagus setaceus</i>		Charm	X			X		
<i>Berkheya radula</i>					X		X	
<i>Berkheya setifera</i>	Rasperdisseldoring				X			
<i>Bidens bipinnata</i>	Spanish blackjack	Alien invasive	X	X	X		X	X
<i>Bidens formosa</i>	Cosmos	Alien invasive	X	X	X			X
<i>Bidens pilosa</i>	Common blackjack	Alien invasive					X	X
<i>Blepharis subvolubilis</i>			X					
<i>Boophane disticha</i>	Poison bulb	<b>GDARD Protected/Declining</b>	X		X			
<i>Bothriochloa insculpta</i>	Pinhole grass			X				
<i>Brachylaena rotundata</i>	Mountain silver-oak					X		
<i>Celtis africana</i>	White Stinkwood					X		
<i>Centella asiatica</i>	Pennywort							
<i>Chamaesyce hirta</i>	Red milkweed	Alien invasive		X		X		

Scientific Name	Common Name	Ecological Status	G1	G2	G3	R	W	T
<i>Chenopodium album</i>	Fat hen	Alien invasive		X				
<i>Chenopodium carinatum</i>	Green goosefoot	Alien invasive			X			
<i>Chloris gayana</i>	Rhodes Grass				X	X		X
<i>Chloris virgata</i>	Feathertop Grass							X
<i>Chrysopogon serrulatus</i>	Golden Beard Grass				X			
<i>Cirsium vulgare</i>	Spear Thistle	Alien Invasive 1b			X		X	X
<i>Clematis brachiata</i>	Traveller's joy			X		X	X	
<i>Clematopsis scabiosifolia</i>	Pluimbossie			X		X		
<i>Cleome maculata</i>			X			X		
<i>Cleome monophylla</i>	Spindlepod			X				
<i>Coleochloa setifera</i>							X	
<i>Combretum molle</i>	Velvet Bushwillow					X		
<i>Commelina africana var. krebsiana</i>			X	X	X			
<i>Convolvulus farinosus</i>	Wild bindweed	Alien invasive		X				
<i>Conyza albida</i>	Tall fleabane	Alien invasive						X
<i>Conyza bonariensis</i>	Horseweed	Alien invasive					X	X
<i>Conyza podocephala</i>	Conyza	Alien invasive					X	
<i>Cortaderia jubata</i>	Pampas Grass	Alien invasive 1b						X

Scientific Name	Common Name	Ecological Status	G1	G2	G3	R	W	T
<i>Cortaderia selloana</i>		Alien invasive 1b						X
<i>Cotoneaster franchetii</i>	Cotoneaster	Alien invasive 1b				X		X
<i>Crabbea acaulis</i>			X					
<i>Crassula sp.</i>			X			X		
<i>Cucumis myriocarpus</i>	Striped wild cucumber	Alien invasive				X		
<i>Cucumis zeyheri</i>	Wild cucumber	Medicinal	X					
<i>Cuscuta campestris</i>	Dodder	Alien invasive		X				
<i>Cymbopogon caesius</i>	Broad-leaved Turpentine Grass	Increaser 1 - Climax	X			X		
<i>Cymbopogon excavatus</i>	Broad-leaved turpentine grass		X	X	X			
<i>Cymbopogon plurinodis</i>	Narrow-leaved turpentine grass		X	X	X	X		
<i>Cynodon dactylon</i>	Couch Grass	Increaser 2 - Pioneer	X	X	X			X
<i>Cyperus esculentis</i>	Yellow Nut Sedge						X	
<i>Cyperus rotundis</i>	Red nut sedge						X	
<i>Datura ferox</i>	Thorn apple	Alien invasive 1b					X	X
<i>Datura stramonium</i>	Common thorn apple	Alien invasive 1b					X	X
<i>Dianthus mooiensis subsp.kirkii</i>	Wild pink		X					
<i>Digitaria monophylla</i>			X					
<i>Diospyros lycioides</i>	Bluebush					X		

Scientific Name	Common Name	Ecological Status	G1	G2	G3	R	W	T
<i>Dombeya rotundifolia</i>	Wild Pear	Medicinal				X		
<i>Echinochloa colona</i>	Jungle rice							X
<i>Echium vulgare</i>	Blue echium	Alien invasive 1b	X		X			
<i>Ehretia rigida</i>	Puzzle bush			X		X		
<i>Elionorus muticus</i>	Sour Grass		X	X	X			
<i>Englerophytum magaliesmontanum</i>	Transvaal Milkplum					X		
<i>Eragrostis bicolor</i>	Speckled vlei grass		X	X	X			
<i>Eragrostis chloromelas</i>	(Narrow) Curly Leaf	Increaser 2 - Subclimax to climax	X	X	X	X	X	
<i>Eragrostis curvula</i>	Weeping Lovegrass		X	X	X			X
<i>Eragrostis gummiflua</i>	Gum Grass	Increaser 2 - Subclimax	X		X		X	
<i>Eragrostis lehmanniana</i>	Lehmann's love grass		X	X	X	X		
<i>Eragrostis racemosa</i>	Narrow Heart Love Grass	Increaser 2 - Subclimax	X		X	X		
<i>Eragrostis superba</i>	Saw-tooth love grass			X		X		
<i>Eucalyptus camaldulensis</i>	Red River Gum	Alien Invasive 1b						X
<i>Eucalyptus sideroxylon</i>	Black Ironbark	Alien Invasive						X
<i>Euclea crispa</i>	Blue Guarri	Medicinal				X		
<i>Eucomis autumnalis</i>	Pineapple flower	Medicinal		X				



Scientific Name	Common Name	Ecological Status	G1	G2	G3	R	W	T
<i>Euphorbia helioscopia</i>	Umbrella milkweed	Alien Invasive				X		
<i>Geigeria burkei</i>	Vermeersiektebossie		X					
<b><i>Gladiolus crassifolius</i></b>	Thick-leaved Gladiolus	Protected LC	X	X				
<i>Gleditsia triacanthos</i>	Honey Locust							X
<i>Glycine max</i>	Soybean							X
<i>Gomphocarpus physocarpus</i>	Milkweed	Alien Invasive						X
<i>Gomphrena celosioides</i>	Bachelor's button	Alien Invasive						
<i>Grewia occidentalis</i>	Cross Berry	Medicinal				X		
<i>Gymnospora heterophylla</i>	Spike thorn					X		
<i>Gymnosporia buxifolia</i>	Common Spikethorn			X				
<i>Haplocarpha scaposa</i>				X		X		
<i>Helichrysum aureonitens</i>	Golden everlasting	Medicinal	X			X		
<i>Helichrysum inornatum</i>			x	X	X	X		
<i>Helichrysum nudifolium</i>			X	X	X	X		
<i>Helichrysum rugulosum</i>				X				
<i>Hermannia lancifolia</i>				X				
<i>Heteropogon contortus</i>	Spear Grass	Increaser 2 - Subclimax	X	X	X	X		
<i>Hyparhennia tamba</i>	Blue Thatching Grass			X				X

Scientific Name	Common Name	Ecological Status	G1	G2	G3	R	W	T
<i>Hyparrhenia hirta</i>	Common Thatching Grass	Increaser 1 - Subclimax to climax	X	X	X	X		
<i>Hypoxis argentea</i>		Medicinal	X	X	X			
<i>Hypoxis hemerocallidea</i>	Star-flower	Medicinal/ <b>Declining, GDARD Protected</b>	X					
<i>Hypoxis rigidula</i>		<b>LC</b>	X	X	X			
<i>Indigofera filipes</i>			X					
<i>Kniphofia ensifolia subsp ensifolia</i>		<b>LC</b>					X	
<i>Lactuca inermis</i>			X					
<i>Lantana camara</i>	Tickberry	Alien Invasive 1b			X	X		
<i>Ledebouria ovatifolia</i>		Medicinal	X					
<i>Leersia hexandra</i>	Southern Cut Grass						X	
<i>Leonotis leonurus</i>	Wild dagga	Medicinal				X		
<i>Leonotis microphylla</i>	Rock Dagga	Medicinal				X		
<i>Lotononis listii</i>			X		X			
<i>Loudetia simplex</i>				X				
<i>Mariscus congestus</i>							X	
<i>Melia azedarach</i>	Syringa	Alien Invasive 1b						X
<i>Melinis repens</i>	Natal Red Top	Increaser 2 - Pioneer to	X		X	X		X

Scientific Name	Common Name	Ecological Status	G1	G2	G3	R	W	T
		subclimax						
<i>Monocymbium cerasiiforme</i>	Boat grass	Decreaser - Climax	X	X				
<i>Monsonia angustifolia</i>	Crane's bill		X		X			
<i>Nemesia fruticans</i>		<b>LC</b>		X				X
<i>Olea europaeae subsp. africana</i>	African Olive	Medicinal				X		
<i>Opuntia ficus-indica</i>	Sweet Prickly Pear	Alien Invasive 1b				X		X
<i>Oxalis corniculata</i>				X				
<i>Oxalis obliquifolia</i>	Sorrel		X	X				
<i>Pachycarpus sp.</i>		Medicinal	X					
<i>Panicum natalense</i>	Natal Panicum		X	X				X
<i>Paspalum notatum</i>	Bahia grass				X			
<i>Paspalum urvillei</i>	Vasey Grass	Exotic						X
<i>Peltophorum africanum</i>	Weeping wattle	Medicinal				X		X
<i>Pennisetum clandestinum</i>	Kikuyu grass							X
<i>Pentanisia angustifolia</i>			X					
<i>Pentarrhinum inspidum</i>	Donkieperske							
<i>Phragmites australis</i>	Common reed						X	
<i>Phytolacca octandra</i>	Inkberry/Pokeweed	Medicinal/Weed 1b						X



Scientific Name	Common Name	Ecological Status	G1	G2	G3	R	W	T
<i>Searsia zeyheri</i>	Blue current					X		
<i>Searsia lancea</i>	Karee	Edible fruit				X		
<i>Searsia leptodictya</i>	Mountain karee					X		
<i>Searsia pyroides</i>	Common wild current					X		X
<i>Senecio coronatus</i>				X	X			
<i>Senecio ilicifolius</i>	Sprinkaan-senecio	Alien Invasive		X				
<i>Senecio inornatus</i>				X				
<i>Senecio venosus</i>					X	X		
<i>Seriphium plumosum</i>	Bankrupt Bush	Weed	X	X	X	X		X
<i>Setaria nigrostis</i>				X				
<i>Setaria pallide-fusca</i>	Garden bristle grass				X			
<i>Setaria sphacelata var. sphacelata</i>	Bristle Grass	Decreaser - Climax	X					
<i>Setaria sphaelata</i>							X	
<i>Solanum incanum</i>	Grey Bitter-apple	Medicinal				X		
<i>Solanum mauritanum</i>	Bugweed	Alien Invasive 1b				X		
<i>Solanum panduriforme</i>	Poison apple	Alien Invasive						X
<i>Solanum sisymbriifolium</i>	Dense-thorned bitter apple	Alien Invasive 1b						X
<i>Sphenostylis angustifolia</i>	Wild sweetpea bush	Medicinal		X				

Scientific Name	Common Name	Ecological Status	G1	G2	G3	R	W	T
<i>Sporobolus africanus</i>	Rats Tail Dropseed				X		X	X
<i>Sporobolus pectinatus</i>				X				
<i>Stellaria media</i>	Starwort	Alien Invasive	X					
<i>Stipagrostis uniplumis</i>	Silky Bushman's Grass							X
<i>Striga elegance</i>	Large witchweed		X					
<i>Striga elegans</i>	Pink variant			X				
<i>Tagetes minuta</i>	Tall Khaki Weed	Alien invasive 1b	X	X	X	X	X	X
<i>Tamarix ramosissima</i>	Pink tamarisk	Alien invasive 1b						X
<i>Themeda triandra</i>	Red grass		X	X	X	X		X
<i>Trachypogon spicatus</i>	Giant Spear Grass	Increaser 1 - Climax	X					
<i>Tricholaena monachne</i>	Blue-seed Grass	Increaser 2 - Subclimax	X					
<i>Trichoneura grandiglumis</i>	Small Rolling Grass	Increaser 2 - Subclimax	X					
<i>Typha capensis</i>	Bulrush	Medicinal					X	
<i>Urelytrum agropyroides</i>	Quinine Grass	Increaser 1 - Climax	X					
<i>Urochloa mosambicensis</i>	Bushveld signal grass			X	X			
<i>Urochloa panicoides</i>	Garden Urochloa	Increaser 2 - Pioneer	X					
<i>Ursinia nana</i>					X			
<i>Vangueria infausta</i>	Wild medlar	Medicinal				X		



Scientific Name	Common Name	Ecological Status	G1	G2	G3	R	W	T
<i>Verbena bonariensis</i>	Tall Verbena	Alien invasive	X	X	X	X	X	X
<i>Vernonia oligocephala</i>	Bicoloured-leaved Vernonia	Medicinal	X			X		
<i>Wahlenbergia caledonica</i>				X	x			
<i>Walafrida densiflora</i>			X					
<i>Xanthium strumarium</i>	Burweed	Alien invasive 1b		X	x			
<i>Xerophyta retinervis</i>	Monkeys Tail					X		
<i>Zea mays</i>	Mielie							X
<i>Zinnia peruviana</i>	Redstar Zinnia	Alien invasive	X			X		
<i>Ziziphus mucronata</i>	Buffalo thorn	Medicinal <b>LC</b>				X		