Proposed construction of the Meteor substation, as well as the 88kV line between the Pulsar, Meteor and Sonland substations, Sebokeng area, Gauteng

DRAFT
Vegetation Assessment

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Indemnity

This report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken. The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information at the time of study. Therefore, the author reserves the right to modify aspects of the report including the recommendations if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.

Although the author exercises due care and diligence in rendering services and preparing documents, she accepts no liability, and the client, by receiving this document, indemnifies the author against all actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, directly or indirectly by the author and by the use of this document.

The Environmental Impact Assessment Regulations (Regulation 17 of Government Notice No. R345 of 2010), requires that certain information is included in specialist reports. The terms of reference, purpose of the report, methodologies, assumptions and limitations, impact assessment and mitigation (where relevant to the scope of work) and summaries of consultations (where applicable) are included within the main report. Other relevant information is set out below:

Expertise of author:

- Working in the field of ecology, and in specific vegetation related assessments, since 2007;
- Is registered as a Professional Natural Scientist with the South African Council for Natural Scientific Professions in the field of ecology (Reg. No. 400019/11); and
- Has been working with plants indigenous to South Africa since 1997.

Declaration of independence:

Dimela Eco Consulting in an independent consultant and hereby declare that it does not have any financial or other vested interest in the undertaking of the proposed activity, other than remuneration for the work performed in terms of the National Environmental Management Act, 1998 (Act 107 of 1998). In addition, remuneration for services provided by Dimela Eco Consulting is not subjected to or based on approval of the proposed project by the relevant authorities responsible for authorising this proposed project.

Disclosure:

Dimela Eco Consulting undertake to disclose, to the competent authority, any material information that has or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the National Environmental Management Act, 1998 (Act 107 of 1998) and will provide the competent authority with access to all information at its disposal regarding the application, whether such information is favourable to the applicant or not.

Based on information provided to Dimela Eco Consulting by the client, and in addition to information obtained during the course of this study, Dimela Eco Consulting present the results and conclusion within the associated document to the best of the authors professional judgement and in accordance with best practise.

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Antoinette Eyssell Date

SACNASP Reg. No. 400019/11

EXECUTIVE SUMMARY

Eskom proposed the construction of the new Meteor substation in the Sebokeng area (Gauteng Province). In addition, an 88kV line is proposed to connect the existing Pulsar substation with the proposed Meteor substation and the existing Sonland substation further south-east. As part of the Basic Assessment, Dimela Eco Consulting was appointed through Limosella Consulting to undertake a vegetation assessment of the proposed powerline routes and alternative, as well as the site proposed site for the Meteor substation.

The proposed 88kV powerline will connect the existing Pulsar substation, situated on the corner of the R28 (Randfontein Road) and the Golden Highway, with the proposed Meteor substation situated about 6 km south-west thereof. From the proposed Meteor substation, the proposed 88kV line will connect to the existing Sonland substation about 10km south-east from the Meteor substation. The proposed development is situated within the Emfuleni Local Municipality (Gauteng Province) and within the quarter degree square 2627DB.

The area studied included various residential areas, agricultural holdings and vacant land. Much of the vacant land was being used for grazing cattle or goats. Some portions of the vacant land was historically cultivated, while some areas were planted for pasture. Where the powerline aligns through residential areas, the land was mostly disturbed or used as small food gardens by the community. The agricultural holdings north of the Sonland substation included a number of alien invasive species, buildings and pasture.

The dominant vegetation type occurring within the study area is Soweto Highveld Grassland which is nationally classified as an Endangered vegetation type as the extent conserved is limited, while ongoing urbanisation and mining threatened the remainder thereof.

The table below summarises the broad vegetation groupings along the proposed lines and substation locality as well as its perceived sensitivity.

Vegetation Description	Powerline / substation locality	Sensitivity
Secondary grassland	1. Proposed Meteor substation locality 2. Sections of the proposed line between Pulsar and Meteor substations, include the provincially protected *Crinum graminicola* 3. Section of the line from Meteor south-eastward	Low
Rocky grassland	1. Small portions of the proposed powerline between the Pulsar and Meteor substations 2. From Houtkop Road the proposed line traverse rocky grassland parallel to Houtkop Road, as well as habitat to provincially protected plant species (*Haemanthus, Crinum* and *Gladiolus*) 3. The alternative route over the ridge crosses over a	Medium to High

Vegetation Description	Powerline / substation locality	Sensitivity
	smaller portion of rocky grassland and are positioned along an existing powerline and servitude. 4. Situated on Class 3 ridge and C-plan Important area 5. Representative of Soweto Highveld Grassland	
Woodland	1. The alternative route over the ridge traverse a small portion of the woodland on the ridge 2. Situated on Class 1 & 3 ridge and C-plan Important area	Medium - High
Moist grassland	1. Much of the proposed lines between are situated in moist grassland. Although portions of the moist grassland are invaded by alien invasive plants, the hydrology should still be protected. 2. Between Pulsar and Meteor substations, the Declining *C bulbispermum* as well as the provincially protected *Kniphofia ensifolia* and *Gladiolus papilio* grew 3. Situated in C-plan Important areas	High

The proposed route and one alternative will impact mainly on moist grassland and rocky grassland that are of conservation value. The proposed Meteor substation locality is situated in secondary grassland which is of low vegetation sensitivity.

No alternative was proposed for the route between Pulsar and Meteor substation as well as from Meteor up to Houtkop Road. From here one alternative is proposed to cross the ridge and rocky grassland, whereas the proposed route runs parallel to the Houtkop Road within rocky grassland. The table below summarises the two routes and give an indication of the preferred route.

Route	Rationale	Order of preference
Alternative route	• Rocky grassland • Potential habitat for protected plants – none confirmed • Route aligns with an existing powerline and access road • Route traverse a smaller portion of rocky grassland	Preferred – ONLY if existing access road can be utilized with no additional crew camps/ access roads over the ridge and in the rocky grassland
Proposed route	• Rocky grassland • Confirmed localities of provincially protected plants • Traverse the base of the ridge where the historic road construction had some impacts • However, a new servitude road will have to be constructed as Houtkop Road is a busy feeder route	Second option. However, if the conditions to the alternative route (see above) cannot be adhered to, then this route becomes the preferred

This assessment found that the proposed route alignment will impact on large areas of sensitive vegetation comprising of moist grassland, rocky grassland as well as populations of protected plant species.

Proposed Meteor substation locality

The substation will be construction on secondary grassland that was classified as being of low vegetation sensitivity. No plants of conservation concern was observed on the proposed site and it is unlikely that the substation will have a negative impact on the surrounding secondary grassland.

Powerline route:

The powerline route will impact mainly on moist grasslands as well as rocky grasslands that are of some conservation value due to its locality on a ridge. As most of the route alignment is fixed, it is advised that some deviations are considered to make use of already transformed vegetation in proximity to moist grasslands. The route alignment between Pulsar and the proposed Meteor substation should be re-considered and moved to outside the moist grassland and the localities of plants of conservation concern.

In order to avoid confirmed localities of protected plants on the ridge, the alternative route over the ridge is recommended, provided that the route aligns closely to the existing powerline and that the existing access road be utilised.

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1. INTRODUCTION

Eskom proposed the construction of the new Meteor substation in the Sebokeng area (Gauteng Province). In addition, an 88kV line is proposed to connect the existing Pulsar substation with the proposed Meteor substation and the existing Sonland substation further south-east. As part of the Basic Assessment (BA), Dimela Eco Consulting was appointed through Limosella Consulting to undertake a vegetation assessment of the proposed powerline routes and alternative, as well as the site proposed site for the Meteor substation.

1.1 Terms of reference

The terms of reference was interpreted as follows:

- Survey the proposed alignments for the 88kV line and the proposed Meteor substation locality;
- Compare the floral assemblages that are expected to occur within the information gathered during a field survey;
- Map the vegetation / habitat types according to structurally distinct vegetation units as well as transformed areas;
- Map the localities of plants of conservation concern that was identified during the field survey or suitable habitat where these plants could potentially occur;
- Assess the possible impacts that the proposed powerline routes and substation could have on the vegetation;
- Recommend mitigation measures to aid the conservation of vegetation during construction and operation; and
- Where alternative routes are proposed for sections of the line, indicate the route that will likely have the least impact on the vegetation.

1.2 Assumptions and Limitations

Vegetation studies should be conducted during the growing season of all plant species that may potentially occur. This may require more than one season's survey with two visits undertaken preferably during November and February. However, this report relied on only one assessment undertaken during January 2014. Sufficient summer rainfall was recorded prior to the field survey.

Much of the proposed line was walked, except where vegetation was obviously disturbed or the area was a safety risk. In addition, large inundated wetland areas where also not traversed. The exact alignment of a portion of the line (across the ridge) was not known at the time of the site visits. The route was deduced from a map and sampling took place in representative areas and where access was possible. Furthermore, the site visit was undertaken in January 2014 and not all the plant species of conservation concern that could occur in the area were in flower at that

stage. Some species are inconspicuous when not in flower and could therefore easily have been overlooked.

1.3 Methodology

The study was undertaken over two days, the 20th of January 2014 and the 27th of January 2014. The assessment entailed a literature review which included the short listing plants of conservation concern that could potentially occur in the area, a field survey, the analysis of data collected and reporting. The methodology used in the assessment is listed in Appendix A.

2. BACKGROUND TO THE STUDY SITE

2.1 Locality

The proposed 88kV powerline will connect the existing Pulsar substation, situated on the corner of the R28 (Randfontein Road) and the Golden Highway, with the proposed Meteor substation situated about 6 km south-west thereof (Figure 1). From the proposed Meteor substation, the proposed 88kV line will connect to the existing Sonland substation about 10km south-east from the Meteor substation. The proposed development is situated within the Emfuleni Local Municipality (Gauteng Province) and within the quarter degree square 2627DB.

2.1.1 Substation locality

The Meteor substation is proposed to be constructed directly south of the R54 road, less than 1km east of the N1 (Figure 1). No alternative sites were proposed.

2.1.2 Powerline routes

Only one route was proposed to connect the existing Pulsar substation with the proposed Meteor substation (Figure 1). From Meteor substation, the line runs westward to where the line crosses Houtkop Road. From here, two alternatives were proposed. The alternative route runs over a ridge-area, next to an existing powerline and through agricultural holdings, whereas the proposed route will travel parallel to Houtkop Road (on the eastern side thereof), around the base of the ridge, to the existing Sonland substation, south of the R541 road.

2.2 Land Use and Land Cover

The area studied included various residential areas, agricultural holdings and vacant land. Much of the vacant land was being used for grazing cattle or goats. Some portions of the vacant land was historically cultivated, while some areas were planted for pasture. Where the powerline aligns through residential areas, the land was mostly disturbed or used as small food gardens by the community. The agricultural holdings north of the Sonland substation included a number of alien invasive species, buildings and pasture.

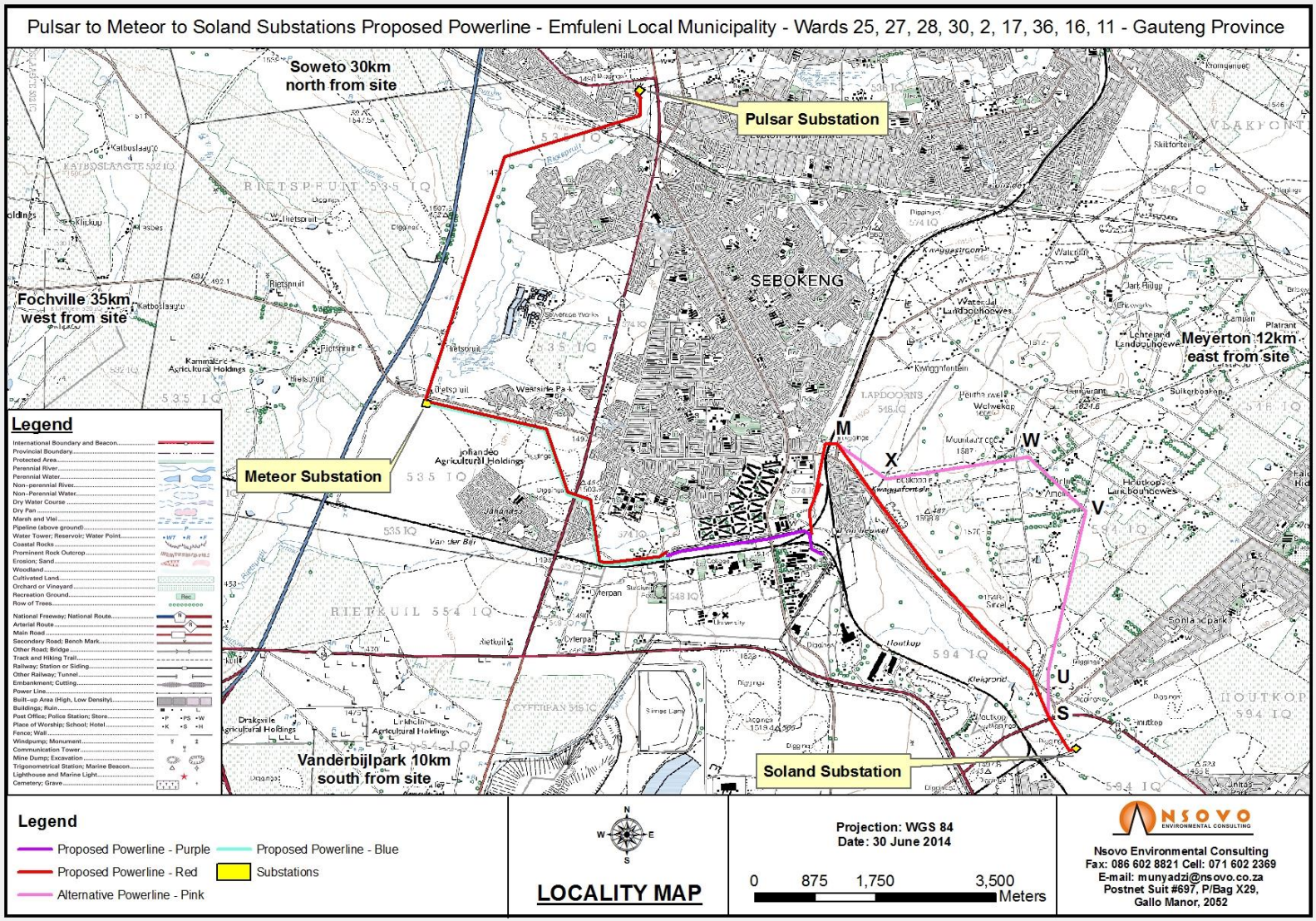


Figure 1: Locality of the proposed powerline and the proposed Meteor substation

2.3 Climate

The study area is situated in a summer rainfall region with a mean average rainfall of 662mm per annum (Mucina & Rutherford, 2006). Winters are cold with frost, while summer temperatures can be as high as 30°C.

2.4 Hydrology

Much of the powerline proposed to connect the Pulsar and the proposed Meteor substation traverse portions of the Rietspruit and associated wetland areas (Figure 2). Smaller wetland areas, as indicated on the National Freshwater Ecosystems Priority Areas (NFEAPA) layer and streams are also traversed by the proposed lines connecting Meteor and Sonland substations (Figure 2).

2.5 Expected Vegetation

The study site is situated within the Grassland Biome of South Africa. This biome is dominated by grasslands wherein high summer rainfall, combined with dry winters, night frost and marked diurnal temperature variations are unfavourable to tree growth. The Grassland Biome therefore comprises mainly of grasses and plants with perennial underground storage organs, for example bulbs and tubers. The majority of plant species in grasslands are non-grassy herbs (forbs), most of which are perennial bulbous or tuberous plants. Furthermore, the majority of Rare and Threatened plant species in the summer rainfall regions of South Africa are restricted to high-rainfall grasslands, making the Grassland Biome in most urgent need of conservation.

Frost, fire and grazing maintain the herbaceous grass and forb layer and prevent the establishment of thickets or encroachment by trees into the grasslands (Tainton, 1999). Fire is a natural disturbance caused by lightning, and regular burning is therefore essential for maintaining the structure and biodiversity of grasslands. If fire is prevented due to activities such as agriculture and mining, the vegetation structure degrade, and alien species could eventually dominate the natural vegetation.

The Grassland Biome can be divided into smaller units known as vegetation types wherein the vegetation and landscape are similar. The dominant vegetation type occurring within the study area is Soweto Highveld Grassland (Mucina & Rutherford, 2006). This grassland occurs in Gauteng and Mpumalanga, where it has become threatened by urbanisation, industrialisation, mining and agriculture and fragmented by the associated infrastructure such as roads. Soweto Highveld Grassland is nationally classified as an Endangered vegetation type as the extent conserved is limited, while ongoing urbanisation and mining threatened the remainder thereof.

Therefore, the study site was investigated to ascertain whether intact (undisturbed or untransformed) Soweto Highveld Grassland exist on the study site, as remaining portions should be conserved in order to preserve this vegetation type.

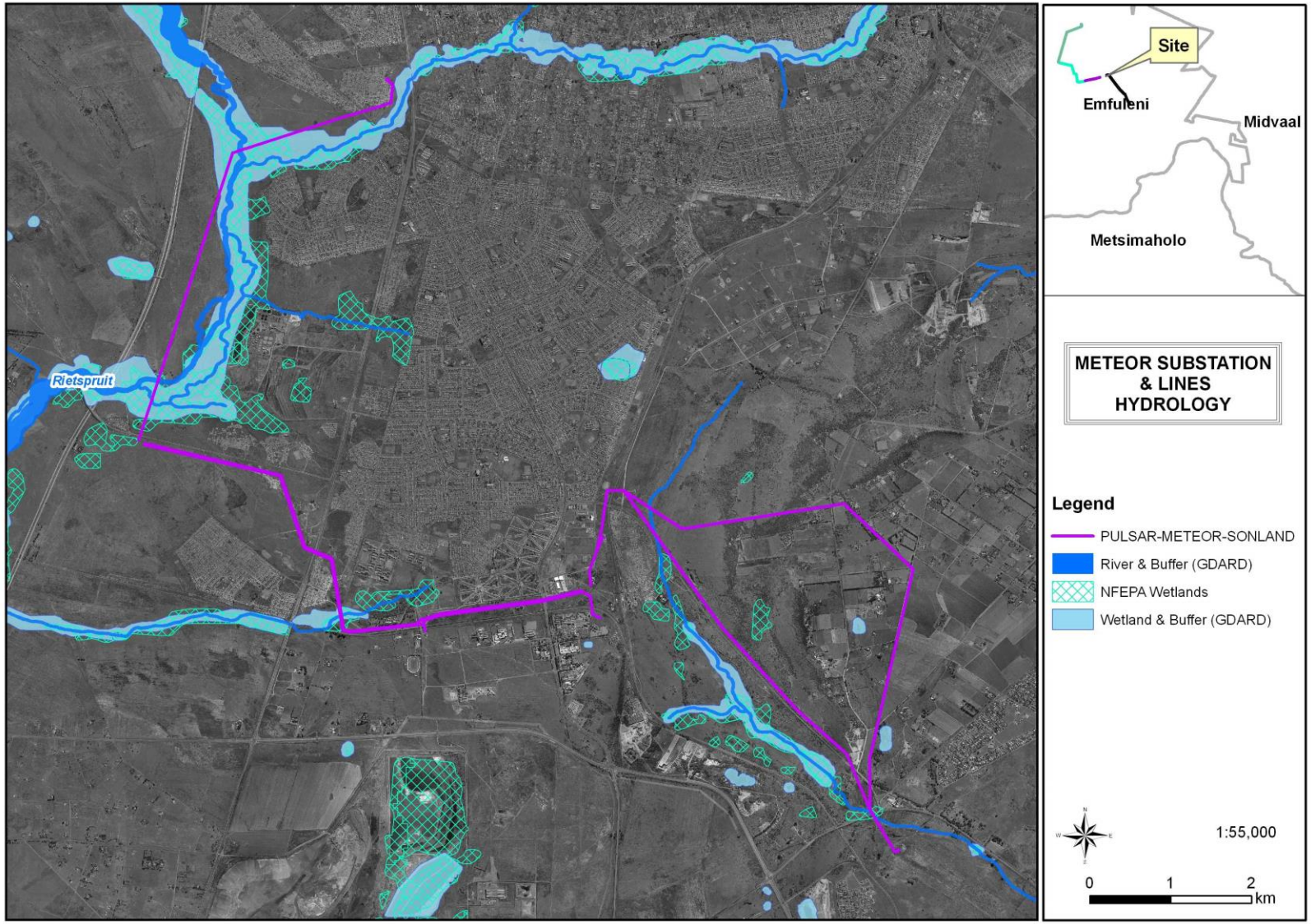


Figure 2: Hydrology of the area studied

2.6 Listed Ecosystems

The proposed development is situated in a "Vulnerable" ecosystem. The South African Biodiversity Act (Act 10 of 2004) provides for the listing of threatened or protected ecosystems. These ecosystems are grouped into Critically Endangered-, Endangered-, Vulnerable- and Protected Ecosystems [(Section 52(1) (a) of the National Environmental Management: Biodiversity Act (Government Gazette 34809, Government Notice 1002, 9 December 2011)].

The proposed development is situated within a listed ecosystem. If natural vegetation is found to occur on the site, this could have environmental authorization implications in terms of the National Environmental Management Act, 1998 (Act No 107 of 1998) [NEMA] and Environmental Impact Assessment (EIA) regulations. This means any development that involves loss of natural habitat in a listed critically endangered or endangered ecosystem is likely to require at least a basic assessment in terms of the EIA regulations. Wherever listed ecosystems occur, these areas should be included as sensitive areas and be incorporated into Environmental Management Frameworks (EMF's). Therefore, impacts should be avoided, minimised, mitigated and / or offset considered were appropriate.

2.7 Gauteng Conservation Plan

The Gauteng Conservation Plan (Version 3.3) (GDARD, 2011) classified areas within the province on the basis of its contribution to reach the conservation targets within the province. These areas are either 'Irreplaceable' (must be conserved), 'Important' to reach the conservation targets or 'Ecological Support Areas' (ESAs) to ensure sustainability in the long term. According to the Gauteng Conservation Plan (version 3.3), the proposed development falls within Critical Biodiversity Areas (includes Irreplaceable and Important areas), as well as Ecological Support Areas. ESA's are areas that are not essential for meeting biodiversity representation targets/thresholds but which nevertheless play an important role in supporting the ecological functioning of critical biodiversity areas and/or in delivering ecosystem services that support socio-economic development, such as water provision, flood mitigation or carbon sequestration.

For much of its extent, the line connecting Pulsar and the proposed Meteor substations will traverse areas classified as Important to reach the conservation targets of the province as well as associated ESA's (Figure 3). Both alternatives to the Sonland substation traverse an Important area. The Important areas are historic localities of the rare plant *Gnaphalium nelsonii,* which is usually associated with wetland conditions.

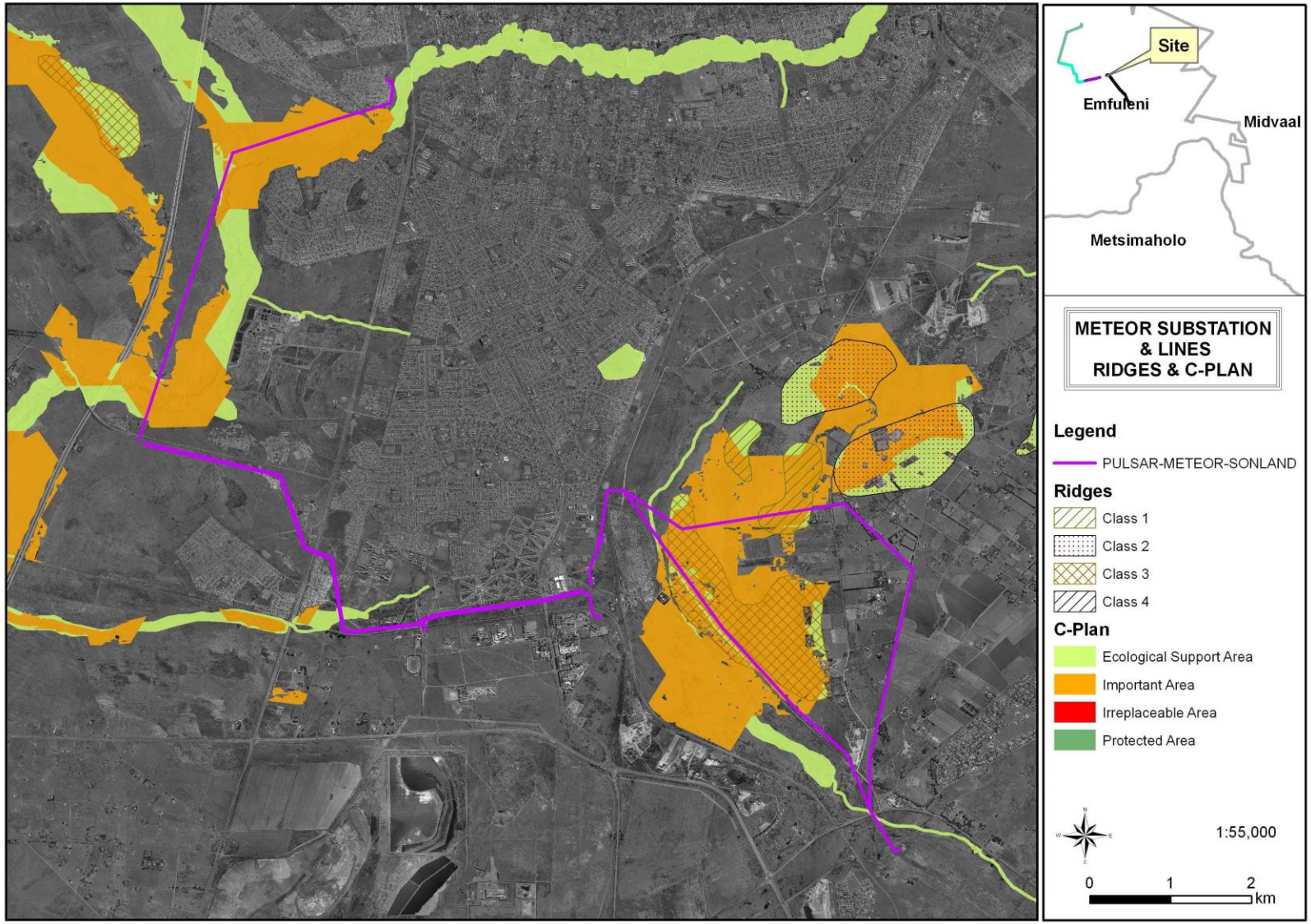


Figure 3: Gauteng C-plan areas within the area studied

2.8 Gauteng Ridge Policy

Ridges are protected environments within Gauteng province (GDACE, 2006). The term ridge refers to hills, koppies, mountains, kloofs and gorges and/or a landscape type or topographic feature that is characterized by two or more of the following features: a crest, plateau, cliff or footslope. The conservation of ridges in Gauteng allow for the protection of the habitat for significantly high numbers of species ensuring for their continued survival in a rapidly urbanizing province. ‘’*Ridges, and the area immediately surrounding the ridges, provide habitat for a wide variety of fauna and flora. The ridges also fulfil functions that are necessary for the sustainability of ecosystems such as the recharging of groundwater, wetlands and rivers, wildlife dispersal and providing essential habitat for pollinators. Ridges also have a socio-cultural role in that they provide aesthetically pleasing environments that are valued by residents, tourists and recreational users. Human activities such as urbanization, mining and the planting of alien vegetation may undermine the contribution that ridges make to the environment*” (GDACE, 2006). Ridges also form ecological corridors for the movement of species, especially in urbanised environments.

The two proposed alternative powerline routes to the Sonland substation, traverse a Class 3 ridge as defined by the Gauteng Ridge Policy (GDACE, 2006). A Class 3 ridge defines ridges of which 35% or more, but less than 65%, of their surface area has been converted to urban development, quarries and/or alien vegetation. As per the policy guideline, the consolidation of properties on Class 3 ridges is supported. Portions of the ridge that the powerlines will traverse, have not been significantly impacted on by past activities, therefore the guidelines for Class 2 ridges should be applied (GDACE, 2006). This implies that development activities and uses that have a high environmental impact will not be permitted, whereas low impact development activities, which comprise of an ecological footprint of 5% or less of the property may be permitted. In addition, low impact development activities on a ridge will not be supported where it is feasible to undertake the development on a portion of the property abutting the ridge. In addition, the alternative route traverse a portion indicated s a Class 1 ridge, which comprise ridges of which 5% or less of their surface area has been converted to urban development, quarries and/or alien vegetation. On Class 1 ridges, further development activities and subdivisions will not be permitted and only low impact activities with an ecological footprint of 5% or less will be permitted in the 200 metre buffer zone of the ridge (GDACE, 2006).

3. RESULTS OF THE FIELD ASSESSMENT

3.1 Broad Vegetation Groups

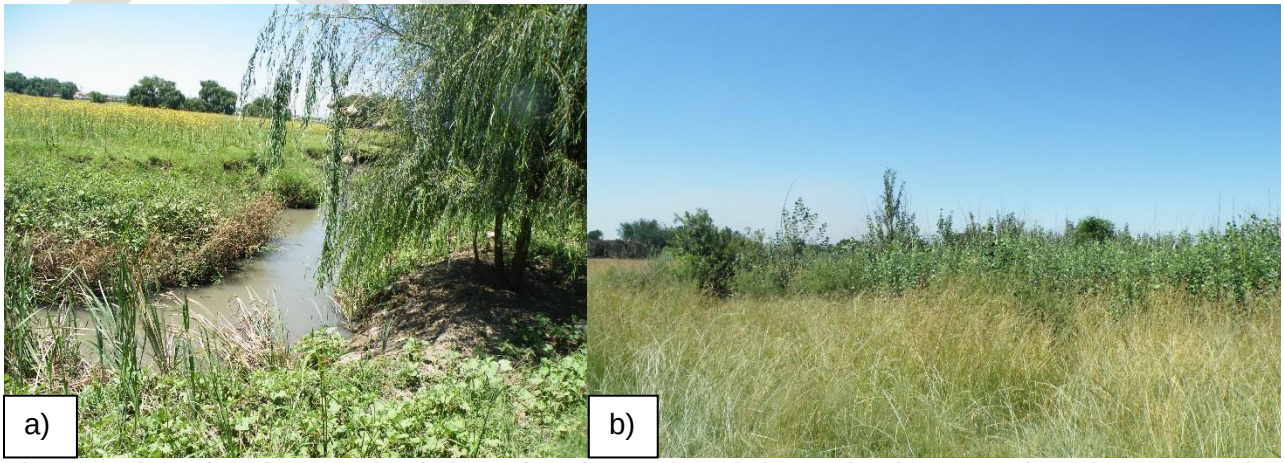
The vegetation in the area studied comprised mainly of grassland, moist grassland (wetland areas), historically disturbed and secondary grassland, as well as some woodland on rocky outcrops (the ridge). Areas where the vegetation was completely removed e.g. residential areas and cultivated areas, are referred to as transformed and will not be further discussed. Each broad natural or semi-natural vegetation grouping is further discussed below.

3.1.1 Moist grassland

Large sections along the proposed route alignment supported plant species that are adapted to growing in saturated soils or with an affinity to moist soils. These areas are described as wetlands in the wetland assessment undertaken by Limosella Consulting (2014) and are mainly situated along the Rietpsruit River between Pulsar and the proposed Meteor substation, while another large wetland area was observed north of the Sonland substation. The vegetation included sedges and rushes and varied from plants that grew in permanently inundated soils to plant species that can grow in temporary saturated soils. The moist grasslands were subjected to a number of impacts and while some portions were relatively intact, other moist grassland portions included a high number of alien invasive plant species and anthropogenic disturbances. Nonetheless, wetland areas are sensitive environments and the vegetation plays many essential roles in the functioning of the hydrology of an area. In addition, wetlands and rivers are protected by national legislation and are essential to maintain ecological corridors and ecological support areas for the movement and survival of species within a landscape fragmented by cultivation and urbanisation.

Between Pulsar and Meteor:

Most of the moist grassland between the Pulsar and the proposed Meteor substation was grazed and some portions were historically planted with pasture. *Berkheya radula* (Boesmanrietjie) formed large stands within the northern portion of this wetland area. The northern portion also contained the highest species diversity and was confirmed habitat for one plant of conservation concern, *Crinum bulbispermum*. In addition, the provincially protected *Kniphofia ensifolia* (Red-hot-Poker) as well as *Gladiolus papilio* (Butterfly Gladiolus) was also observed in this section of the powerline (See sections 3.2 and 3.3) (Figure 4).Directly north of the proposed Meteor substation, the wetland area was encroached by alien invasive trees such as *Salix babylonica* (Weeping Willow) and *Populus canescens* (Grey Poplars) (Photograph 1; Figure 4).



Photograph 1: a) Moist grassland along the Rietspruit and a) a wetland area north of the proposed Meteor substation invaded by the exotic Poplar tree

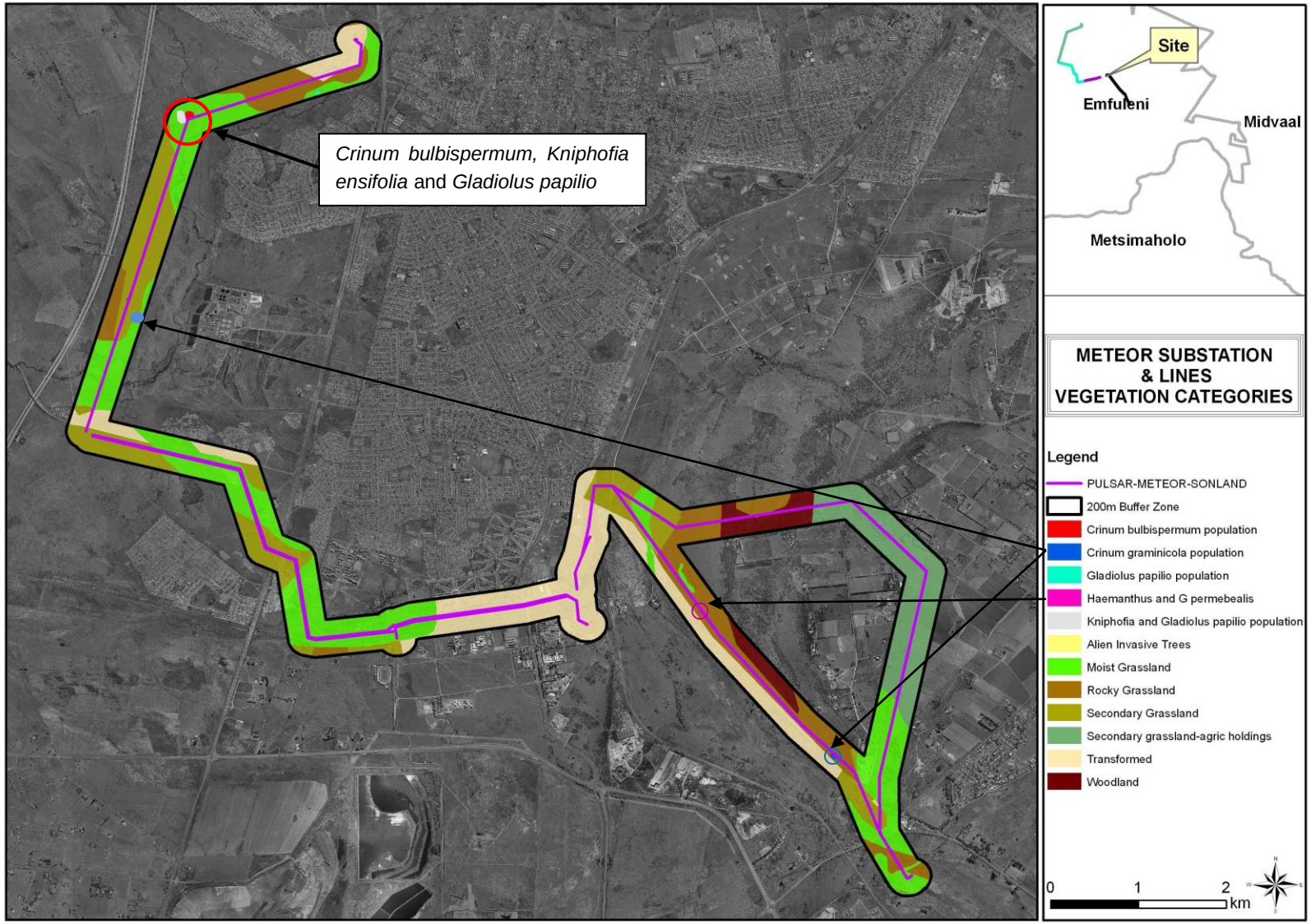


Figure 4: Vegetation communities along the surveyed routes (note the map includes a 200m buffer on either side of the line)

Between Meteor and the R28 road, across from the West Side park residential area
East of Meteor, a disturbed area showed sign of moist grasslands conditions. Aerial images (Google Earth, 2011) and topographic maps indicated that diggings took place within this area in the past and it is likely that sand was mined here. Due to the historic disturbances the vegetation comprised of dominant stands of the grass *Hyparrhenia hirta* (Common Thatching Grass) with patches of the invasive weed *Arundo donax* (Giant Reed). The forb *Senecio gregatus*, which often grows in moist areas, were also noted.

Between the R28 and Houtkop Road
East of the R28, the line traversed a moist grassland where the R28 and a railway line intersect. This moist grassland was historically disturbed by mining activities as well as construction of the railway and nearby urban areas. A large waste dump was situated on the northern portion of this moist grassland and has been colonised by weedy and invasive plant species. *Berkheya radula* and *Nidorella* sp. also formed dominant stands in this wetland area. Weedy plants included *Melilotus alba* (Bokhara Clover) and *Cirsium vulgare* (Scotch Thistle). In addition, the shrub *Seripheum plumosum* (Bankrupt Bush), usually associated with overgrazed or disturbed areas, as well as the tree *Acacia karroo* (Sweet Thorn) were encroaching into this moist grassland (Photograph 2; Figure 4). At the time of the field survey, no plants of conservation concern were noted in this moist grassland.

Photograph 2: Moist grassland along the railway line with some invasive species encroaching into the moist grassland (right)

East of Moshoeshoe Road:
In July 2014, the route in this portion changed in order to avoid the informal settlement between Moshoeshoe Road and Houtkop Road. The line turns northward and traverse a moist grassland area that was not ground-truthed at the time of this assessment. However, aerial images indicate that this moist grassland area was historically ploughed.

North of Sonland substation:
A large moist grassland area stretched from the Sonland substation northwards underneath the

R54 road and along the western edge of Houtkop Road. Much of this moist grassland was impacted on in the past due to road works, damming and expansion of the Sebokeng informal settlements. The moist grassland was dominated by *Phragmites australis* (Common Reed) and include a number of alien invasive tree species such as *Populus species* (Poplar) and *Eucalyptus* species (Blue Gum). Topographic maps indicated that parts of this moist grassland was historically ploughed. Closer to the Sonland substation and south of the R54, the moist grassland is likely more seasonal than permanently wet and in a more natural state with grasses such as *Setaria incrassata* and *Agrostis lachnantha* dominating (Photograph 3). Due to the disturbed state, no plants of conservation concern was observed in sampling areas, and it is thought to be unlikely to occur.

Photograph 3: Moist grassland north of the Sonland substation

3.1.2 Secondary grassland

Secondary grasslands develop where the original, primary (undisturbed) grassland vegetation was removed (e.g. by cultivation). After such disturbances cease, pioneer grassland species colonise the disturbed areas leading to a secondary grassland state with a lower species diversity as opposed to the primary (climax) state prior to any disturbances. In the absence of any further disturbances, continuous succession should theoretically lead to the development of the original climax (or primary) state of the grassland. However, primary grasslands are species rich ecosystems, which once disturbed, are difficult, if not impossible to restore.

Historic aerial images (Google Earth, 2011), as well as topographic maps indicated that cultivation took place within grasslands along the proposed routes as well as at the proposed locality for the Meteor substation. The assessment found that some of the historically cultivated areas were planted with pasture grasses (e.g. *Digitaria eriantha*), while others were dominated by pioneer grasses such as *Eragrostis plana* (Tough Love Grass), *E. lehmanniana* and *Cynodon dactylon* (Couch Grass). Derelict cattle dip areas and kraals between Pulsar substation and the proposed Meteor substation confirmed that the area was historically used for large scale cattle farming. The secondary grasslands, and in particular at the proposed Meteor substation site, comprised a low species diversity and basel cover. The substation site included

dominant stands of *Hyparrhenia hirta* (Common Thatching Grass) as well as *Digitaria eriantha* (Finger Grass) and the yellow flowering pioneer forb specie, *Conyza podocephala* (Photograph 4).

Due to the severe and long term soil disturbances, it is unlikely that secondary grassland will revert to primary grassland. It is doubtful that geophytes or plants of conservation concern survived the cultivation, except in areas around wetlands where the soil was too wet to plough. Although some herbaceous species were observed in the secondary grasslands (e.g. *Cleome maculata, Comelina africana* var *krebsiana, Felicia muricata, Indigofera zeyheri* and *Hermannia depressa*), the diversity was observed to be low (Photograph 4).

No plants of conservation concern was observed in the secondary grasslands. However, *Crinum graminicola*, a provincially protected bulb, was observed on the edge of secondary grassland and rocky grassland about halfway between Pulsar and the proposed Meteor substation.


Photograph 4: a) Low basel cover in the secondary grassland along the proposed route and b) at the Meteor substation locality

3.1.3 Secondary Grassland on agricultural holdings

The alternative route traverse agricultural holdings on the eastern part of the ridge. Grasslands within the holdings were either grazed, trampled, regularly mowed or historically cultivated. These grasslands were thus classified as secondary. These secondary grasslands also included areas transformed by the land use, as well as woodland dominated by *Acacia karoo* or alien invasive trees such as *Eucalyptus* species (Blue Gum) and *Pinus* species (Pine) (Photograph 5). Some patches of rocky grassland were observed. These areas were small and isolated between cultivated areas and secondary grasslands. Due to constant disturbances is unlikely that plants of conservation concern were present within the agricultural holdings. However, the Declining *Hypoxis hemerocallidea* can adapt to disturbance and may be present.

Photograph 5: Isolated grassland patches in-between secondary grassland and alien plant species in the agricultural holdings

3.1.4 Rocky grassland and woodland

Ridges and rocky outcrops are usually characterized by high biodiversity and therefore their protection contributes to conservation of biodiversity. According to climate change modelling, level topography will be particularly sensitive to future climate change and major extinction in these areas can be expected (Rutherford *et al.,* 2001). As such, in a landscape affected by climate change, probabilities for species survival will be higher on ridges (GDACEL, 2001). Rocky outcrops are characterized by high spatial heterogeneity due to the range of differing aspects (north, south, east, west and variations thereof), slopes and altitudes all resulting in differing soil (e.g. depth, moisture, temperature, drainage, nutrient content), light and hydrological conditions (GDACEL, 2001), supporting therefore a higher variety of plant species.

3.1.4a) Rocky grassland

Grassland areas that were not historically ploughed along the proposed route alignments, were classified as rocky grassland. The rocky nature of the grassland likely prevented it from being historically ploughed. Although the grasslands were grazed by cattle, the species diversity were higher than secondary grasslands. Typical forb species included *Indigofera comosa, Hypoxis iridifolia, Pentanissia prunelloides, Ajuga ophrydis, Dianthus mooiensis, Delosperma herbeceum* and *Bulbostylis burchellii.* Grass species included *Themeda triandra* (Red Grass), *Brachiara serrata* (Saw-tooth Grass), *Eragrostis chloromelas* (Narrow Curly Leaf) and *E. curvula* (Photograph 6).

Photograph 6: Rocky grassland areas north of the proposed Meteor substation

The highest diversity of forbs were observed in the rocky grassland was on the small ridge east of Houtkop Road (Photograph 7). The grassland was more rocky and included plants such as *Clematis villosa* (Pluimbossie), *Barleria macrostegia, Sutera caerulea* (Ruikbossie) and two provincially protected plants, *Haemanthus humilis* and *Gladiolus permebealis* (Patrysuintjie). The rocky grassland was representative of the original Soweto Highveld Grassland that occurred in the area prior to anthropogenic disturbances and are thus of conservation value.

Photograph 7: Rocky grassland at the base of the ridge, north of Sonland substation

3.1.4b) Woodland

The ridge north of the Sonland substation included a woodland area on its upper slopes. In grasslands, woody species are usually restricted to riparian areas or rocky slopes where there is some protection from fire and frost. The rocky ridge supported diversity of woody species as scattered shrub and solitary small trees. The tree layer was dominated by *Acacia karoo* (Sweet Thorn), *Searsia pyroides* (Common Wild Currant) and *Celtis africana* (White Stinkwood). Other woody species included *Ehretia rigida* (Deurmekaarbos), *Mundulea sericea* (Cork Bush) and the small *Searsia magalismontana* (Bergtaaibos) scrambling over rocky areas. Herbaceous species

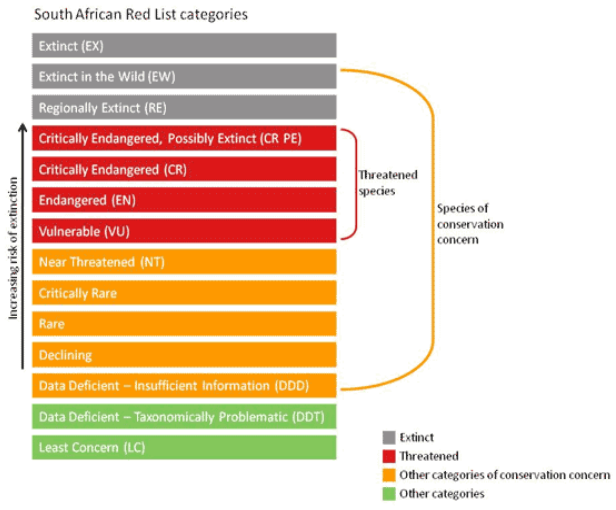
included *Leonotus leonorus,* (Wild Dagga), *Gerbera* species*, Clematis villosa* and *Lippea* cf *scaberrima* (Photograph 8).

Acacia karoo is also a pioneer tree species and disturbed areas within the rocky grassland was dominated by this tree. The base of the ridge, parallel to Houtkop Road, were disturbed by the historic road building, as well as subsequent localised disturbances and are dominated by *Acacia karoo*. Successively, other tree species also colonised this area.

Photograph 8: Woodland vegetation on the ridge

3.2 Plants of Conservation Concern

Plants of conservation concern are those plants that are important for South Africa's conservation decision making processes and include all plants that are Threatened, Extinct in the wild, Data deficient, Near-threatened, Critically rare, Rare and Declining (Figure 5). These plants are *nationally* protected by the National Environmental Management: Biodiversity Act (Raimondo *et al*, 2009).



(Source: http://redlist.sanbi.org/redcat.php)

Figure 5: Threatened species and species of conservation concern

A list of plants of conservation concern was compiled using information from the South African National Biodiversity Institute's (SANBI) checklist (SANBI, 2009), Raimondo *et al*, (2009) and the GDARD's Conservation plan (GDARD, 2011). Ten plants of conservation concern could occur within the area that the powerline and substation are situated within (Table 1). Of these, only the *Crinum bulbispermum* was confirmed to occur in the moist grassland between the Pulsar and proposed Meteor substation. The rocky grassland are suitable habitat for additional species with a high likelihood of occurring, although not observed in sampled areas at the time of the field survey (Table 1).

The proposed line between Pulsar and Meteor will directly impact on the *Crinum bulbispermum* population (Figure 6).

Table 1: Plants of conservation which could occur

Specie	Conservation status	Occurrence or likely occurrence
Cineraria longipes	Vulnerable	Highly unlikely. Distribution is more south-eastward towards the Suikerbosrand
Bowiea volubilis subsp. volubilis	Vulnerable	This climber usually occurs along mountain ranges and in thickly vegetated river valleys. Often grows under bush clumps and in boulder screes it is often found in open and or on steep rocky hills usually in well-shaded situations. Likely occurrence in
Lithops lesliei subsp. *lesliei*	Near Threatened	Suitable habitat exist on a rocky sheet area on the ridge – likely impacted on by the proposed route. However, the area was surveyed but the plant was not observed. It must be noted that plant is difficult to spot if not in flower.
Stapelia paniculata subsp. *paniculata*	Near Threatened	Highly unlikely to occur within the study area. This plant's natural distribution is restricted to the Western Cape and if recorded within the proposed projects quarter degree square (SANBI, 2012), it is either a typo or was recorded ex-situ
Gnaphalium nelsonii	Rare	This plant is indicated by the Gauteng C-plan to occur within wetland areas along the ridge and Rietspruit River. There is a small likelihood of occurring in seasonal moist grasslands (wetlands).
Boophane disticha	Declining	Likely occurrence on the ridge, but although this plant is easily recognised even if not in flower, none were observed at the time of the field survey.
Crinum bulbispermum	**Declining**	**Confirmed to occur within the moist grasslands associated with the Rietspuit (between Pulsar and Meteor substations) (see Appendix C). The proposed line will directly impact on this population which middle coordinate is 26°33'13.99"S and 27°48'36.09"E**
Hypoxis	Declining	Likely occurrence in all grassland areas. The author has

Specie	Conservation status	Occurrence or likely occurrence
hemerocallidea		noted this plant in disturbed areas before and it can seemingly survive some impact. Although it was not observed at the time of the field survey, there is a likelihood that the plant occurs (see Appendix C)
Lepidium mossii.	Data Deficient	Has previously been recorded in Nancefield, Gauteng (approximately 60km north of the site). It is unlikely to occur.
Lessertia mossii	Data Deficient	No data available
Acalypha caperonioides var. *caperonioides*	Data Deficient	Likely occurrence in rocky grasslands. However, this plant was not observed in sampled areas at the time of the field survey.

3.3 Provincially Protected Plants

A number of provincially protected plants are listed in the Transvaal Nature Conservation Ordinance Act No. 12 of 1983. These plants are not to be removed, damaged, or destroyed without permit authorisation from Gauteng Department of Agriculture and Rural Development (GDARD) or the North West Department of Agriculture, Conservation, Environment and Rural Development (NWDARD). Table 2 indicates the protected plant species that were observed to occur along the proposed powerline route alignment. The protected species were restricted to moist grasslands and rocky grasslands.

The line between Pulsar and the proposed Meteor substation will impact directly on the *Crinum bulbispermum, Kniphofia ensifolia* and *Gladiolus papilio* population. The proposed line parallel to Houtkop Road, will impact directly on the protected *Haemanthus huilis, Galdiolus permebealis* and *Crinum graminicola* populations (Figure 6).

Table 2: Provincially protected plant species

Plant species	Common name	Vegetation community
All species of *Crinum*	Crinums	• *Crinum bulbispermum* occurred in the moist grassland between Pulsar and the proposed Meteor substation, on the bend of the proposed line (26°33'13.99"S; 27°48'36.09"E). It could also occur in other moist grassland along the route. • *Crinum graminicola* was observed on the border between secondary and rocky grassland between the Pulsar and Meteor substation at coordinate 26°34'21.71"S; 27°48'14.35"E. • Another *Crinum graminicola* population was observed along the proposed route to Sonland substation, just east of Houtkop Road, in rocky grassland at coordinate 26°37'9.76"S; 27°52'34.60"E

Plant species	Common name	Vegetation community
All species of *Haemanthus*	Paint Brush	• *Haemanthus humilis* was confirmed to occur in rocky grassland on the base of the ridge. This plant was wedged in between rocks (26°36'16.44"S; 27°51'45.44"E)
All species of *Kniphofia*	Red Hot Pokers	• *Kniphofia ensifolia* was confirmed to occur in moist grassland between Pulsar and the proposed Meteor substation, on the bend of the proposed line at 26°33'14.42"S; 27°48'34.46"E
All species of *Gladiolus*	Gladioli	• Two *Gladiolus papilio* populations was confirmed to occur in moist grassland between Pulsar and the proposed Meteor substation. The first population was about 180m south of the proposed line at 26°33'5.58"S; 27°49'24.48"E, while the second population was traversed by the line (on the bend) at 26°33'13.55"S; 27°48'33.37"E. • *Gladiolus permebealis* was confirmed to occur in the rocky grassland on the base of the ridge (26°36'16.07"S; 27°51'46.39"E) and likely also occurs along the proposed alternative route crossing over the ridge

3.4 Alien Invasive Plant Species

Declared weeds and invader plant species have the tendency to dominate or replace the canopy or herbaceous layer of natural ecosystems, thereby transforming the structure, composition and function of natural ecosystems. Therefore, it is important that these plants controlled and eradicated by means of an eradication and monitoring programme. Some invader plants may also degrade ecosystems through superior competitive capabilities to exclude native plant species (Henderson, 2001).

The amended Regulations (Regulation 15) of the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) (CARA) identifies three categories of problem plants:

Category 1 (Declared weeds): plants may not occur on any land other than a biological control reserve and must be controlled or eradicated. Therefore, no person shall establish plant, maintain, propagate or sell/import any category 1 plant species;

Category 2 (Declared invaders): plants are plants with commercial application and may only be cultivated in demarcated areas (such as biological control reserves) otherwise they must be controlled; and

Category 3 (Declared invaders): plants are ornamentally used and may no longer be planted, except those species already in existence at the time of the commencement of the regulations (30 March 2001), unless they occur within 30 m of a 1:50 year flood line and must be prevented from spreading.

In addition, a second draft of the Alien and Invasive Species Regulations, as well as a new draft list of categories of invasive species in terms of the National Environmental Management: Biodiversity Act (Act 10 of 2004) was published in the Government Gazette No. 32090, in April 2009. Should the regulations become law, any species designated under section 70 cannot be propagated, grown, bought or sold by the industry without a permit. Whereas CARA previously classified problem plants into two groups - declared weeds and plant invaders - the amended regulations make provision for four groups: declared weeds (Category 1 plants), plant invaders (Category 2 and Category 3 plants) and indicators of bush encroachment. The first three groups consist of undesirable alien plants and are covered by Regulation 15. Bush encroachers, which are indigenous plants that require sound management practices to prevent them from becoming problematic, are covered separately by Regulation 16 and are not covered by this alien invasive plant management plan. Below is a brief explanation of the three categories in terms of the National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEMBA):

> Category 1a: Invasive species requiring compulsory control. Remove and destroy. Any specimens of Category 1a listed species need, by law, to be eradicated from the environment. No permits will be issued.
> Category 1b: Invasive species requiring compulsory control as part of an invasive species control programme. Remove and destroy. These plants are deemed to have such a high invasive potential that infestations can qualify to be placed under a government sponsored invasive species management programme. No permits will be issued.
> Category 2: Invasive species regulated by area. A demarcation permit is required to import, possess, grow, breed, move, sell, buy or accept as a gift any plants listed as Category 2 plants. No permits will be issued for Category 2 plants to exist in riparian zones.
> Category 3: Invasive species regulated by activity. An individual plant permit is required to undertake any of the following restricted activities (import, possess, grow, breed, move, sell, buy or accept as a gift) involving a Category 3 species. No permits will be issued for Category 3 plants to exist in riparian zones.

The alien plant species identified on the study site is listed in Appendix B. The main invaders in moist grasslands were *Verbena* species, *Mirabilis jalapa* and the invasive tree *Populas x canescens* (Poplar). Grasslands contained the weed *Cirsium vulgare* (Scottish Thistle), while a high degree of *Opuntia* species (Prickly Pear) invasion was observed on a rocky area between Pulsar and Meteor substation (outside of the 100m buffer). Where the category 1 and 2 species occur within the footprint of the final route alignment or substation localities, they should be removed and re-infestation monitored as part of an alien invasive monitoring plan.

4. VEGETATION IMPORTANCE AND SENSITIVITY

It has been clearly demonstrated that vegetation not only forms the basis of the trophic pyramid in an ecosystem, but also plays a crucial role in providing the physical habitat within which

organisms complete their life cycles (Kent & Coker 1992). Therefore, the vegetation of an area will largely determine the ecological sensitivity thereof. The vegetation sensitivity assessment aims to identify whether the vegetation within the study area is of conservation concern and thus sensitive to development as it is amongst others:

- Situated in a listed ecosystem or threatened vegetation unit;
- Habitat or potential habitat to plants species of conservation concern, protected plants or protected trees;
- Situated within ecologically sensitive features such as wetlands or riparian areas;
- Natural, untransformed and un-fragmented natural vegetation.

4.1 Sensitivity ratings

In order to determine the sensitivity of the vegetation along the proposed route alignment, weighting scores as listed below (Table 3) were applied. The vegetation with the lowest score represents the vegetation that has the least / limited sensitivity (Table 4). Sensitive vegetation or areas of conservation importance were classified based on the findings of the study and the criteria as listed in Appendix A.

Table 3: Weighting scores

Scoring	13-18	12	7-11	6	0-5
Sensitivity	High	Medium-high	Medium	Low-medium	Low

4.2 Sensitivity Analysis

The sensitivity analysis results of the above assessment were classified as per Table 4 below:

Table 4: Scoring of vegetation that occur within the study area

Vegetation	**Conservation Status of regional Vegetation unit**	**Listed Ecosystem**	**Legislated Protection**	**Plants of conservation concern**	**Ecological Function**	**Conservation Importance**	**Total Score out of max of 18**
Secondary grassland	0	1	0	1	1	**1**	**4 Low**
Woodland	2	2	2 (Gauteng Ridge policy)	2	2	2	**12 Medium-high**
Rocky grassland	2	2	2 (Gauteng Ridge policy)	2	2	2	**12 Medium-high**

Vegetation	Conservation Status of regional Vegetation unit	Listed Ecosystem	Legislated Protection	Plants of conservation concern	Ecological Function	Conservation Importance	Total Score out of max of 18
Moist grassland	2	2	3 (National)	2	2	3	**14 High**

As per Table 4, the result of the assessment indicated that the moist grassland and the rocky grassland, especially on the ridge, as well as the woodland on the ridge are of high and medium to high vegetation sensitivity respectively. This was mainly due to legislated protection (Gauteng Ridge Policy and National Water Act) and the fact that the moist grasslands and rocky grassland supported protected plant species (Figure 6).

4.2.1 Vegetation of high sensitivity to the proposed powerline development

Moist grassland vegetation

Moist grassland vegetation help maintain the hydrology of the area and slows the flow of water, both by physically blocking the passage of water, and by absorbing the water into its root systems. This moderates the impacts of flooding on downstream and surrounding areas. Moist grasslands (wetland areas) are protected by national legislation and are essential to maintain ecological corridors for the movement and survival of species within a landscape fragmented by cultivation and urbanisation. In addition, the hydrological processes associated with the wetlands and are closely associated with the intactness of the vegetation within and surrounding these moist grasslands.

A large portion of the proposed route will impact on moist grasslands, therefore the route alignment impacts on the vegetation associated with moist grasslands should be restricted to the smallest distance possible.

4.2.2 Vegetation of medium to high sensitivity to the proposed powerline development

Rocky grassland

Within the Gauteng Province, rocky outcrops and ridges are offered some protection by the Gauteng Ridge Policy (GDACEL, 2001 (updated 2006)). Although the rocky grasslands observed along the powerline routes are impacted by edge affects from nearby roads and developments as well as grazing, the vegetation composition was still greatly intact and has a high likelihood of supporting threatened plants. Most of the intact rocky grassland observed is restricted to the ridge north of the Sonland substation. Although the proposed route will be situated parallel to the Houtkop Road and will traverse patches of vegetation historically disturbed, a number of provincially protected plants were observed here. The alternative route crosses over the ridge where current grazing has an impact. The alternative route aligns next to an existing powerline route and servitude road and impact on a shorter portion of rocky grassland.

Woodland

The woodland vegetation, like the rocky grassland, forms part of the ridge vegetation and are therefore given some protection by the Gauteng Ridge Policy. No protected plant species was observed in the woodlands and it is thought that only *Bowiea volubilis* has the potential to occur within the woodland.

4.2.3 Vegetation with a Low Sensitivity to the proposed powerline and substation development

Secondary grassland

The secondary grassland comprised mainly of land that was historically cultivated or are currently divided into several agricultural plots where some grassland remains. The species composition in the secondary grassland typically include a higher frequency of pioneer species, a low diversity of species and a low basel cover. It is assumed that cultivation removed plant species of conservation concern from these areas.

Transformed and alien invasive tree groups

Land that is currently cultivated, part of residential and urban areas or used for other industries were classified by this report as having no natural habitat remaining and therefore are of low sensitivity to the proposed powerline route.

A summary of the vegetation communities observed along the proposed powerline alternative routes and proposed substation localities are presented in Table 5 and geographically represented in Figure 6. Plant species identified in each community is listed in Appendix B.

Table 5: Summary of sensitivities along the proposed routes and proposed substation locality

Vegetation Description	Powerline / substation locality	Sensitivity
Secondary grassland	1. Proposed Meteor substation locality 2. Sections of the proposed line between Pulsar and Meteor substations, include the provincially protected *Crinum graminicola* 3. Section of the line from Meteor south-eastward	Low
Rocky grassland	1. Small portions of the proposed powerline between the Pulsar and Meteor substations 2. From Houtkop Road the proposed line traverse rocky grassland parallel to Houtkop Road, as well as habitat to provincially protected plant species (*Haemanthus, Crinum* and *Gladiolus*) 3. The alternative route over the ridge crosses over a smaller portion of rocky grassland and are positioned along an existing powerline and servitude. 4. Situated on Class 1 & 3 ridge areas, as well as C-plan Important area	Medium to High

Vegetation Description	Powerline / substation locality	Sensitivity
	5. Representative of Soweto Highveld Grassland	
Woodland	1. The alternative route over the ridge traverse a small portion of the woodland on the ridge 2. Situated on Class 3 ridge and C-plan Important area	Medium - High
Moist grassland	1. Much of the proposed lines between are situated in moist grassland. Although portions of the moist grassland are invaded by alien invasive plants, the hydrology should still be protected. 2. Between Pulsar and Meteor substations, the Declining *C bulbispermum* as well as the provincially protected *Kniphofia ensifolia* and *Gladiolus papilio* grew 3. Situated in C-plan Important areas	High

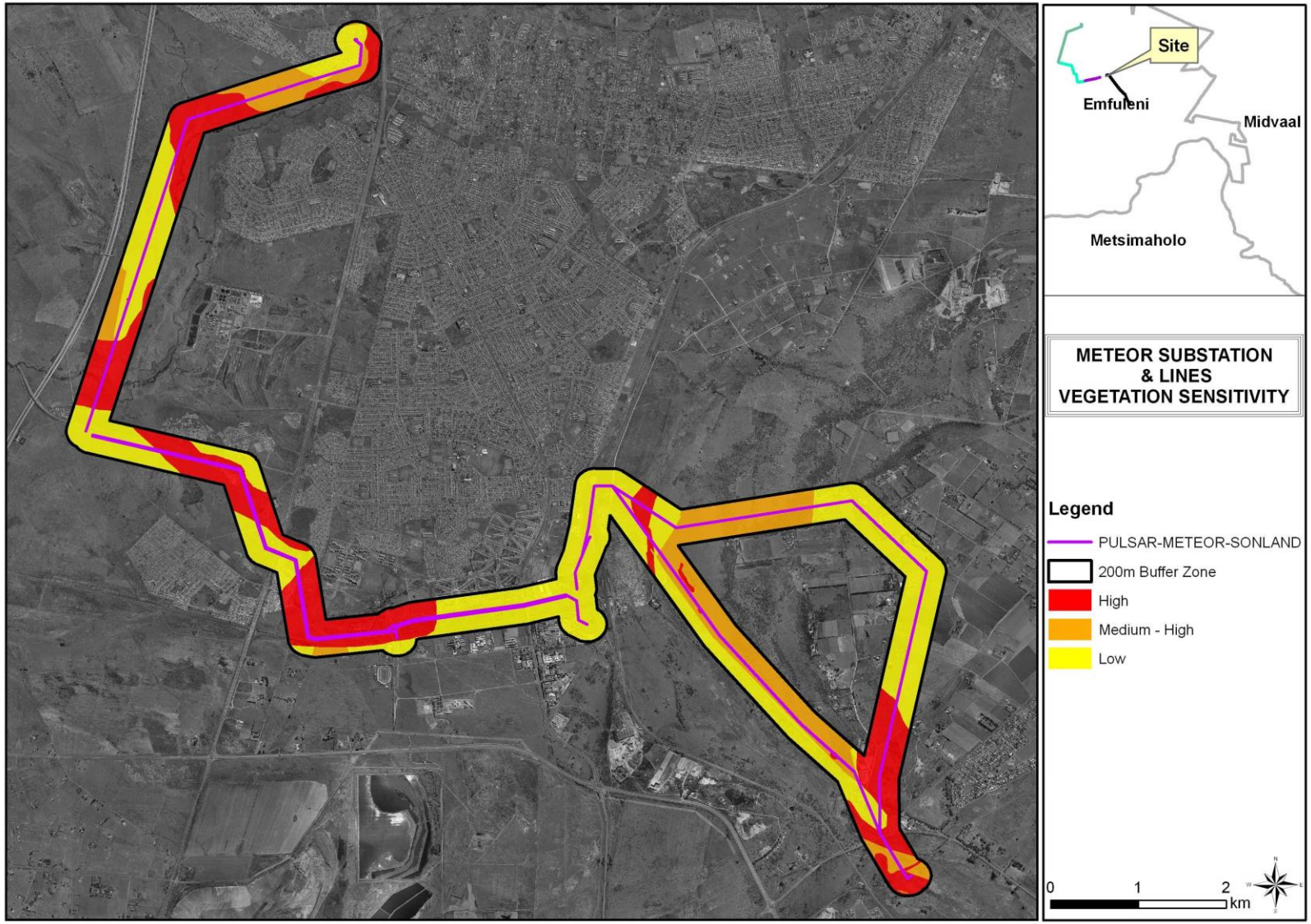


Figure 6: Vegetation Sensitivity Map (note the map includes a 200m buffer on either side of the proposed powerline routes)

5. COMPARISON OF ROUTE ALIGNMENTS / SUBSTATIONS

The proposed route and one alternative will impact mainly on moist grassland and rocky grassland that are of conservation value. The proposed Meteor substation locality is situated in secondary grassland which is of low vegetation sensitivity.

No alternative was proposed for the route between Pulsar and Meteor substation as well as from Meteor up to Houtkop Road. From here one alternative is proposed to cross the ridge and rocky grassland, whereas the proposed route runs parallel to the Houtkop Road within rocky grassland. Table 6 summarises the two routes and the preferred route.

Table 6: Comparison between alternative routes

Route	Rationale	Order of preference
Alternative route	• Rocky grassland • Potential habitat for protected plants – none confirmed • Route aligns with an existing powerline and access road • Route traverse a smaller portion of rocky grassland	Preferred – ONLY if existing access road can be utilized with no additional crew camps/ access roads over the ridge and in the rocky grassland
Proposed route	• Rocky grassland • Confirmed localities of provincially protected plants • Traverse the base of the ridge where the historic road construction had some impacts • However, a new servitude road will have to be constructed as Houtkop Road is a busy feeder route	Second option. However, if the conditions to the alternative route (see above) cannot be adhered to, then this route becomes the preferred

6. IMPACT ASSESSMENT AND MITIGATION

Mankind depends on the natural environment for a large number of ecological services provided for by ecosystems, ecological processes and plant species in general. However, any development activities in natural systems will impact on the surrounding natural environment and usually in a negative way. In order to limit or negate these impacts, the source, extent, duration and intensity of the possible impacts needs to be identified. Once the significance of the impacts is understood, the development could both adequately plan for and mitigate these impacts to a best practise and acceptable level. However, if the impacts are significant, especially in already threatened ecosystems and vegetation units, and no adequate mitigation measures could reduce or avert these impacts, then the development should not be allowed to proceed.

6.1 Potential Impacts of Powerlines on Vegetation

The most significant impact of electrical powerlines are expected to occur during the construction phase, whereas the new pylons and powerlines, once in use, have relatively contained impacts on the vegetation and can successfully be mitigated to limit or even negate the negative impacts. Arguably the greatest threat to the rehabilitation of disturbed areas, are the potential of invasive plant species to colonise the disturbed soil and spread into adjacent natural areas. If remedial measures and monitoring is properly employed, (e.g. ESKOM's erosion guidelines and environmental policies as well as mitigation as set out by this report), the vegetation that will be disturbed during construction could rehabilitate well over time, and long term impacts on vegetation and faunal habitats could thus be minimal. Furthermore, where existing roads or servitudes are employed during construction and implementation, the impacts of these when compared with extensive agriculture, rural settlements or urbanisation, can be considered as medium to low.

6.2 Potential Impacts of Substations

The construction of a substation necessitates the clearing of vegetation for the whole of the development footprint. It is thus assumed that no vegetation cover will be left on site and that some edge effects can occur within the surrounding vegetation. Once constructed, the substation is unlikely to significantly impact on the adjacent vegetation. The most probable impact in grasslands is that due to the threat it poses to the substation infrastructure, natural grassland fires will likely be prevented which could lead to a decrease in the health of adjacent natural grassland vegetation.

6.3 Impact Assessment Criteria

The possible impacts, as described in the next section, were assessed based on the following:

6.3.1 Extent of the Impact

A description of whether the impact is restricted to the development footprint, the study site (extending only as far as the study site), or whether the impact will extend beyond the study area and its immediate surroundings, regional, or to a national scale.

6.3.2 Duration of the Impact

- Short term: the impact will disappear with mitigation or will be mitigated through a natural process in a period shorter than that of the construction phase
- Short to Medium term: the impact will be relevant to the end of a construction phase
- Medium term: the impact will last up to the end of the development phases, where after it will be entirely negated
- Long term: the impact will continue or last for the entire operational lifetime of the development, but will be mitigated by direct human action or by natural processes thereafter

- Permanent: this impact is not reversible and human intervention e.g. rehabilitation, is unlikely to negate the impact sufficiently (e.g. acid mine drainage)

6.3.3 Intensity

This indicates the degree to which the impact changes or could change the conditions or quality of the environment. This was qualified as:

- Low: the impact alters the affected environment in such a way that the natural processes or functions are not affected
- Medium: the affected environment is altered, but functions and processes continue, albeit in a modified way
- High: function or process of the affected environment is disturbed to the extent where it temporarily or permanently ceases.

6.3.4 Probability of Occurrence

This describes the probability of the impact actually occurring. This is rated as:

- Improbable: low likelihood, the chance of this impact occurring is between 0 and 25%. However, mitigation measures might be needed in the event of this impact occurring.
- Probable: a distinct possibility, the chance of this impact actually occurring is approximately 50% and therefore it needs to be mitigated
- Highly probable: the impact is most likely to occur and the planning phase must address the relevant mitigation measures to limit the impact
- Definite: this impact will occur regardless of any prevention measures, or is currently occurring. Mitigation measures or contingency plans must be implemented to contain the impact.

6.3.5 Significance with and without mitigation

Without mitigation measures (WOMM):

- Low: the impact is of little importance, but may require some mitigation
- Medium: the impact is of importance and is therefore considered to have a negative impact. Mitigation is required to reduce the negative impacts to acceptable levels
- High: the impact is of major importance and mitigation is essential. Failure to mitigate, with the objective of reducing the impact to acceptable levels, could render the entire development option or entire project proposal unacceptable.

With mitigation measures (WMM):

- Low: the impact will be mitigated to the point where it is of limited importance
- Medium: despite the successful implementation of the mitigation measures that reduce the negative impacts to acceptable levels, the negative impact remains significant. However, taken within the overall context of the project, the persistent impact does not constitute a fatal flaw

- High: The impact is of major importance. Mitigation of the impact is not possible on a cost-effective basis. The impact is regarded as high importance and taken within the overall context of the project, is regarded as a fatal flaw. An impact regarded as high significance, after mitigation could render the entire development option or entire project proposal unacceptable.

6.4 Impacts Assessment

Table 7 list the activities that could impact on the vegetation as a result of the construction of the proposed powerline and associated infrastructure, as well as impacts that may be associated with the operation and maintenance thereof. The impacts are assessed in Table 7 below and suitable mitigation measures are given in Section 6.5.

Table 7: Assessment of impacts associated with the construction and operation of the powerline and substation

Phase	Impact	Source	Extent	Duration	Intensity	Probability of occurrence	Significance	
							WOMM	WMM
Construction	1. Destruction of sensitive vegetation – mainly moist grassland and rocky grassland	• Clearing of vegetation for pylon construction; • Access roads; • Illegal disposal and dumping of construction material such as cement or oil as well as maintenance materials during construction; and • Storage of metal structures within natural vegetation	Sensitive vegetation	Short to medium term	Medium	Definite	Medium	Medium to low
	2. Exposure to erosion and subsequent sedimentation of moist grasslands and Rietspruit River	• Removal of vegetation in and in proximity to moist grasslands	Moist grasslands	Short to medium term	Medium	Definite	High	Medium
	3. Destruction of plants of conservation concern	• Construction activity where these plants were confirmed to occur or could potentially occur	Moist and rocky grassland	Short to medium term	Medium	Defnite	High	Medium-Low (depending on which mitigation measures are followed)
	4. Spread of alien invasive vegetation	• Contaminated construction vehicles and tools; and • Alien invasive species	All areas	Medium term	Medium	Probable	Medium	Low

Phase	Impact	Source	Extent	Duration	Intensity	Probability of occurrence	Significance	
							WOMM	WMM
		spread from current infestation into disturbed soils						
Operational	5. *Positive* impact by removing alien invasive plants, although care must be taken not to remove all vegetation at once, especially within the rainy season (could result in soil erosion and soil loss).	• Removing of existing invasive alien vegetation in areas proposed for the cable and within servitudes • Follow-up control is essential or the positive impact will be negated	Alien vegetation along the route alignment and substation locality	Long term	Medium	Probable	Medium	Low
	6. Destruction of natural vegetation	• Maintenance vehicles driving within sensitive vegetation • Failed rehabilitation in moist grasslands could lead to soil erosion during rainfall events	Moist grasslands	Long term	Medium	Probable	Medium	Low
	7. Bush encroachment	• Degradation of natural vegetation that could lead to the increase of bush encroacher species – especially in rocky grassland vegetation on the ridge	Rocky grassland	Long term	Medium	Probable	Medium	Low

6.5 Mitigation Measures

6.5.1 Destruction of natural vegetation

The construction of the powerline route and substation would inevitably require the removal of vegetation for the purpose of access roads, servitudes and the pylon footprint. Areas where structures are stored would flatten vegetation that could be detrimental to the persistence of the vegetation. In addition, the illegal disposal of construction material such as oil, cement etc. could destroy natural vegetation.

Mitigation Measures

An independent Ecological Control Officer (ECO) should be appointed to oversee construction.

- The route alignments must be fixed through areas with the least vegetation sensitivity. Where the route traverse moist grassland, the route should be re-aligned to fall outside of a buffer area as recommended by the wetland specialist (Limosella, 2014)
- A temporary fence or demarcation must be erected around the construction area (include the servitude, construction camps, areas where material is stored and the actual footprint of the development) to prevent access to sensitive environs.
- Prohibit vehicular or pedestrian access into natural areas beyond the demarcated boundary of the construction area.
- No open fires are permitted within naturally vegetated areas.
- Formalise access roads and make use of existing roads and tracks where feasible, rather than creating new routes through naturally vegetated areas.
- A vegetation rehabilitation plan should be implemented. Grass can be removed as sods and stored within transformed vegetation – remove alien invasive vegetation prior to storing grasslands sods in transformed areas. Smaller shrubs and bulbs should also be removed and used for rehabilitation. The plants must preferably be removed during the winter months and be replanted by latest springtime. The grass sods should not be stacked on top of each other. Once construction is completed, these sods should be used to rehabilitate the disturbed areas from where they have been removed. In the absence of timely rainfall, the sods should be watered well after planting and at least twice more over the next 2 weeks.
- Construction workers may not remove flora and neither may anyone collect seed from the plants without permission from the local authority.
- No activities should take place during rainy events and at least 2 days afterwards.

6.5.2 Exposure to erosion

The removal of surface vegetation will expose the soils, which in rainy events would wash down into moist grasslands that is situated along most of the route alignments, causing sedimentation. In addition, indigenous vegetation communities are unlikely to colonise eroded soils successfully and seeds from proximate alien invasive plants can spread easily into these eroded soil.

Mitigation Measures

- Re-alignment of some of the routes should be considered – especially where routes traverse moist grassland.
- Do not allow erosion to develop on a large scale before taking action.
- No construction / activities should be undertaken within the moist soils until a Water Use License was granted by the Department of Water Affairs (DWA).
- Make use of existing roads and tracks where feasible, rather than creating new routes through grassland areas.
- Retain vegetation and soil in position for as long as possible, removing it immediately ahead of construction / earthworks in that area (DWAF, 2005).
- Runoff from roads must be managed to avoid erosion and pollution problems.
- Remove only the vegetation where essential for construction and do not allow any disturbance to the adjoining natural vegetation cover. The grassland can be removed as sods and re-established after construction is completed.
- Colonisation of the disturbed areas by plants species from the surrounding natural vegetation must be monitored to ensure that vegetation cover is sufficient within one growing season. If not, then the areas need to be rehabilitated with a grass seed mix containing species that naturally occur within the study area.
- Protect all areas susceptible to erosion and ensure that there is no undue soil erosion resultant from activities within and adjacent to the construction camp and work areas.

6.5.3 Removal / Destruction of protected plants and plants of conservation concern

The construction of the powerline between Pulsar and Meteor substations, as well as in rocky grasslands north of Sonland substation will result in the removal of plant species of conservation concern, impact on their habitat, pollinators and inevitably the persistence of these species. This could put further strain on the already declining populations.

Mitigation Measure

- *Primary mitigation:*
  The route alignment between Pulsar and the proposed Meteor substation should be re-aligmed to prevent the line and access roads to impact on the habitat of the *Crinum bulbispermum, Kniphofia ensifolia* and *Gladiolus papilio* population confirmed to occur within this route alignments footprint. Ideally, the alignment should be moved to outside the recommended buffer as set out in the wetland report (Limosella, 2014).
  In addition, the route north of Sonland contain provincially protected *Crinum graminicola, haemanthus humilis* and *Gladiolus permebealis*. In order to avoid these plants, the alternative route should be considered. Prior to construction, the amended route alignment should preferably be walked by a specialist to identify any possible plant species of conservation concern. Note that this should be done in the growing season of plants (Oct-March).

- *Alternative mitigation (if above is absolutely not possible):*
  The plants of conservation concern should be removed by a suitably qualified specialist prior to construction. This can only be done if authorised by the local conservation authority (GDARD) by means of a permit. Once construction is complete, the plants should be reused as part of rehabilitation of the disturbed areas and replanted from where they were removed. The survival of these plants should be monitored for at least 3 years after rehabilitation.

General mitigation:

- Where possible, construction activities must be restricted to previously disturbed areas.
- Implement a Plant Rescue and Rehabilitation Plan: Where the plants of conservation concern are deemed to be under threat from the construction activity, the plants should be removed by a suitably qualified specialist and replanted as part of vegetation rehabilitation after the construction (Note, these plants may only be removed with the permission of the provincial authority - permit).
- Route deviations that take place after this report, should be checked by an ecologist / botanist for presence of plants of conservation concern.
- Construction workers may not tamper or remove these plants and neither may anyone collect seed from the plants without permission from the local authority.
- Cordon off the sensitive vegetation that house the protected plant species and the plants of conservation concern and protect from construction activities and vehicles.
- Slight deviations of access road / pylon alignments must be permitted, so as to avoid plant populations of conservation concern (DWAF, 2005).

6.5.4 Potential increase in invasive vegetation

The seed of alien invasive plant species that occur on and in the vicinity of the construction areas could spread into the disturbed and stockpiled soil. Also, the construction vehicles and equipment were likely used on various other sites and could introduce alien invasive plant seeds or indigenous plants not belonging to this vegetation unit to the construction site.

Mitigation Measures

- Alien invasive species that were identified within the study area and in specific along the final route alignment should be removed prior to construction-related soil disturbances. By removing these species, the spread of seeds will be prevented into disturbed soils which could thus have a positive impact on the surrounding natural vegetation.
- All alien seedlings and saplings must be removed as they become evident for the duration of construction.
- Manual / mechanical removal is preferred to chemical control.
- All construction vehicles and equipment, as well as construction material should be free of plant material. Therefore, all equipment and vehicles should be thoroughly cleaned prior to access on to the construction areas. This should be verified by the ECO.

6.5.5 Positive impact by removing alien invasive plants

Alien invasive plants could spread into the soils disturbed by the construction. In addition, the invasive species could out-compete natural vegetation, displace natural grassland and lead to a species poor transformed landscape. By removing alien vegetation along the route alignment, the numbers of alien species, as well as the potential for these plants to spread into disturbed soil are reduced, *provided that rehabilitation was successful.*

Mitigation measures

- Compile and implement an alien invasive monitoring plan to remove alien invasive plant species along the chosen route alignments, prior to construction.
- Rehabilitate all areas cleared of invasive plants as soon as practically possible, utilising specified methods and species.
- Monitor all sites disturbed by construction activities for colonisation by exotics or invasive plants and control these as they emerge. Monitoring should continue for at least two years after construction is complete.
- Follow manufacturer's instruction when using chemical methods, especially in terms of quantities, time of application etc.
- Ensure that only properly trained people handle and make use of chemicals.
- Dispose of the eradicated plant material at an approved solid waste disposal site.
- Only indigenous plant species naturally occurring in the area should be used during the rehabilitation of the areas affected by the construction activities.

6.5.6 Deterioration of natural vegetation

The vegetation occurring along the constructed powerline could degrade over time if suitable rehabilitation of the disturbed soils does not take place. Furthermore, maintenance work and vehicles could damage the vegetation along the route which could lead to soil erosion, habitat modification, trampling of vegetation as well as the destruction of protected plants and plants of conservation concern.

Mitigation Measures

- After construction, the land must be cleared of rubbish, surplus materials, and equipment, and all parts of the land must be left in a condition as close as possible to that prior to construction.
- Ensure that maintenance work does not take place haphazardly, but according to a fixed plan.
- Cordon off areas that are under rehabilitation as no-go areas using danger tape and steel droppers. If necessary, these areas should be fenced off to prevent vehicular, pedestrian and livestock access.
- Delay the re-introduction of livestock (where applicable) to all rehabilitation areas until an acceptable level of re-vegetation has been reached.

- Maintenance workers may not trample natural vegetation and work should be restricted to previously disturbed footprint. In addition, mitigation measures as set out for the construction phase should be adhered to.

6.5.7 Bush encroachment

The natural vegetation could degrade over time if suitable rehabilitation of the disturbed soils does not take place. In addition, *Acacia karoo* (Sweet Thorn) which occurs naturally on the ridge, could increase in numbers in disturbed areas, if the vegetation is not rehabilitated. The invasion by this tree species could lead to the demise of the grassland and loss of grazing potential to the local subsistence grazers.

Mitigation Measures

- Use grass sods that were removed prior to construction to rehabilitate the construction footprints. Sods must not be stored for lengthy periods and should not be stacked on top of each other or on top of grazed and moist grasslands. The sods should preferably be removed during the winter months and replanted by springtime latest.
- Cordon off areas that are under rehabilitation as no-go areas using danger tape and steel droppers. If necessary, these areas should be fenced off to prevent vehicular, pedestrian and livestock access.
- Delay the re-introduction of livestock (where applicable) to all rehabilitation areas until an acceptable level of re-vegetation has been reached.
- Remove *Acacia karoo* seedlings along with any alien vegetation in rehabilitated grassland.
- Maintenance workers may not trample natural vegetation and work should be restricted to previously disturbed footprint. In addition, mitigation measures as set out for the construction phase should be adhered to.

7. IMPACT STATEMENT AND CONCLUSION

This assessment found that the proposed route alignment will impact on large areas of sensitive vegetation comprising of moist grassland, rocky grassland as well as populations of protected plant species.

Proposed Meteor substation locality

The substation will be construction on secondary grassland that was classified as being of low vegetation sensitivity. No plants of conservation concern was observed on the proposed site and it is unlikely that the substation will have a negative impact on the surrounding secondary grassland.

Powerline route:

The powerline route will impact mainly on moist grasslands as well as rocky grasslands that are

of some conservation value due to its locality on a ridge. As most of the route alignment is fixed, it is advised that some deviations are considered to make use of already transformed vegetation in proximity to moist grasslands. The route alignment between Pulsar and the proposed Meteor substation should be re-considered and moved to outside the moist grassland and the localities of plants of conservation concern.

In order to avoid confirmed localities of protected plants on the ridge, the alternative route over the ridge is recommended, provided that the route aligns closely to the existing powerline and that the existing access road be utilised.

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9. GLOSSARY

Alien species	Plant taxa in a given area, whose presence there, is due to the intentional or accidental introduction as a result of human activity
Biodiversity	Biodiversity is the variability among living organisms from all sources including inter alia terrestrial, marine and other aquatic ecosystems and ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems
Biome	A major biotic unit consisting of plant and animal communities having similarities in form and environmental conditions, but not including the abiotic portion of the environment.
Buffer zone	A collar of land that filters edge effects.
Conservation	The management of the biosphere so that it may yield the greatest sustainable benefit to present generation while maintaining its potential to meet the needs and aspirations of future generations. The wise use of natural resources to prevent loss of ecosystems function and integrity.
Conservation concern (Plants of..)	Plants of conservation concern are those plants that are important for South Africa's conservation decision making processes and include all plants that are Threatened (see **Threatened**), Extinct in the wild, Data deficient, **Near threatened**, Critically rare, Rare and **Declining**. These plants are nationally protected by the National Environmental Management: Biodiversity Act. Within the context of these reports, plants that are provincially protected are also discussed under this heading.
Conservation status	An indicator of the likelihood of that species remaining extant either in the present day or the near future. Many factors are taken into account when assessing the conservation status of a species: not simply the number remaining, but the overall increase or decrease in the population over time, breeding success rates, known threats, and so on.
Community	Assemblage of populations living in a prescribed area or physical habitat, inhabiting some common environment.
Critically Endangered	A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future.

Data Deficient	There is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. However, "data deficient" is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate.
Declining	A taxon is declining when it does not meet any of the five IUCN criteria and does not qualify for the categories Threatened or Near Threatened, but there are threatening processes causing a continuous decline in the population (Raimondo *et al*, 2009).
Ecological Corridors	Corridors are roadways of natural habitat providing connectivity of various patches of native habitats along or through which faunal species may travel without any obstructions where other solutions are not feasible
Ecosystem	Organisms together with their abiotic environment, forming an interacting system, inhabiting an identifiable space
Edge effect	Inappropriate influences from surrounding activities, which physically degrade habitat, endanger resident biota and reduce the functional size of remnant fragments including, for example, the effects of invasive plant and animal species, physical damage and soil compaction caused through trampling and harvesting, abiotic habitat alterations and pollution
Endangered	A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future
Endemic	Naturally only found in a particular and usually restricted geographic area or region
Exotic species	Plant taxa in a given area, whose presence there, is due to the intentional or accidental introduction as a result of human activity
Forb	A herbaceous plant other than grasses.
Habitat	Type of environment in which plants and animals live
Indigenous	Any species of plant, shrub or tree that occurs naturally in South Africa
In Situ	"In the place" In Situ conservation refers to on-site conservation of a plant species where it occurs. It is the process of protecting an endangered plant or animal species in its natural habitat. The plant(s) are not removed, but conserved as they are. Removal and relocation could kill the plant and therefore in situ conservation is preferred/ enforced.
Invasive species	Naturalised alien plants that have the ability to reproduce, often in large numbers. Aggressive invaders can spread and invade large areas
Mitigation	The implementation of practical measures to reduce adverse Impacts
Near Threatened	A Taxon is Near Threatened when available evidence indicates that that

	it nearly meets any of the five IUCN criteria for Vulnerable, and is therefore likely to qualify for a threatened category in the near future (Raimondo *et al*, 2009).
Plant community	A collection of plant species within a designated geographical unit, which forms a relatively uniform patch, distinguishable from neighboring patches of different vegetation types. The components of each plant community are influenced by soil type, topography, climate and human disturbance. In many cases there are several soil types within a given plant community (Gobbat *et al*, 2004)
Protected Plant	According to Provincial Nature Conservation Ordinances or Acts, no one is allowed to sell, buy, transport, or remove this plant without a permit from the responsible authority. These plants are protected by provincial legislation.
Threatened	Species that have naturally small populations, and species which have been reduced to small (often unsustainable) population by man's activities
Red Data	A list of species, fauna and flora that require environmental protection - based on the IUCN definitions. *Now termed Plants of Conservation Concern*
Species diversity	A measure of the number and relative abundance of species
Species richness	The number of species in an area or habitat
Threatened	Threatened Species are those that are facing a high risk of extinction, indicated by placing in the categories Critically Endangered (CR), Endangered (E) and Vulnerable (VU) (Raimondo *et al,* 2009)
Transformation	The removal or radical disturbance of natural vegetation, for example by crop agriculture, plantation forestry, mining or urban development. Transformation mostly results in a serious and permanent loss of biodiversity and fragmentation of ecosystems, which in turn lead to the failure of ecological processes. Remnants of biodiversity may survive in transformed landscapes
Vegetation Unit	A complex of plant communities ecologically and historically (both in spatial and temporal terms) occupying habitat complexes at the landscape scale. Mucina and Rutherford (2006) state: "Our vegetation units are the obvious vegetation complexes that share some general ecological properties such as position on major ecological gradients and nutrient levels, and appear similar in vegetation structure and especially floristic composition".
Vulnerable	A taxon is Vulnerable when it is not Critically Endangered or Endangered but meets any of the five IUCN criteria for Vulnerable and are therefore facing a high risk of extinction in the wild in the future(Raimondo *et al*, 2009)

APPENDIX A: METHODOLOGY

The study was undertaken over two days, the 13th of January 2014 and the 27th of January 2014. The assessment entailed a literature review which included short listing plants of conservation concern that could potentially occur along the cable routes, a field survey, the analysis of data collected and reporting.

Literature Review:
The description of the regional vegetation relied on literature from Mucina & Rutherford (2006). Plant names follow Van Wyk & Van Wyk (1997), Van Wyk & Malan (1997), Pooley (1998), Henderson (2001), Van Oudtshoorn (2002) and Bromilow (2010). The study was undertaken in accordance with the Requirements for Biodiversity Assessments Version 2 (GDARD, 2012).

Field survey:
Some areas along the proposed powerline route were found to have been cultivated in the past, transformed by disturbances and urban development. The field survey therefore focussed on identifying natural and untransformed vegetation, unique features that could indicate local sensitivities such as threatened and protected plants, as well as sensitive ecological features such as wetlands, ridges and rivers that are essential for the maintenance of ecosystems and ecological processes. Where access allowed, random transects were walked within a minimum of a 100m corridor along the proposed and alternative powerline routes. Note that the total extent of the routes was not walked. In order to identify species, protected trees and variation within the vegetation community, transects concentrated on moving through environmental gradients encountered within the site and surrounds. This was continued until few or no new species were encountered. Any additional information on any other feature thought to have ecological significance within the site, such as dominant species cover abundance, soil type, erosion, rocky cover, alien/exotic/invasive plants, as well as plant species of conservation concern and/or their habitat was also recorded. Plant identification and vegetation description relied on species recorded in the sampling points along the walked transects.

Vegetation Sensitivity
The following criteria and weighting was used to determine the vegetation sensitivity, function and conservation importance:

1. The status of the regional vegetation that is expected to occur on the study site, only where natural vegetation is still remaining.

Conservation status*	Scoring
Critically Endangered	3
Endangered	2
Vulnerable	1
Least threatened	0

*This scoring is not applicable (N/A) for areas devoid of natural vegetation.

2. Whether the study area is situated within a Listed Ecosystem in terms of Section 52 of the National Environmental Management: Biodiversity Act (Act 10 of 2004).

Listed Ecosystem*	Scoring
Primary state	3
Sub-climax state	2
Secondary state	1
No natural vegetation remaining	0

3. Whether the vegetation or ecological feature is protected by legislation:

Listed Ecosystem*	Scoring
National legislation	3
Provincial policies and guidelines	2
Municipal or other protection	1
No legislated protection	0

4. The presence of suitable habitat for plants of conservation concern as well as the actual occurrence thereof.

Suitable habitat / presence	Scoring
Confirmed presence	3
Confirmed presence of Declining species and Suitable habitat and some likelihood of occurrence of Threatened species	2
Suitable habitat but unlikely to occur	1
No suitable habitat	0

5. Ecological Function: areas important to ecological processes such as ecological corridors, hydrological processes and important topographical features such as ridges.

Ecological function	Scoring
High: Sensitive vegetation communities with low inherent resistance or resilience towards disturbance factors; vegetation that are considered important for the maintenance of ecosystem integrity. Most of these vegetation communities represent late succession ecosystems with high connectivity with other important ecological systems.	3
Medium to high: Vegetation communities that occur at disturbances of low-medium intensity and representative of secondary succession stages with a high degree of connectivity with other ecological systems OR disturbed vegetation connected to an ecological and protected system e.g. ridge, wetland or river	2
Medium: Vegetation communities that occur at disturbances of low-medium intensity and representative of secondary succession stages with some degree or limited connectivity with other ecological systems	1
Low: Degraded and highly disturbed vegetation with little ecological function	0

6. Conservation Importance: indication of the necessity to conserve areas based on factors such as the importance of the site on a national and/or provincial scale and on the ecological state of the area (degraded or pristine). This is determined by the presence of a high diversity, rare or endemic species and areas that are protected by legislation.

Ecological importance	Scoring
High: Ecosystems with high species diversity and usually provide suitable habitat for a number of threatened species. OR protected ecosystems e.g. wetlands, riparian vegetation etc These areas should be protected	3
Medium to high: Ecosystems with intermediate levels of species with the possible occurrence of threatened species	2
Medium: Ecosystems with intermediate levels of species diversity without any threatened species.	1
Low: Areas with little or no conservation potential and usually species poor (most species are usually exotic).	0

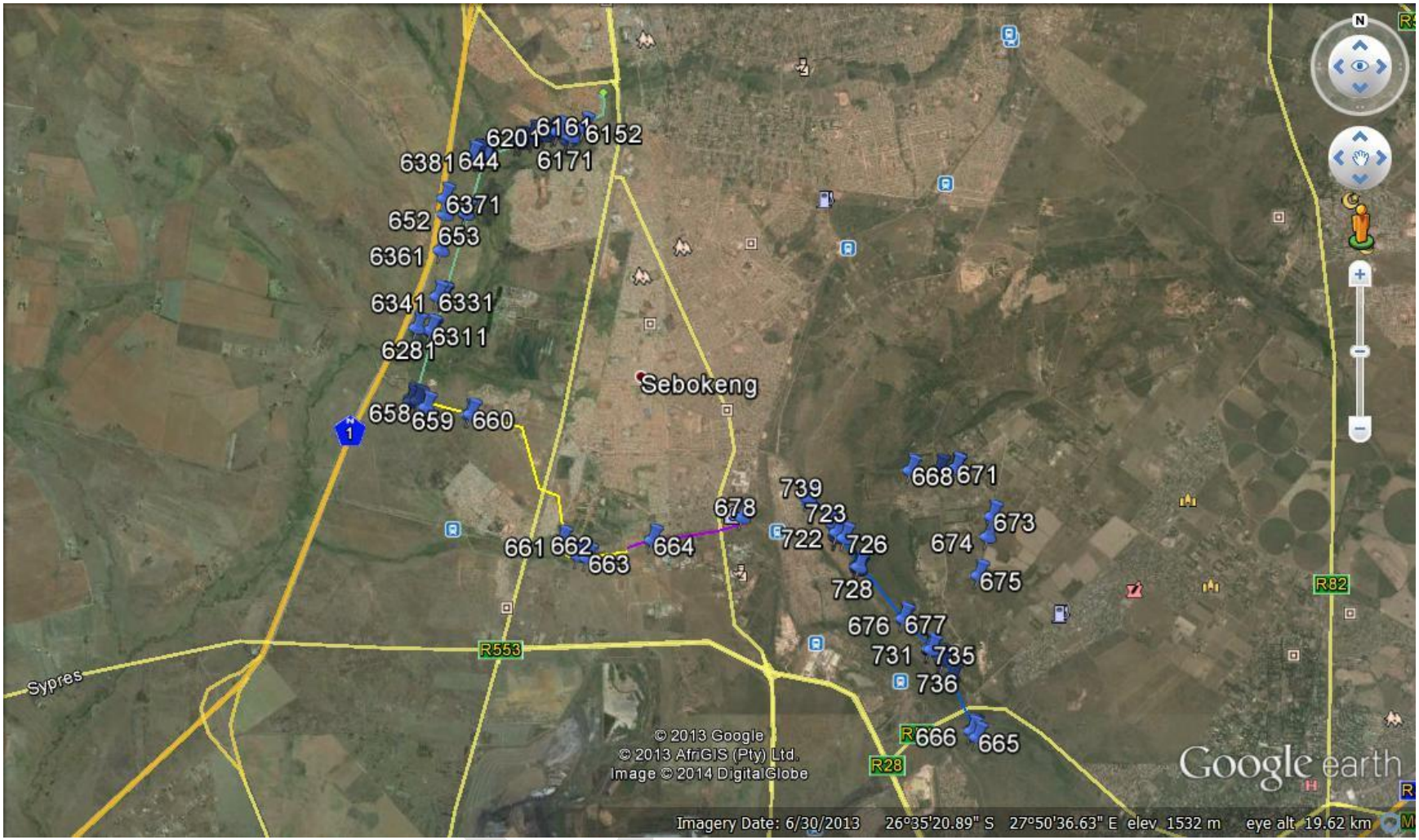


Figure 7: Sample Point Map

APPENDIX B: PLANT SPECIES

The table below lists the plant species that were observed during the site visit as well as the vegetation that the plants mainly occurred in.

P=Provincially protected **M**=Medicinal **D**=Declining PT=Protected tree Y=Occurs in vegetation grouping

	Specie Name	Common Name	Habitat / Notes	Moist grassland	Secondary grassland	Rocky grassland	Woodland
Grasses	*Alloteropsis semialata*	Black-seed Grass	Rocky, sour soil.				
	Andropogon appendiculatus	Vlei Bluestem	Occurs in moist places, often associated with shady areas.	y			
	Aristida aequiglumis	Three-awn	Looks like *A junciformis*. Open grassland, moist areas				
	Aristida bipartita	Rolling Grass	Moist places or overgrazed veld and road reserves.	y		y	
	Brachiaria serrata	Saw-tooth grass	Rocky, undisturbed places		y	y	y
	Bulbostylis burchellii		Grassland, common on rocky ridges				
	Cymbopogon pospischilii	Narrow-leafed Turpentine Grass	Grassland.		y	y	
	Cynodon dactylon	Couch grass	Most soils, usually in disturbed areas. Increaser II grass	y		y	
	Digitaria eriantha	Finger Grass	Sandy, rocky soil in arid areas or next to rivers/vlei's in areas with higher rainfall. Planted for pasture				
	Diheteropogon amplectens	Broad-leaved Bluestem	Open grassland as well as open areas within bushveld. Mostly in poor rocky slopes. Decreaser		y		
	Elionurus muticus	Copper grass / Wire Garss	Common in overgrazed veld, sour grassland. Increaser III, perennial grass			y	
	Eragrostis capensis	Heart-seed Love Grass	Disturbed areas often in vlei-areas	y		y	y
	Eragrostis chloromelas	Narrow Curly leaf	Open Grassland.		y	y	y
	Eragrostis curvula	Weeping Love Grass	Mostly occurs in disturbed areas		y	y	
	Eragrostis lehmanniana	Lehmann's Grass	Sandy soil, mostly in disturbed land. Increaser II grass			y	
	Eragrostis plana	Tough Love Grass	Disturbed areas, mostly in moist patches. Increaser II grass	y			
	Heteropogon contortus	Spear Grass	Rocky, sloped land and common on disturbed road reserves. Increaser II grass		y	y	
	Hyparrhenia hirta	Common Thatching	Well drained, rocky soil in open grassland and disturbed	y	y	y	y

	Specie Name	Common Name	Habitat / Notes	Moist grassland	Secondary grassland	Rocky grassland	Woodland
		Grass	areas. Increaser I grass				
	Hyperrhenia tamba	Blue Thatching Grass	Road reserves and where water accumulates, also next to rivers	y			
	Melinis nerviglumis	Bristle-leaved Red Top	Undisturbed grassland, rocky slopes and soils.				y
	Melinis repens	Natal Red Top	Disturbed grassland. Increaser II grass		y	y	
	Paspalum dilatatum	Dallis Grass	Introduced grass, moist areas in vlei's and close to rivers	y			
	Pogonarthria squarrosa	Herringbone Grass	Disturbed places, sparsely distributed in natural, open grassland	y		y	
	Setaria incrassata	Vlei Bristle Grass	Moist places or in turf soils	y			
	Themeda triandra	Red Grass	Undisturbed or disturbed open grassland. Decreaser Grass				
Forbs	*Ajuga ophrydis* **(M)**		Grassland, often in colonies		y	y	
	Albuca cf setosa	Slymuintjie	Grassland		y	y	
	Arctotis arctotoides		Grassland and sometimes in vlei's		y		
	Asparagus laricinus	Cluster-leaved Asparagus	Thicket or disturbed areas, waste places. Difficult to eradicate if encraoching into grassland		y	y	
	Barleria macrostegia	Tongklapper	Rocky grassland		y		
	Berkheya radula	Boesmanrietjie	Moist grassland and vlei's			y	
	Berkheya setifera **(M)**	Rasperdisseldoring	Grassland, usually in large colonies.				
	Bulbine narcissifolia	Strap-leaved Bulbine	Poor soils in grassland, proliferation an indication of overgrazing.				
	Bulbostylis burchellii		Grassland, often on rocky ridges		y	y	
	Bulbostylis hispidula subsp. pyriformis		Temporary moist areas	y			
	Chironia palustris	Marsh Chironia	Marshy areas, often forming clumps	y			
	Clematis villosa	Pluimbossie	Grassland, particularly rocky ridges		y		
	Cleome maculata		Grassland, often a weed of disturbed sandy places			y	
	Comelina africana var		Grassland		y	y	

	Specie Name	Common Name	Habitat / Notes	Moist grassland	Secondary grassland	Rocky grassland	Woodland
	krebsiana **(M)**						
	Conyza podocephala		Roadsides and disturbed grasslands			y	
	Corchorus asplenifolius **(M)**		Grassland				
	Cotula anthemoides	Gansgras	Moist places, often forming dense stands.	y			
	Crabbea acaulis		Grassland		y		
	Crassula capitella subsp nodulosa		Grassland	y			
	*Crinum cf bulbispernum***(P) (D) (M)**	Orange River Lily	Moist soils, usually along rivers and vleis		y		
	Crinum cf graminicola	Graslelie	Grassland, usually in sandy soil, localized and rather rare		y	y	
	Cyanotis speciosa **(M)**	Doll's Powderpuff	Grassland		y	y	
	Delosperma herbeceum	Highveld White Vygie	Grassland		y		
	Dianthus mooiensis	Frilly Dianthus	Grassland		y		
	Dicoma macrocephale		Grassland		y		
	Dipcadi viride	Grootslymuinte	Grassland, often in vleis	y			
	Felicia muricata		Grassland, proliferating in overgrazed/disturbed places			y	
	Geigeria burkei	Vermeerbos	Common in overgrazed and disturbed areas			y	
	Gerbera piloselloides **(M)**	Small Yellow Gerbera	Grassland				
	Gladiolus permeabilis subsp. edulis	Patrysuintjie	Grassy slopes, rocky ridges		y		
	Gladiolus papilio	Butterfly Gladiolus	Along wetland areas or drainage lines	y			
	Gomphocarpus fructicosus	Milkweed	Grassland, often along roadsides and abandoned cultivated fields.			y	
	Haemanthus humilis **(P)**		Shady places in between rocks.		y		
	Helichrysum cerastioides var cerastioides	Wolbossie	Grassland, rocky areas		y		
	Helichrysum coriaceum	Vaalteebossie	Grassland and rocky hillsides		y		
	Helichrysum nudifolium **(M)**	Hottentot's tea	Grassland		y	y	
	Helichrysum rugulosum **(M)**		Grassland, often in vlei's			y	

	Specie Name	Common Name	Habitat / Notes	Moist grassland	Secondary grassland	Rocky grassland	Woodland
	Helichrysum setosum	Yellow Everlasting	Rocky grassland.		y		
	Hermannia depressa	Rooi-opslag / Creeping Hermannia	Grassland, also in trampled and overgrazed areas		y	y	
	Hypoxis iridifolia		Grassland		y		
	Indigofera comosa		Grassland and rocky ridges		y	y	
	Indigofera zeyheri		Grassland			y	
	Ipomoea simplex		Grassland, often on rocky ridges				
	Kniphofia ensifolia subsp ensifolia		Marshy places	y			
	Ledebouria cooperi **(M)**		Grassland, often in moist places	y	y	y	
	Ledebouria revoluta		Grassland.			y	y
	Leonotus leonorus	Wild Dagga	Grassland		y		y
	Lippea cf scaberrima		Grassland		y		y
	Lobelia erinus **(M)**	Wild Lobelia	Seasonally wet places in grasslands, often forming stands.	y			
	Mimulus gracillis		Moist places	y			
	Nidorella auriculata		Grassy, sometimes disturbed / moist places				
	Pentanissia prunelloides **(M)**	Broad-leaved Pentanissia	Grassland		y		
	Pentharrhinum insipidum	African heartvine	Forest margins, woodland		y		y
	Peucadenim magalismontaum	Wild Parsley	Grassland		y	y	
	Portulaca kermesina		Grassland, usually in sandy soils.		y		
	Pygmaeothamnus zeyheri	Sand Apple / Goor Apple	Sandy or stony grassland and bushveld, often forming colonies.		y		
	Ranunculus multifidus	Buttercup	Grassland usually in vlei's	y			
	Scabiosa columbaria	Wild scabiosa	Grassland, mainly in rocky areas		y		y
	Selago densiflora		Grassland and bushveld.			y	
	Senecio coronatus **(M)**	Wooly Grassland Senecio / Sybossie	Grassland usually in large colonies		y	y	
	Senecio gregatus		Grassland, often in moist places	y			

	Specie Name	Common Name	Habitat / Notes	Moist grassland	Secondary grassland	Rocky grassland	Woodland
	Senecio innornatus		Grassland often in moist places	y			
	Senecio oxyriifolius	False nasturtium	Grassland, mainly amongst rocks		y		
	Seripheum plumosum	Bankruptbush	Grassland, proliferating in overgrazed areas.	y	y	y	y
	Sutera caerulea	Ruikbossie	Grassland, mainly on ridges, wedged between rocks		y		
	Tephrosia lupinifolia	Vingerblaarertjie	Grassland		y		
	Turbinia oenotheroides	Krismisblom	Grassland		y		
	Ursinia nana		Weedy plant, often in disturbed places		y	y	
	Vigna vexillata		Grassland		y		
	Wahlenbergia caledonica		Grassland, rocky or seasonally moist places	y			
	Zornia milneana		Grassland		y		
Tree	*Acacia karroo*	Sweet Thorn	Widespread, often proliferate in overgrazed areas			y	Y
	Celtis africana	Stinkwood	Wooded areas or bush clumps, usually on dolomite				Y
	Ehretia rigida	Puzzle Bush	Wooded grassland, bushveld				Y
	Mundulea sericea	Cork Bush	Grassland and bushveld, usually associated with rocky outrops				Y
	Searsia magalismontana	Bergtaaibos	Grassland and Bushveld, on rocky ridges.			y	Y
	Searsia pyroides (Rhus pyroides)	Common Wild Currant	Montain grassland, bushveld				Y
	Vangueria infausta	Wild Medlar	Mainly on rocky hillsides.			y	Y
	Ziziphus mucronata	Buffalo-thorn	Widespread, in various habitats				Y
	Ziziphus zeyheriana	Dwarf Buffalo-thorn	Grassland				Y
Sedges	*Cyperus congestus*		Depressions in grassland, damp and temporary wet areas, ditches	y			
	Cyperus longus	Waterbiesie	Grassland and periodically inundated depressions.	y			
	Cyperus rupestris var rupestris		Rocky sheets or edges of pools	y			
	Phragmites australis	Common Reed	Drainage lines, marshy places along streams, often in pure stands.	y			

	Specie Name	Common Name	Habitat / Notes	Moist grassland	Secondary grassland	Rocky grassland	Woodland
	Typha capensis	Bulrush	Grows in marshy areas and along watercourses.	y			
Ferns / mosses	*Sellaginella dregei*	Resurrection Selaginella	Forms mats on granite outcrops, in full sun.			y	
	Pellaea calomelanos ***(P)***	Hard Fern	Grassland, often in moist or rocky places.			y	
	Cheilanthus cf hirta ***(P)***	Lip Fern	Between rocks			y	
Alien Invasive Plants	*Canna spp*	Canna	Weed in drainage lines and riparian areas	y			
	Cirsium vulgare	Scotch Thistle	Category 1 (CARA)	y	y		
	Conyza albida	Tall Fleabane	Weed		y		
	Eucalyptes species	Bluegums	Declared invader, Category 2, proposed category 1b	y	y		
	Melilotus alba	Bokhara Clover	Naturalised weed in disturbed places	y	y		
	Mirabilis jalapa	Four-o'clocks	Currently a Cat 3, but proposed to be Category 1b	y	y		
	Opuntia species	Sweet Prickly Pear	Catery 1 (CARA)			y	
	*Pinus species**	Pine	Declared weed, Category 2 (Henderson, 2001).	y		y	
	Populus x canescens *	Grey Poplar	Declared invader	y			
	Salix babylonica	Weeping Willow	Category 2 Invader, although this specie is not listed in the NEMBA list. The spreading root mass can reduce the depth of waterways thereby increasing the risk of flooding	y			
	Verbena bonariensis	Wild Verbena	Category 1b (NEMBA)	y			
	Verbena brasiliensis		Common weed of disturbed and moist places, declared category 1b invader	y			
	Verbena tenuisecta	Fine-leaved Verbena	Common in disturbed places		y	y	

APPENDIX C: Identification of protected plants

Description and images	Confirmed and likely localities
Crinum bulbispermum (Declining) • Bulbous plant in moist grasslands • Dormant in winter (underground) • Flowers in Oct-Nov – pink • Usually form a thick false stem up to 400 mm • Leaves are blue-green   From: http://www.biodiversityexplorer.org/plants/amaryllidaceae/crinum_bulbispermum.htm *Crinum bulbispermum* (Orange River lily, Vaal River lily), growing along the Kliprivier, Gauteng. [images Craig Gibbon ©]	• Between Pulsar and proposed meteor substation, on the bend of the proposed line • Centre coordinate: 26°33'13.99"S and 27°48'36.09"E 

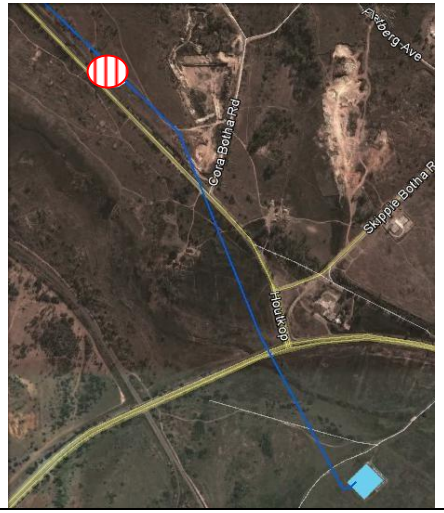
Crinum graminicola (Provincially protected)

- Bulbous plant in rocky and secondary grassland
- Dormant in winter (underground)
- Flowers in Oct-Nov – pink to orange
- Leaves are green and straplike, usually carried flat on the ground

Bottom image by Andrew Hankey from http://www.ispot.org.za/node/223611

- *Crinum graminicola* was observed on the border between secondary and rocky grassland between the Pulsar and Meteor substation at centre coordinate 26°34'21.71"S; 27°48'14.35"E.

- Another *Crinum graminicola* population was observed along the proposed route to Sonland substation, just east of Houtkop Road, in rocky grassland at coordinate 26°37'9.76"S; 27°52'34.60"E

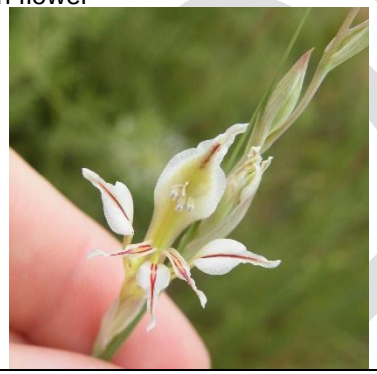


Haemanthus humulis (provincially protected)

- Rocky grassland Bulbous plant, usually wedge in between rocks
- Two, broad and hairy leaves from the buls
- White to pink flowers are produced with the leaves in summer
- Dormant in winter


Gladiolus permebealis (provincially protected)

- Rocky grassland
- Herbaceous perrennial
- Flowers in summer-autum
- Grasslike leaves
- Difficult to spot if not in flower

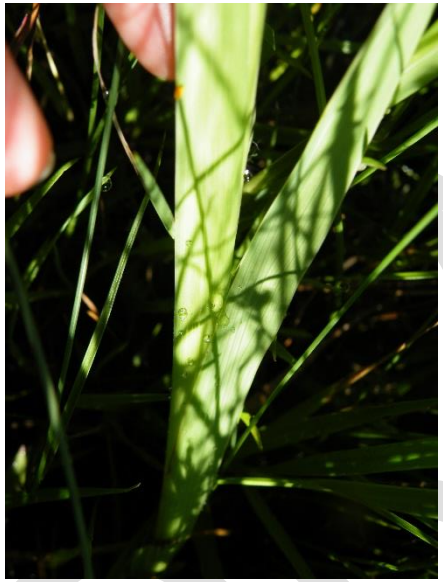


- *Haemanthus humilis* was confirmed to occur in rocky grassland on the base of the ridge. This plant was wedged in between rocks 26°36'16.44"S; 27°51'45.44"E

- *Gladiolus permebealis* was confirmed to occur in the rocky grassland on the base of the ridge (26°36'16.07"S; 27°51'46.39"E) and likely also occurs along the proposed alternative route crossing over the ridge

Gladiolus papilio (provincially protected)

- Moist grassland
- Drooping flowers in summer
- Difficult to spot if not in flower
- Grasslike leaves



- Two *Gladiolus papilio* populations was confirmed to occur in moist grassland between Pulsar and the proposed Meteor substation. The first population was about 180m south of the proposed line at 26°33'5.58"S; 27°49'24.48"E, while the second population was traversed by the line (on the bend) at 26°33'13.55"S; 27°48'33.37"E.

Kniphofia ensifolia (provincially protected)

- Erect herb in moist grasslands
- Large V-shaped, basal leaves with finely toothed margins
- Flowers in summer, dense, spike-like inflorescens up to 1.5m long
- Flowers red in bud, and greenish to cream when open.

Image from http://www.biodiversityexplorer.org/plants/xanthorrhoeaceae/kniphofia_ensifolia.htm
Kniphofia ensifolia under cultivation in Vienna Botanical Gardens, Austria. [photo H.G. Robertson, Iziko ©]

- *Kniphofia ensifolia* was confirmed to occur in moist grassland between Pulsar and the proposed Meteor substation, on the bend of the proposed line at 26°33'14.42"S; 27°48'34.46"E