The Proposed Aggeneis-Paulputs 400kV Powerline and Substations Upgrades, Northern Cape Province

Final 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.

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The Environmental Impact Assessment Regulations (Government Notice No. R982 of 4 December 2014), 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.

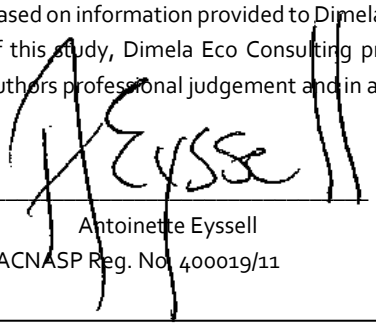
Declaration of independence:

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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SACNASP Reg. No. 400019/11

EXECUTIVE SUMMARY

Eskom has appointed Mokgope Consulting to undertake a full Scoping and EIA Process, including specialist assessment studies for the following activities:

1. Construction of a new 400kV transmission DC power line with three (3) alternative corridors from Aggeneis to Paulputs substations (approximately 97km); and
2. Aggeneis and Paulputs substations will require upgrades to accommodate the 400kV power line which may or may not require expansion of the yards.

Three alternatives are proposed for the 400kV corridor, as well as a deviation to corridor 3, namely deviation 3A. As part of the Environmental Impact Assessment (EIA) process, Mokgope Consulting appointed Dimela Eco Consulting, to undertake a vegetation assessment of the proposed the development.

The terms of reference were interpreted as follows:

- Review the existing report for a 200kV line with similar route alternatives proposed in 2010;
- Provide a status quo and description of the vegetation found to be present along the proposed powerline alternatives, and substation localities;
- Compare the findings with the regional vegetation expected to occur, the Namakwa Biodiversity Sector Plan and the Succulent Karoo Ecosystem Programme (SKEP) Priority Areas;
- List plant species that are of conservation concern that were confirmed to occur or are likely to occur and highlight the areas that these species are likely to occur as being of high ecological concern;
- Recommendations with regards to the route alternative that will have the least impact on vegetation of conservation importance; and
- Assessment of the expected impacts that the proposed development could have on the vegetation observed, as well as cumulative impacts on nearby sensitive vegetation.

This report relied on a single site visit undertaken during September 2016. The project was initiated during the winter of 2016, while the peak in annual rainfall in the area is only expected during late summer to autumn (March to April), with a possibility of some rainfall in spring. Due to project time frames, this site visit was scheduled in spring to potentially coincide with some spring rains that may occur. However, no rains were experienced and the area was below average dry. The public participation process lead to the inclusion of Deviation 3A, about nine months after the vegetation site visit was undertaken. Thus, Deviation 3A was not ground trothed, neither the additional 2km corridors around Paulputs substation.

The assessment entailed a literature review which included short listing plants of conservation concern that could potentially occur within or in the vicinity of the proposed powerline route alternative corridors and substation localities, a site visit to the proposed area and reporting

Biomes and regional vegetation

The study area stretches over three South African Biomes. The majority of the proposed powerline route corridor alternatives are situated within the Nama-Karoo Biome. Outliers of the Succulent Karoo Biome, as well as the Desert Biome will also be traversed. Biomes can be divided into smaller units known as bioregions. The majority of the proposed corridors are situated in the Bushmanland Bioregion of the Nama Karoo with a portion of the lines between the town of Pofadder and the Paulputs substation situated in the Gariep Desert Bioregion. The Richtersveld Bioregion of the Succulent Karoo comprises of small outliers on inselbergs and rocky areas. The Succulent Karoo vegetation types are likely the most sensitive vegetation within the study area and can be avoided if the proposed routes can circumvent inselbergs.

The proposed powerline corridors could impact on six (6) vegetation types as listed. One of these vegetation types, Bushmanland Inselberg Shrubland, part of the Succulent Karoo, are only directly traversed by route alternative 3, but occurs within the corridors of all three routes, and deviation 3A. The inselbergs support a high number of local endemics, especially succulent species. No listed ecosystems occur along the three corridor alternatives.

Hydrology and topography:

The proposed powerline routes will cross numerous non-perennial rivers and drainage lines. The majority of these drain westward towards the Fontein se River and Sambok River, and ultimately to the Orange River situated about 22km north of the study area. The study area comprises mainly of plains, often sloping or irregular in between surrounding rocky hills, inselbergs and mountains. Aggeneis substation is situated at an elevation of approximate 790m and Paulputs substation at approximate 820m. The lowest areas in between these points comprise drainage lines or typical wash vegetation in the breaks between the mountains or inselbergs which constitutes the highest points along the route alternatives.

Namakwa Biodiversity Sector Plan and the Succulent Karoo Ecosystems Priority Area

The powerline corridors traverse Critical Biodiversity Areas as well as Ecological Support Areas as delineated in the Namakwa Biodiversity Sector Plan. In addition, one of the Succulent Karoo Ecosystems Priority Area (SKEP) priority areas, the Bushmanland Inselbergs, occurs west of Pofadder and can be impacted on by the proposed powerline route, particularly route alternative 3. These inselbergs support a highly diverse dwarf succulent shrubland.

The majority of the southern extent of all three proposed powerline corridors will traverse the Kamiesberg Bushmanland Augrabies Focus Area which represents the largest remaining natural area for the expansion of the protected area network and forms part of the planned Lower Orange River Trans-frontier conservation area. Therefore, it is advisable that any electrical infrastructure in this area be planned in consultation with the South African National Biodiversity Institute (SANBI) as well as the Department of Environmental Affairs (DEA).

Bathusi Environmental Consulting undertook a fauna and flora study for a 200kV transmission line proposed between Aggeneis substation and the Paulputs substation in the year 2010. This was to inform a Basic Impact Assessment (BIA) for the Aggeneis-Paulputs 2nd 220kV transmission power line in the years 2011 and 2012. Presently the line is planned to be upgraded to a 400kV and although the 400kV line route alternatives are slightly different than the originally planned 200kV line, much of this existing specialist information remains relevant.

The vegetation observed along the proposed alternative corridors was found to be representative of the biomes and the broad scale vegetation types. Due to the arid nature of much of the surveyed area, the vegetation was found to be mainly used for grazing. Therefore, the natural species composition was observed to still be largely intact and as expected based on the literature review.

Six vegetation associations were delineated, and their importance and vulnerability assessed as follows:

Vegetation association	Vulnerability and Importance
1. Sandy grassland and desert plains	Medium
2. Arid gravelly grassland	Medium
3. Gravel and quartz veld	High
4. Rocky desert and outcrop vegetation	Medium to high
5. Inselberg vegetation	High
6. Drainage lines and riparian	Medium

The proposed powerline corridors will impact on much of the same broad vegetation communities. All three proposed corridors will traverse vegetation of medium importance to a more-or-less equal extent. Alternative corridor 3 and deviation 3A traverse inselberg vegetation of a high conservation importance and are therefore not a preferred route alternative. Alternative corridors 1 and 2 run parallel to an existing powerline through the important quartz veld and if the existing disturbed footprint can be utilised for much of the construction, these routes are preferable. However, route alternative corridor 1 passes directly west of the Gamsberg and within its associated sensitivities, increasing its potential to impact on sensitive and vulnerable vegetation. All three corridors will traverse rocky, mountainous areas, however, route alternative 3 corridor include more free-standing outcrops, whereas the existing powerline through the mountains north of Pofadder disturbance footprint could be utilised for the construction of the line if route alternative 1 or 2 is selected.

Alternative route 1 and 2 are similar in route alignment and vegetation associations traversed. Although route alternative 1 is situated parallel and within 100m of an existing 400kV powerline and existing servitudes and access roads could therefore be used, this corridor passes within the Critical biodiversity Areas west of the Gamsberg. Therefore, alternative corridor 2 will likely have the least impact on

vegetation of concern and is the preferred route. If route alternative corridor 1 could be moved further west, or linked with alternative corridor 2 in this section, this route could also be considered feasible.

The unfavourable climate at the time of the assessment and limited access to the entire proposed footprint areas, means a pre-construction walkthrough survey is imperative and should be conducted between March – May, depending on rainfall. This must take place prior to commencement of activity to ensure that all protected, threatened and endemic species are marked to enable avoidance and/or rescue. The walk down should also identify local sensitivities such as quartz patches that should be spanned in order to conserve the habitat and species *in situ*.

In conclusion, the proposed development(s) could proceed provided that the mitigation measures a set out in this report are implemented as a minimum to limit the potential impacts on vegetation during construction and operation of the developments.

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1 INTRODUCTION

Eskom has appointed Mokgope Consulting to undertake a full Scoping and EIA Process, including specialist assessment studies for the following activities:

1. Construction of a new 400kV transmission DC power line with three (3) alternative corridors from Aggeneis to Paulputs substations (approximately 97km); and
2. Aggeneis and Paulputs substations will require upgrades to accommodate the 400kV power line which may or may not require expansion of the yards.

To facilitate final route determination, three possible alternative route corridors of 2km wide (1km on either side of the centre line) were identified. The purpose of having a 2km corridor is to ensure more space for biodiversity assessment surveys along the corridor and to avoid any environmental sensitive features during the powerline construction along the route. The corridors closer towards Paulputs substation will be 4km wide. This is to allow sufficient space within the corridors to locate the powerline and to avoid clashes with the Independent Power Producers (IPPs) in proximity to Paulputs substation. The proposed project also entails the upgrade of the existing substations to accommodate the proposed powerline. Once the final route corridor is authorised, a 55m servitude (27.5m on either side of the centre line) would be negotiated and acquired within the final corridor with the affected landowners (prior to construction phase).

In addition, Aggeneis and Paulputs substations would require footprint expansions.

<u>Upgrade at Aggeneis substation:</u>

- Aggeneis is an existing substation with a footprint of approximately 11.6ha.
- The substation will require future footprint extensions.
- The substation will be populated by the designated 2nd feeder bay on the 400kV side
- Aggeneis will require a new 400/132kV Transformer. However, there will be no need for additional oil collection dams as they already exist at the substation.

<u>Upgrade at Paulputs substation:</u>

- Paulputs is an existing substation with a current footprint of approximately 3ha.
- The substation will be expanded by approximately 7.8ha on the south easterly side of the proposed 400kV terrace;
- The Paulputs substation will be populated by the designated 2nd feeder bay on the 220kV side; and
- There will be an addition of a 500MVA 400/132kV transformer, which will require an oil collection dam for storage of the transformer oil.

As part of the Environmental Impact Assessment (EIA) process, Mokgope Consulting appointed Dimela Eco Consulting, to undertake a vegetation assessment of the proposed the development.

1.1 Terms of reference

The terms of reference were interpreted as follows:

- Review the existing report for a 200kV line with similar route alternatives proposed in 2010 (Bathusi Environmental, 2010);
- Provide a status quo and description of the vegetation found to be present along the proposed powerline alternatives, and substation localities;
- Compare the findings with the regional vegetation expected to occur (Mucina & Rutherford, 2006), the Namakwa Biodiversity Sector Plan (Namakwa District, 2008) and the Succulent Karoo Ecosystem Programme (SKEP) Priority Areas (SKEP, 2013);
- List plant species that are of conservation concern (e.g. Red Data listed species) that were confirmed to occur or are likely to occur and highlight the areas that these species are likely to occur as being of high ecological concern;
- Recommendations with regards to the route alternative that will have the least impact on vegetation of conservation importance; and
- Assessment of the expected impacts that the proposed development could have on the vegetation observed, as well as cumulative impacts on nearby sensitive vegetation.

1.2 Assumptions and Limitations

Local variations in the vegetation are not always distinguishable on the broad scale assessment undertaken for this report. Due to the extent of the proposed powerline corridor alternatives, as well as inaccessibility of large portions of vegetation within the proposed corridors, comprehensive mapping of all the different vegetation communities present in the study area was not feasible as it can only be accomplished through thorough sampling during different seasons. Although the vegetation observed along the corridors could be subdivided into numerous smaller vegetation units or plant communities, this would have involved numerous sampling points within the proposed corridors. For a project of this extent, extended time on site and thorough sampling would be costly and was deemed unfeasible at this stage of the impact assessment.

At the time of the field survey (September 2017), deviation 3A was not part of the project description and only a corri08der of 2km was to be surveyed around the proposed routes. Therefore, deviation 3A and the 4km corridors closer to Paulputs substation was not ground-truthed at the time of the field survey.

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 a single site visit undertaken during

September 2016. The project was initiated during the winter of 2016, while the peak in annual rainfall in the area is only expected during late summer to autumn (March to April), with a possibility of some rainfall in spring. Due to project time frames, this site visit was scheduled in spring to potentially coincide with some spring rains that may occur. However, no rains were experienced and the area was below average dry (see section 3.2).

Plant species resprouting from storage tubers (geophytes) will take advantage of the first rains, stored reserves and low grass cover after the dry season to grow and flower during summer (December to March) and then die back. Herbs, forbs, and grasses first need adequate rainfall before being able to fully grow and flower between February and April. Most of the geophytes, forbs, succulents, and grasses can only be fully identified if they are actively growing AND have either flowers or fruit. At the time of the survey rains had not been sufficient to enable any significant recovery or growth of the vegetation. In addition, portions of vegetation along the proposed route alternatives were overgrazed, which hampered positive identification of grasses. It is assumed that several plants might have been dormant at the time of the site visit, and therefore possibly overlooked.

Some areas were inaccessible during the time of the site visit due to locked gates and mountainous terrain. The entire length of the line was therefore not assessed, rather representative and accessible areas were sampled by the specialist.

2 METHODOLOGY

The assessment entailed a literature review which included short listing plants of conservation concern that could potentially occur within or in the vicinity of the proposed powerline route alternative corridors and substation localities, a site visit to the proposed area and reporting (Appendix A).

2.1 Literature Review

The description of the regional vegetation relied on literature from Mucina & Rutherford (2006). Plant names follow Le roux, (1994), Shearing (1994), Van Wyk & Van Wyk (1997), Van Wyk & Malan (1997), Pooley (1998), Henderson (2001), Van Oudtshoorn (2002), Van der Walt (2004), Bromilow (2010), Court, 2010), Anderson (2011a) and Anderson, (2011b). In the absence of a guideline document for the Northern Cape Province, the study was undertaken in accordance with the Gauteng Requirements for Biodiversity Assessments Version 2 (GDARD, 2012) as best practice. Other literature consulted include the Strategic Biodiversity Basic Assessment report for a proposed 200kV powerline along much of the same routes as this project (Bathusi Environmental Consulting, 2010), the avifauna report for the 200kV line (Pachnoda Consulting CC, 2010), a fauna & flora specialist report for the proposed Boesmanland 75MW solar farm near Aggeneys (Simon Todd Consulting, 2012) and a vegetation baseline and impact assessment report for the Gamesberg Zinc Project (Desmet, 2013).

2.2 Field survey

The site visit took place from the 21st to the 23rd of September 2016. The field survey 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, inselbergs and rivers that are essential for the maintenance of ecosystems and ecological processes and which is likely to support plant species of conservation concern. Sampling was undertaken randomly in accessible areas within the 2km wide proposed corridors. A map of the sampling areas is given in Appendix A. Any additional information on any other feature thought to have ecological significance within the sampling areas, such as dominant species vegetation cover, 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 areas, in walked transects, areas driven, as well as relevant literature and distribution data.

2.3 Mapping

Mapping has been done by comparing data recorded in sampled areas to the visual inspection of available Google-Earth Imagery and extrapolating surveyed sample points to the entire study area. Vegetation associations described are predominant but could include numerous smaller vegetation associations that was not sampled or mapped separately. Vegetation delineations are therefore approximate. For the purpose of this study, the identification and basic descriptions of vegetation that are presented in this document should be adequate to highlight the likely status and sensitivities associated with the respective vegetation associations observed along the proposed corridors, as well as evaluating the likely impacts that will result from the proposed development.

2.4 Sensitivity Analysis

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). Vegetation is thus an important determination of the biodiversity of an area. The vegetation sensitivity assessment aimed to identify whether the broad vegetation associations within the proposed powerline route alternative corridors are of ecological importance and vulnerable to linear infrastructure development as it is amongst others:

- Situated in a listed ecosystem or threatened vegetation unit;
- Habitat or potential habitat to plant species of conservation concern, protected plants or protected trees as well as the probability of such species to survive or re-establish itself following disturbances, and alterations to their specific habitats;
- Situated within ecologically sensitive features such as wetlands, riparian areas or ridges, koppies and inselbergs,
- In good ecological condition and functional.

This implies that in the sensitivity analysis not only aspects that currently prevail on the area should be taken into consideration, but also if there is a possibility of a full restoration of the original environment and its biota, or at least the rehabilitation of ecosystem services resembling the original state after an area has been significantly disturbed.

The criteria and weighting scores used to determine the vegetation sensitivity, function and conservation importance are given in Appendix A.

3 BACKGROUND TO THE STUDY AREA

3.1 Locality

The proposed 400 kV powerline corridors stretch from the existing Aggeneis substation, about 8km south-west of the town of Aggeneys, to the existing Paulputs substation, situated about 32km north-east of the town of Pofadder in the Northern Cape Province. The proposed project falls within the Namakwa District Municipality and in the Khâi-Ma Local Municipality.

The proposed routes traverse eight quarter degree squares: 2918BB (town of Aggeneys), 2918BD (Aggeneis substation), 2919AA, 2919AB (town of Pofadder), 2919BA, 2919AC, 2918CD and 2918DC (Paulputs substation). The area covered by the three route alternatives are collectively referred to in this report as the 'study area'.

Three alternatives are proposed for the 400kV corridor, as well as one deviation: Deviation 3A (Figure 1):

Route 1: This route is approximately 94km in length and aligns parallel to an existing powerline (about 50m to the east thereof). From the Aggeneis substation, Route 1 and route 2 aligns with an existing powerline for the first 3.5km. Route 1 stretches north-east to cross to the south of the N14 just north of Gamsberg and continuous to run parallel to the existing powerline route all the way to reach the Paulputs substation from the substations southern side.

Route 2: This route is approximately 86km in length and follows the same alignment as Route 1 for the initial 3.5km. Where Route 1 aligns south of the N14 between Aggeneys and Pofadder, Route 2 aligns north of the N14. The route remains in proximity to an existing dirt road util it re-aligns with Route 1 about 11km west of Pofadder. From here, Route 2 runs parallel to the existing 400kV powerline route and Route 1 to the Paulputs substation. Prior to reaching the Paulputs substation, Route 2 makes a short deviation westward to enter the Paulputs substation from its western side.

Route 3: This route is the longest at approximately 101km. It differs from Route 1 and 2 as it stretches eastward from the Aggeneis substation and passes over an inselberg east of Aggeneys town and south-east of Gamsberg. The first ±15km aligns with an existing 400kV powerline (situated about 400m south of this existing line). It also passes south of the town of Pofadder where after it aligns northward towards the Paulputs substation.

Deviation 3A: This route is approximately 99km in length and follows the same alignment as Route 3 for the first 14km. Just west of Gamsberg, the rout turns northwards and joins up with Route 2.

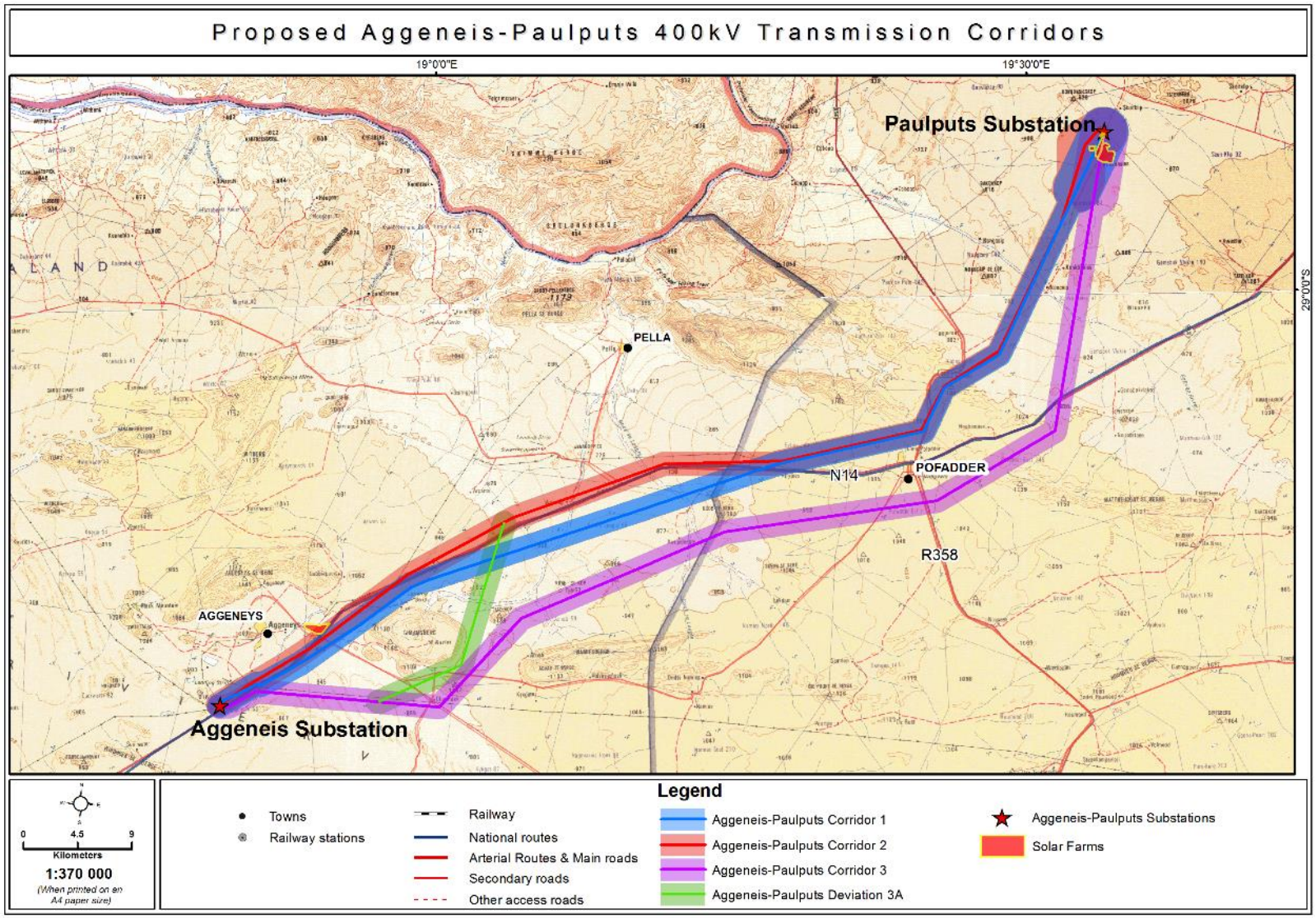


Figure 1: Locality map for the alternative corridors, and deviation 3A

3.2 Climate

The Northern Cape Province is considered semi-arid. The western portion of this province receives rainfall in winter, whereas the eastern portion usually receives summer rainfall. Rainfall increases to the east of the province and average approximately 400mm per annum. This study area falls in-between these two regions with most rain experienced during the autumn months (March-April) and range between 23mm and 34mm per year. A small increase in rainfall could be expected in spring. The average midday temperatures in the area range from 14°C in July to 29°C in January, with July being the coldest month (Weatheronline.com) (Figure 2).

Prior to the site visit, the area received below normal rainfall for the time-period July-September 2016 (Figure 3) (South African Weather Service, 2016).

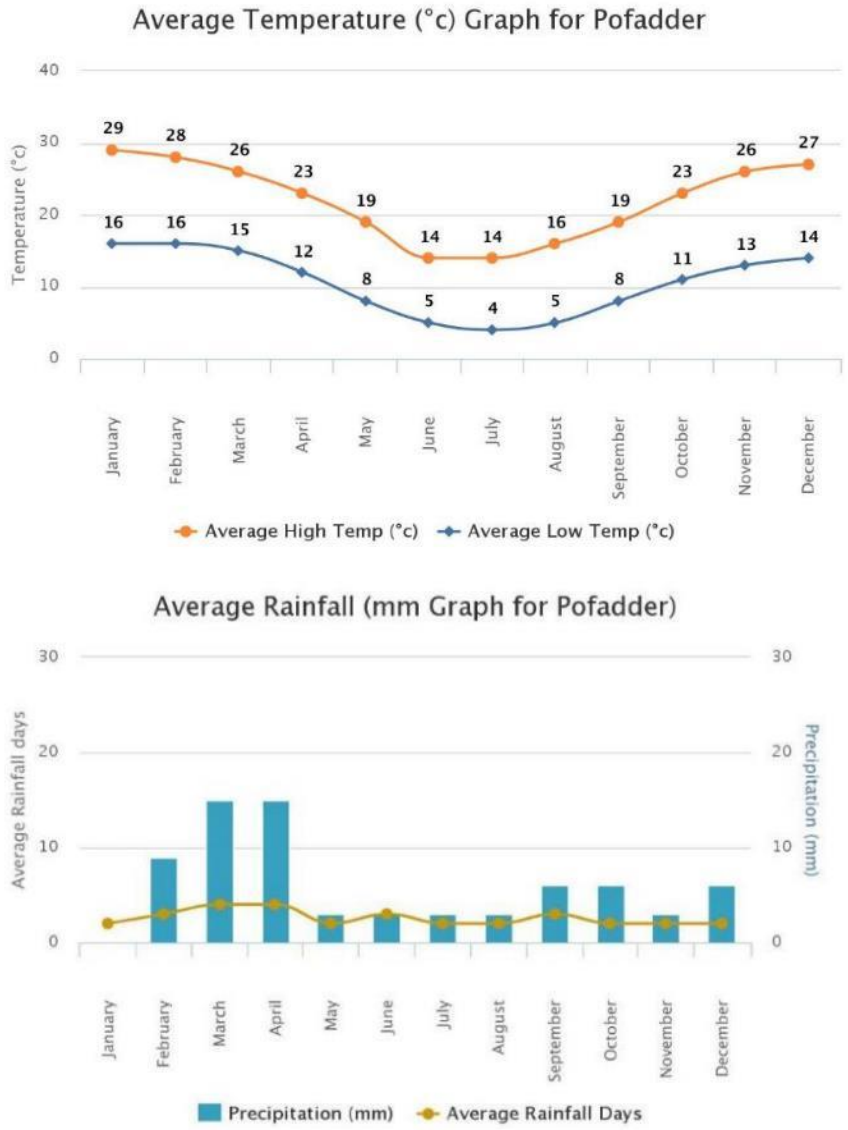


Figure 2: Climate diagram for the study area around Pofadder

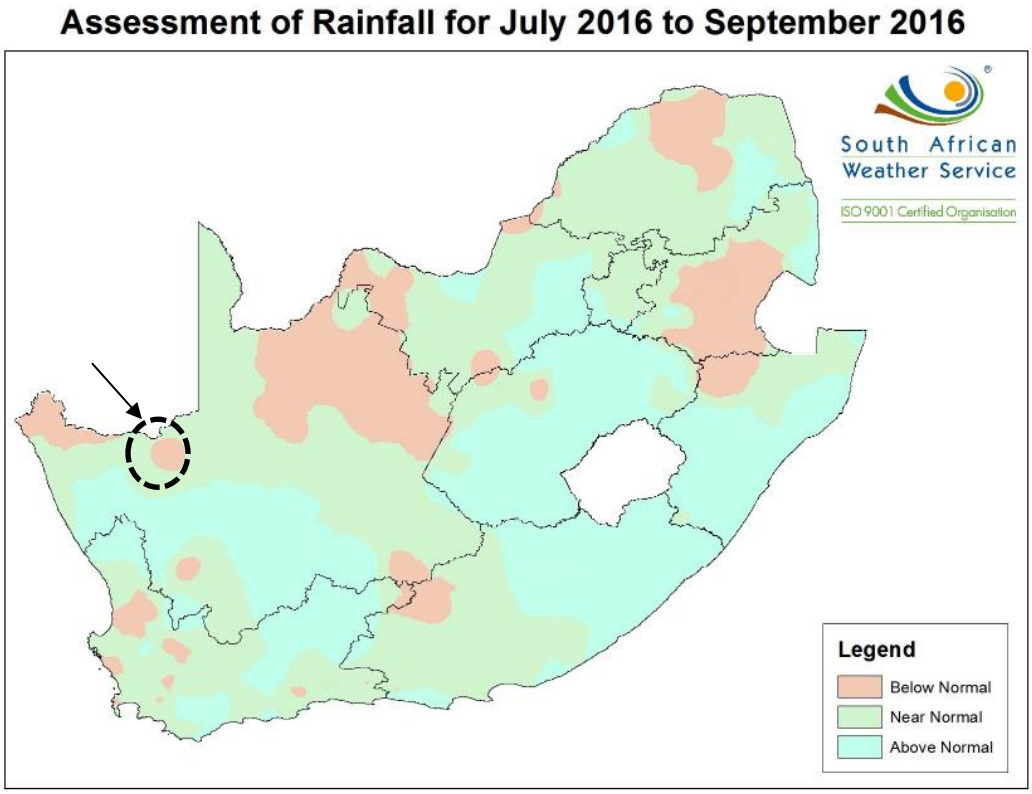


Figure 3: Below normal to near normal rainfall in the study area preceding the site visit (Drought Monitoring – September 2016, South African Weather Service, 2016)

3.3 Hydrology

The proposed powerline routes will cross numerous non-perennial rivers and drainage lines. The majority of these drain westward towards the Fontein se River and Sambok River, and ultimately to the Orange River situated about 22km north of the study area (Figure 4).

3.4 Topography

The study area comprises mainly of plains, often sloping or irregular in between surrounding rocky hills, inselbergs and mountains (Mucina & Rutherford, 2006). Aggeneis substation is situated at an elevation of approximate 790m and Paulputs substation at approximate 820m. The lowest areas in between these points comprise drainage lines or typical wash vegetation in the breaks between the mountains or inselbergs which constitutes the highest points along the route alternatives. Figure 5 shows areas with slopes of 5 degrees or higher along the alternative corridors. These areas are usually 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; Esler *et al,* 2006). Higher biodiversity and thus ecological sensitivities can be expected here.

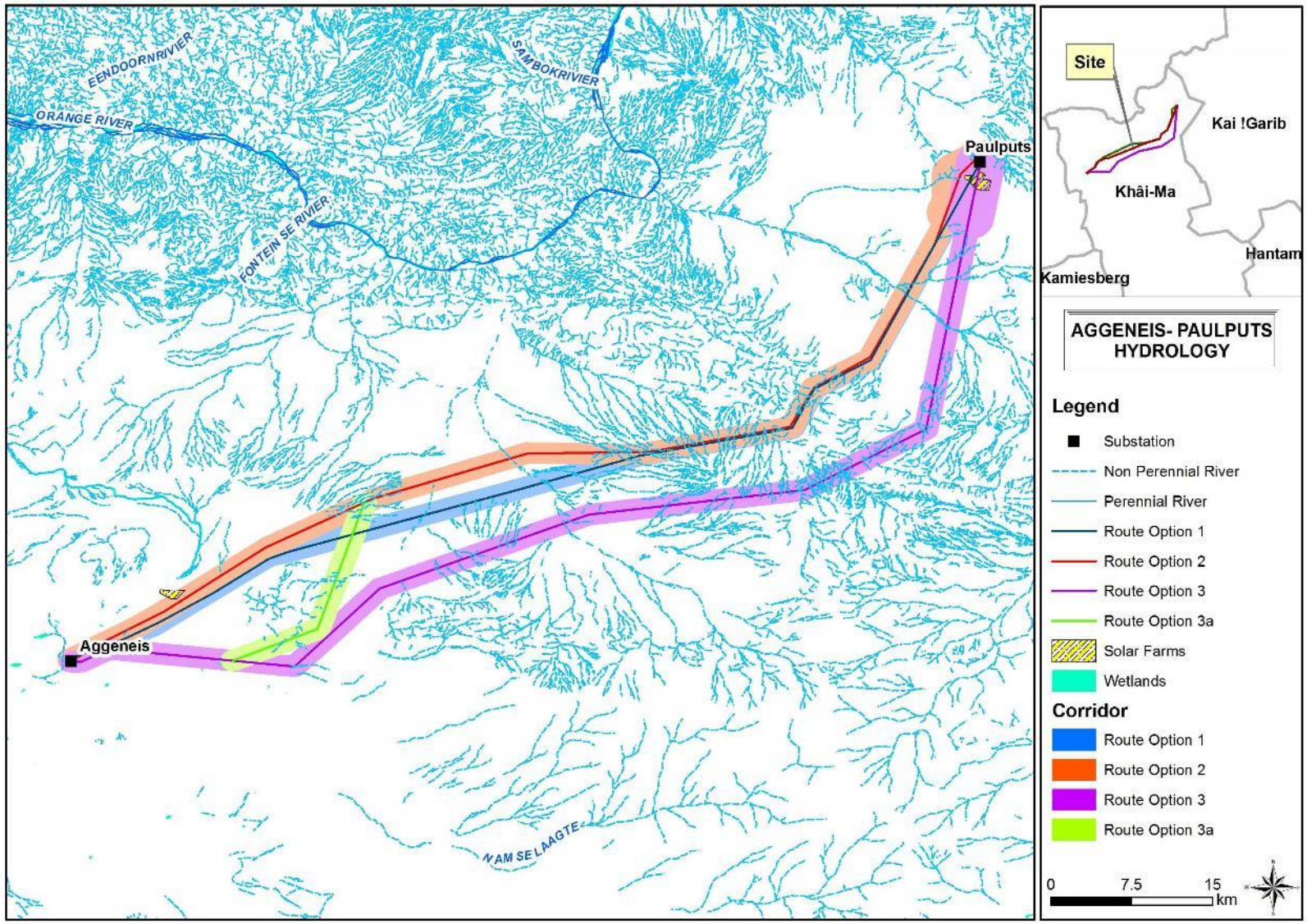


Figure 4: Hydrology of the area that the proposed 400kV powerlines corridor alternatives are situated in (as per the existing NFEPA spatial layers)

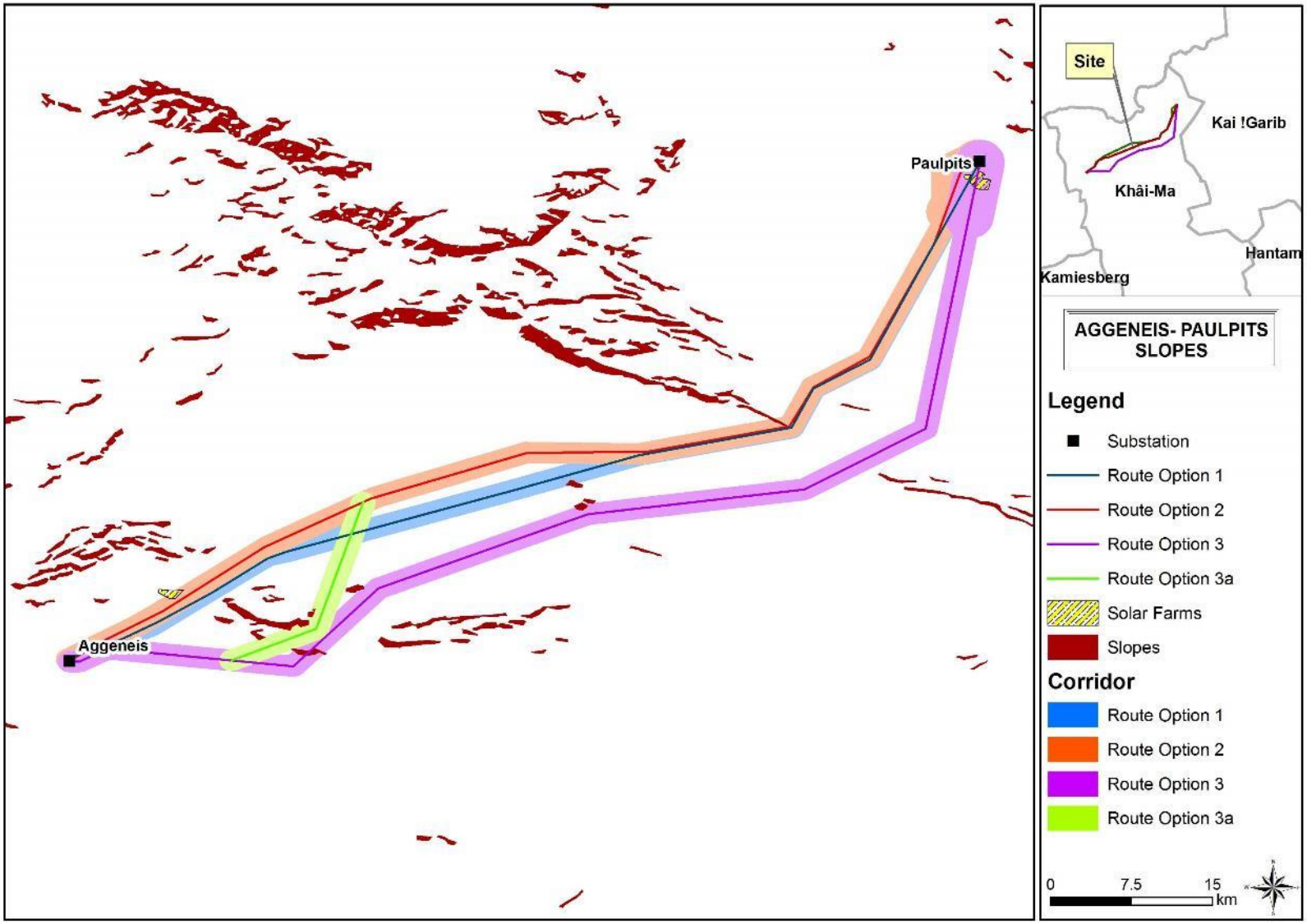


Figure 5: Slopes of 5 degrees and more along the proposed route alternatives. These areas potentially support a higher species diversity and sensitive vegetation

3.5 Historical Vegetation Type Overview

3.5.1 Biomes

The study area stretches over three South African Biomes. The majority of the proposed powerline route corridor alternatives are situated within the Nama-Karoo Biome. Outliers of the Succulent Karoo Biome, as well as the Desert Biome will also be traversed.

The Nama Karoo Biome is an arid biome in which most of the rivers are non-perennial (Mucina & Rutherford, 2006). The mean annual rainfall ranges from 50mm where this biome borders the Desert Biome (e.g. Pofadder area) to 520mm in its eastern extent. Rainfall occurs mostly during late summer or autumn (December to April), with some spring rain also likely. The majority of this biome is covered by a lime-rich, weakly developed soil over sedimentary rock and although less than 5% of rain reaches the rivers, the high erodibility of soils poses a major problem where overgrazing occurs (Low & Robello, 1996). The dominant vegetation is a grassy, dwarf shrubland, intermixed with succulents, geophytes and annual forbs. Grasses tend to be more common in depressions and grazing rapidly increases the relative abundance of shrubs. The Nama-Karoo is subjected to alien invasive species such as *Opuntia aurantiaca* (prickly pear) and *Prosopis glandulosa* (honey-mesquite). Most of the land is used for grazing and under conditions of overgrazing, many indigenous species may proliferate, including *Rhigozum trichotomum* (threethorn), *Chrysocoma ciliata* (bitterbos) and *Vachelia karroo* (sweet thorn). There are very few rare or threatened plant species in the Nama Karoo Biome.

To the west, the Nama Karoo grades into the Succulent Karoo Biome and outliers of this biome are found on inselbergs and gravel patches within the study area. The Succulent Karoo Biome comprises semi-desert with winter rainfall and supports a high biodiversity. Soils are lime-rich, weakly developed soils on rock. The vegetation is dominated by dwarf, succulent shrubs, of which the Vygies (Mesembryanthemaceae) and Stonecrops (Crassulaceae) are particularly prominent. Mass flowering displays of annuals (mainly Daisies from the Asteraceae family) occur in spring, often on degraded or fallow lands. Grasses are rare, except in some sandy areas, while the number of plant species, mostly succulents, is very high and unparalleled elsewhere in the world for an arid area of this size (Low & Robello, 1996). Although this biome supports a high number of plants of conservation concern, less than 0.5% of its distribution area are formally conserved and it requires urgent conservation attention. (Low & Robello, 1996).

The Desert Biome is subjected to harsher environmental conditions with limited and highly variable rainfall. The South African desert comprises intrusions into the Nama Karoo around the Richtersveld and the Springbokvlakte (Low & Robello, 1996). Due to the low rainfall, the vegetation is dominated by annual plants, mainly grasses. Perennial plants are mostly restricted to specialised habitats such as drainage lines. Rocky outcrops with succulents and sparse and low shrubland dominated by succulents also occur (Mucina & Rutherford, 2006). In the eastern parts of the South African desserts (the Gariep Desert of the study area), grassy and woody plants dominate, while leaf succulents are more significant. The desert is characterised by less than 80mm of mean annual precipitation and sparse perennial vegetation with less than 10% canopy cover. The species diversity, in particularly the Richtersveld, is higher than other global deserts with comparable aridity.

3.5.2 Vegetation Types Overview

Biomes can be divided into smaller units known as bioregions, each comprising of a number of vegetation types wherein the vegetation, soil and landscapes are similar (Mucina & Rutherford, 2006). The majority of the proposed corridors are situated in the Bushmanland Bioregion of the Nama Karoo with a portion of the lines between the town of Pofadder and the Paulputs substation situated in the Gariep Desert Bioregion. The Richtersveld Bioregion of the Succulent Karoo comprises of small outliers on inselbergs and rocky areas (Table 1). The Succulent Karoo vegetation types are likely the most sensitive vegetation within the study area and can be avoided if the proposed routes can circumvent inselbergs.

The proposed powerline corridors could impact on six (6) vegetation types as listed in Table 1 and geographically presented in Figure 6 (Mucina & Rutherford, 2006). One of these vegetation types, Bushmanland Inselberg Shrubland are only directly traversed by Route 3, but occurs within the corridors of all three routes. The inselbergs support a high number of local endemics, especially succulents of the families Aizoaceae, Apocynaceae, Crassulaceae, Portulacaceae (Avonia, Anacampseros) and closely related Didiereaceae (Ceraria) (Mucina & Rutherford, 2006). Mining around the town of Aggeneys and on top of Gamsberg poses a potential threat to this vegetation type. The remainder of the vegetation types along the proposed powerline route corridors are not considered to be threatened. Although classified as Least Threatened, very little or none of these vegetation types are formally protected e.g. in reserves or other protected areas (Table 1).

Table 1: Vegetation types that will be traversed by the proposed routes

Biome	**Bioregion** (vegetation organisation level between that of vegetation type and biome)	**Vegetation Type**	**Conservation Status**
Nama-Karoo	Bushmanland Bioregion	1. Bushmanland Arid Grassland The vegetation comprises sparse grassland, dominated by white grass (*Stipagrostis* species) on plains on a slightly sloping plateau. In some areas, low shrubs of *Salsola* change the vegetation structure. Good rainfall years result in rich display of annual herbs.	Least Threatened. Small patches statutorily conserved in Augrabies Falls National Park and Goegab Nature Reserve and the vegetation is mostly untransformed.
		2. Bushmanland Sandy Grassland Dense, sandy grassland plains dominated by white grasses (*Stipagrostis* & *Schmidtia* species) and abundant drought-resistant shrubs. After rainy winters rich displays of ephemeral spring flowers can be seen	Least Threatened although none conserved in statutory conservation areas. Very little of the area has been transformed but the invasive tree *Prosopis sp.* can be seen as a threat.

Biome	**Bioregion** (vegetation organisation level between that of vegetation type and biome)	Vegetation Type	Conservation Status
Succulent Karoo	Richtersveld Bioregion	3. Bushmanland Inselberg Shrubland Occurs on a group of prominent inselbergs and smaller koppies. The vegetation comprises shrubland with both succulent and non-succulent elements and with sparse grassy undergrowth on steep slopes of the inselbergs (e.g. Gamsberg east of Aggeneys).	Potentially threatened by mining around Aggeneys
		4. Aggeneys Gravel Vygieveld Flat or sloping plains at foothills or on peneplains of inselbergs, scattered between Pofadder and Aggeneys. The plains appear as distinctly white surface quartz layers against the background of red sand or reddish soil and supporting sparse, low-growing vegetation dominated by small leaf-succulents, with some perennial component.	Least Threatened, albeit poorly protected. Due to low vegetation cover, grazing is not a threat and very little threat from invasive species has been recorded
Desert	Gariep Desert	5. Eastern Gariep Plains Desert Comprises sheet wash, often sloping plains between the surrounding rocky hills and mountains. The vegetation is grassland, dominated by 'white grasses', some spinescent (*Stipagrostis* species), on much of the flats with additional shrubs and herbs in the drainage lines or on more gravelly or loamy soil next to the mountains.	Least Threatened Not statutorily conserved and few intact examples of this vegetation remain. Heavy grazing and arid climate have significantly altered the structure and composition of vegetation of this unit. In some areas the invasive tree *Prosopis glandulosa* could become a serious problem.
		6. Eastern Gariep Rocky Desert Occurs on all the rocky desert areas along the Orange River, including mountainous areas. Bare rock outcrops are covered with very sparse shrubby vegetation in crevices and are separated by broad sheet-wash plains	Least Threatened None of this vegetation is statutorily conserved in South Africa

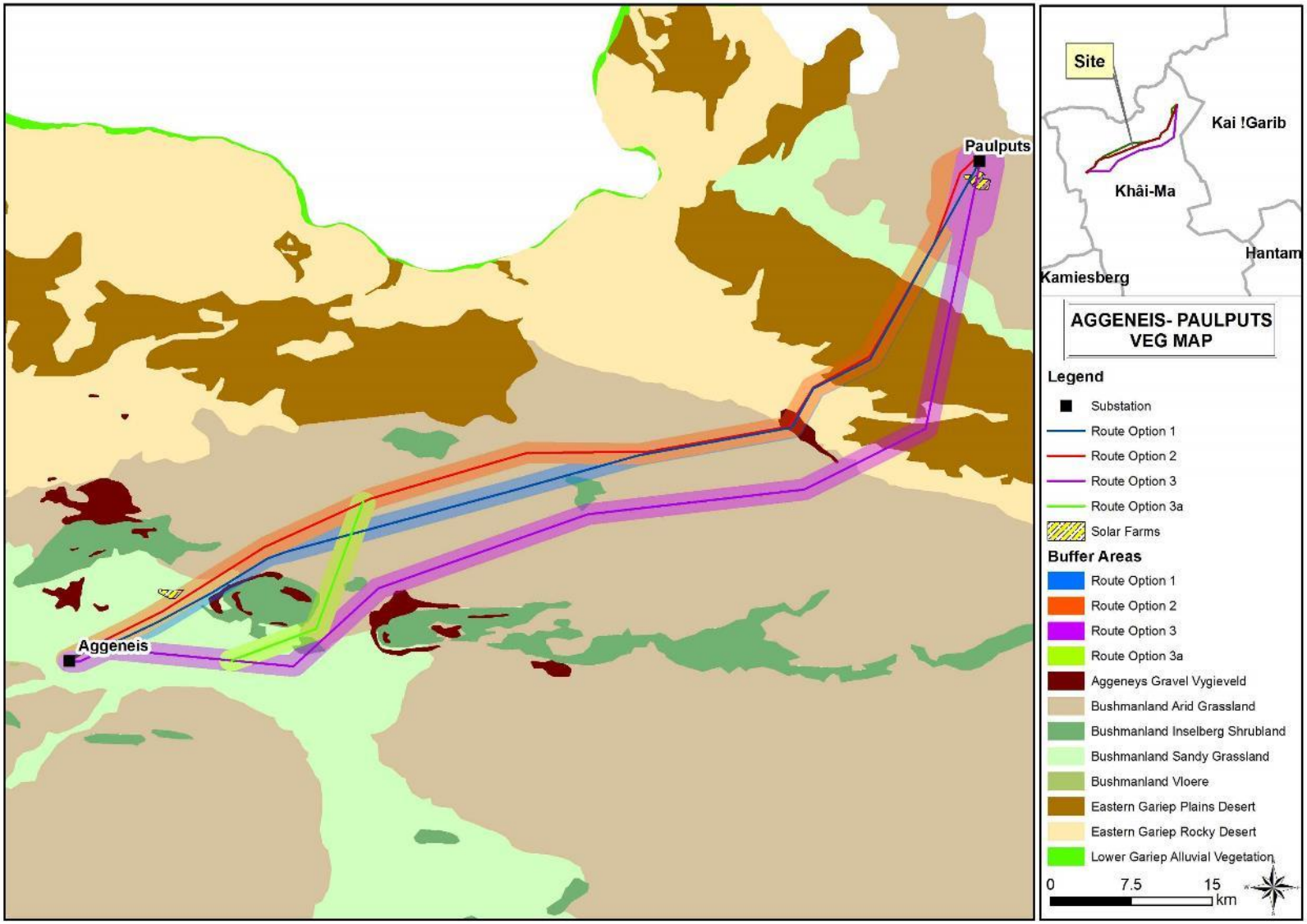


Figure 6: Vegetation types occurring within and in proximity to the proposed Aggeneis-Paulputs route alternative corridors

3.6 Listed Ecosystems

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)). Development a listed ecosystem 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.

No listed ecosystems occur along the three corridor alternatives or deviation 3A.

3.7 Namakwa Biodiversity Sector Plan (Bioregional Plan)

The proposed 400kV powerline is situated within the Namakwa District and are included in the Namakwa Biodiversity Sector Plan. This Biodiversity Sector Plan maps areas of biodiversity concern to ensure that biodiversity information can be accessed and utilized by local municipalities to inform land use planning and development as well as decision making processes within the NDM (Namakwa District, 2008). The Namakwa Districts biodiversity map indicates where Critical Biodiversity Areas (CBAs), as well as Ecological Support Areas (ESAs) occur along the proposed route alternatives (Figure 7).

CBAs are Terrestrial (T) and Aquatic (A) features in the landscape that are critical for retaining biodiversity and supporting continued ecosystem functioning and services (SANBI, 2007).Furthermore, CBAs are areas of the landscape that need to be maintained in a *natural or near-natural state* in order to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. In other words, if these areas are not maintained in a natural or near-natural state then biodiversity conservation targets cannot be met. Maintaining an area in a natural state can include a variety of biodiversity-compatible land uses and resource uses (e.g. tourism, game farming). The CBA's are ranked as follows:

- CBA 1 (including PA's, T1 and A1) which are natural landscapes with no disturbances and which is irreplaceable in terms of reaching conservation targets within the district
- CBA 2 (including T2 and A2) which are near natural landscapes with limited disturbances which has intermediate irreplaceability with regards to reaching conservation targets

ESAs on the other hand, support key biodiversity resources (e.g. water) or ecological processes (e.g. movement corridors such as ridges) in the landscape. ESA's are functional landscapes that are moderately disturbed but maintain basic functionality that connect CBAs. Although ESAs are areas that are not essential for meeting biodiversity representation targets/thresholds, it 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. The degree of restriction on land use and resource use in these areas may be lower than that recommended for critical biodiversity areas.

The powerline corridors traverse CBAs (T1 and T2) as well as ESAs through-out their extent. Both the T1 (Critical Terrestrial Habitats) and T2 (Important Terrestrial Areas) were identified by experts as being important for biodiversity areas and include features such as quartz patches, as well as important fauna habitats. The ESA's comprise biodiversity corridors aimed at retaining connectivity between all geographic areas in the district and nationally. Table 2 below indicates land uses that are compatible within CBAs and ESAs, land uses that are not and those land uses that can be undertaken with restrictions. As per Table 2, linear developments such as powerlines within the CBA and ESAs, are restricted by site specific conditions and controls if the activity is unavoidable.

Table 2: The Namakwa District matrix of recommended land-use activities in relations to the different CBA categories (adapted from Ferrar & Lotter 2007 IN Desmet & Nel, 2008).

Type of Land Use	Protected Area or Conservation Area (PA/CA)	Critical Biodiversity Area 1 (CBA1 or T1)	Critical Biodiversity Area 2 (CBA2 or T2)	Ecological Support Areas (ESA)	Other Natural Areas (ONA)
Conservation Management	Y	Y	Y	Y	Y
Extensive Game Farming	Y	Y	Y	Y	Y
Extensive Livestock Production	R	Y	Y	Y	Y
Rural Recreational Development	R	N	R	R	Y
Rural (Communal) Settlement	N	N	N	R	Y
Dryland Crop Cultivation	N	N	N	R	Y
Intensive Animal Farming (e.g. Dairy, piggery's)	N	N	N	R	Y
Irrigated Crop Cultivation	N	N	N	R	Y
Urban & Business Development	N	N	N	N	R
Major/Extensive Development Projects	N	N	N	R	R
Linear Engineering Structures	N	R	**R**	**R**	R
Water Projects & Transfers	N	N	R	R	R
Underground Mining	N	N	R	R	Y
Surface Mining, Dumping & Dredging	N	N	N	R	R

Notes:

Y = YES, permitted and actively encouraged activity;

N = NO, not permitted, actively discouraged activity; and,
R = RESTRICTED by compulsory, site-specific conditions & controls when the activity is unavoidable. This land use is not usually permitted.

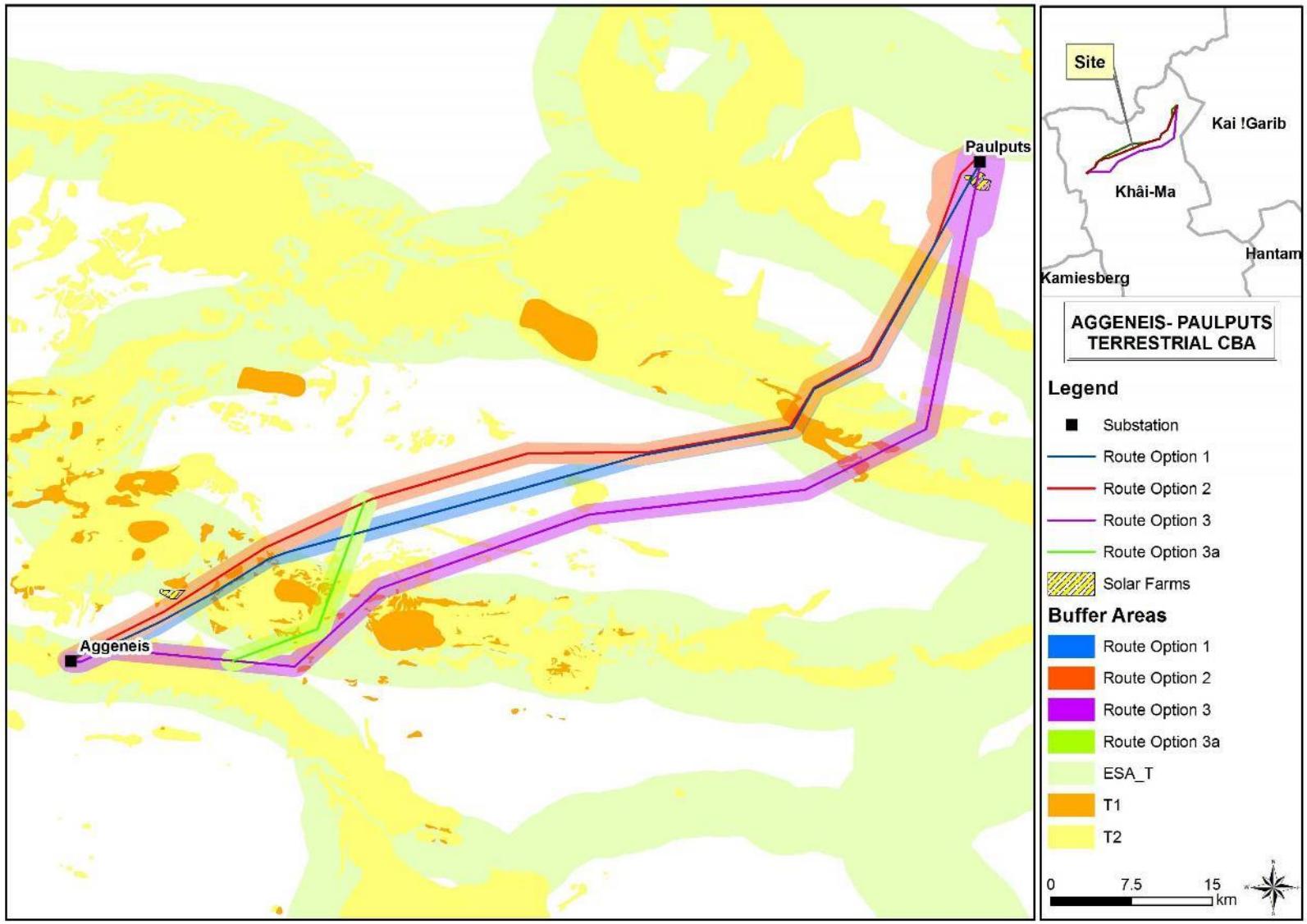


Figure 7: Critical Biodiversity Areas (T2 and T2) as well as ESA's along all three proposed route alternative corridors

3.8 Succulent Karoo Ecosystem Programme (SKEP) Priority Areas

The Succulent Karoo Ecosystem Programme (SKEP) is a long term, multi-stakeholder bioregional conservation and development programme with the aim of defining a way to conserve this Succulent Karoo ecosystem, and to develop conservation as land-use. In order to protect the Succulent Karoo, nine (9) geographic priority areas were identified as the most efficient locations for achieving the conservation targets of SKEP (Figure 8 & 9). These geographic priority areas were refined on the basis of their ability to contribute to the maintenance of Red Data List species, and maintain important ecological processes, particularly in the face of climate change (SKEP, 2013). In these priority areas, SKEP will seek to establish informal conservation networks that will achieve vegetation and process targets.

One of the SKEP priority areas, the Bushmanland Inselbergs, occurs west of Pofadder and can be impacted on by the proposed powerline route. The area is dominated by a plain of desert grasslands and dotted by inselbergs that are important refugia for plants and animals and act as stepping-stones for rock-loving species migrating east west across the sand-covered plains of Bushmanland. These inselbergs support a highly diverse dwarf succulent shrubland and some has been impacted on by mining and overgrazing.

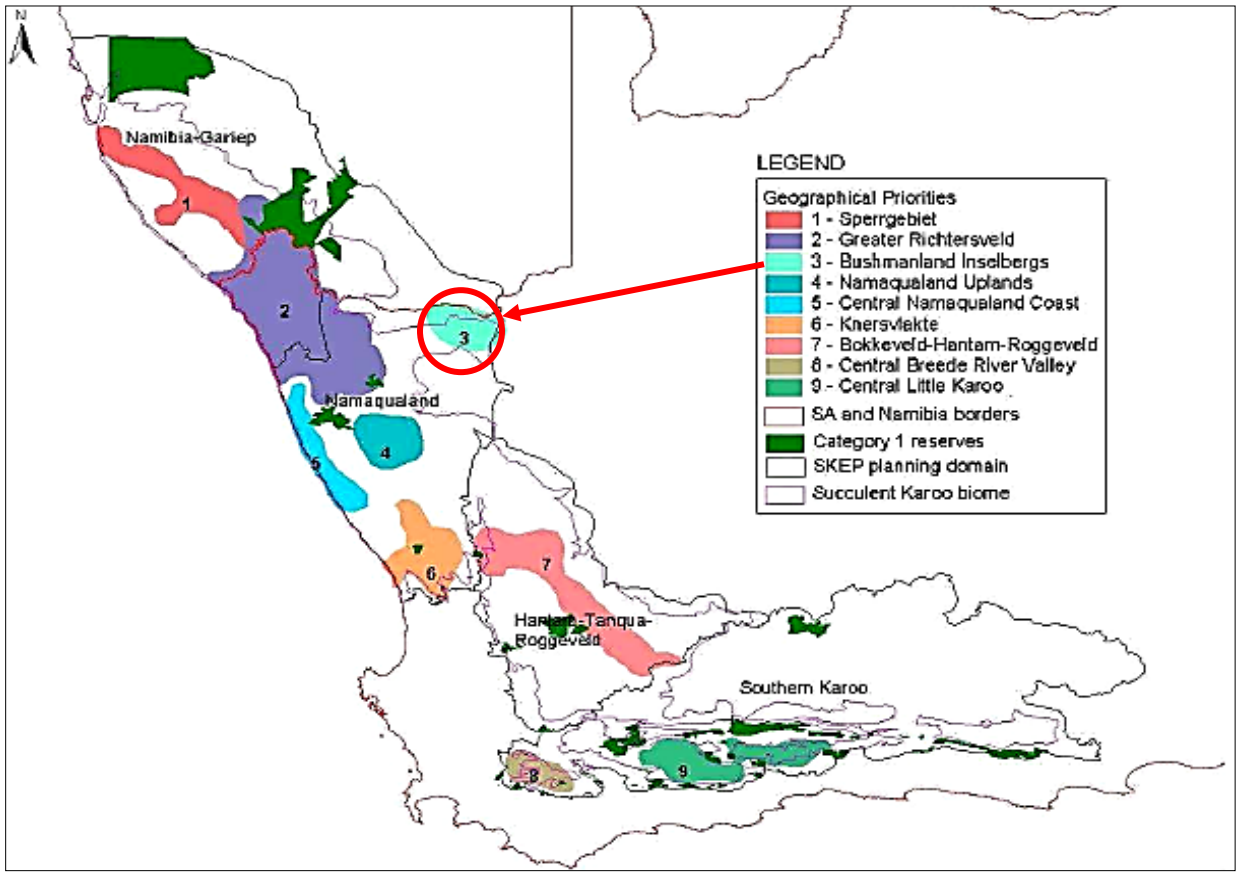


Figure 8: Planning domain of SKEP indicating the 9 priority areas, including the Bushmanland Inselbergs around Pofadder (http://bgis.sanbi.org/skep/project.asp)

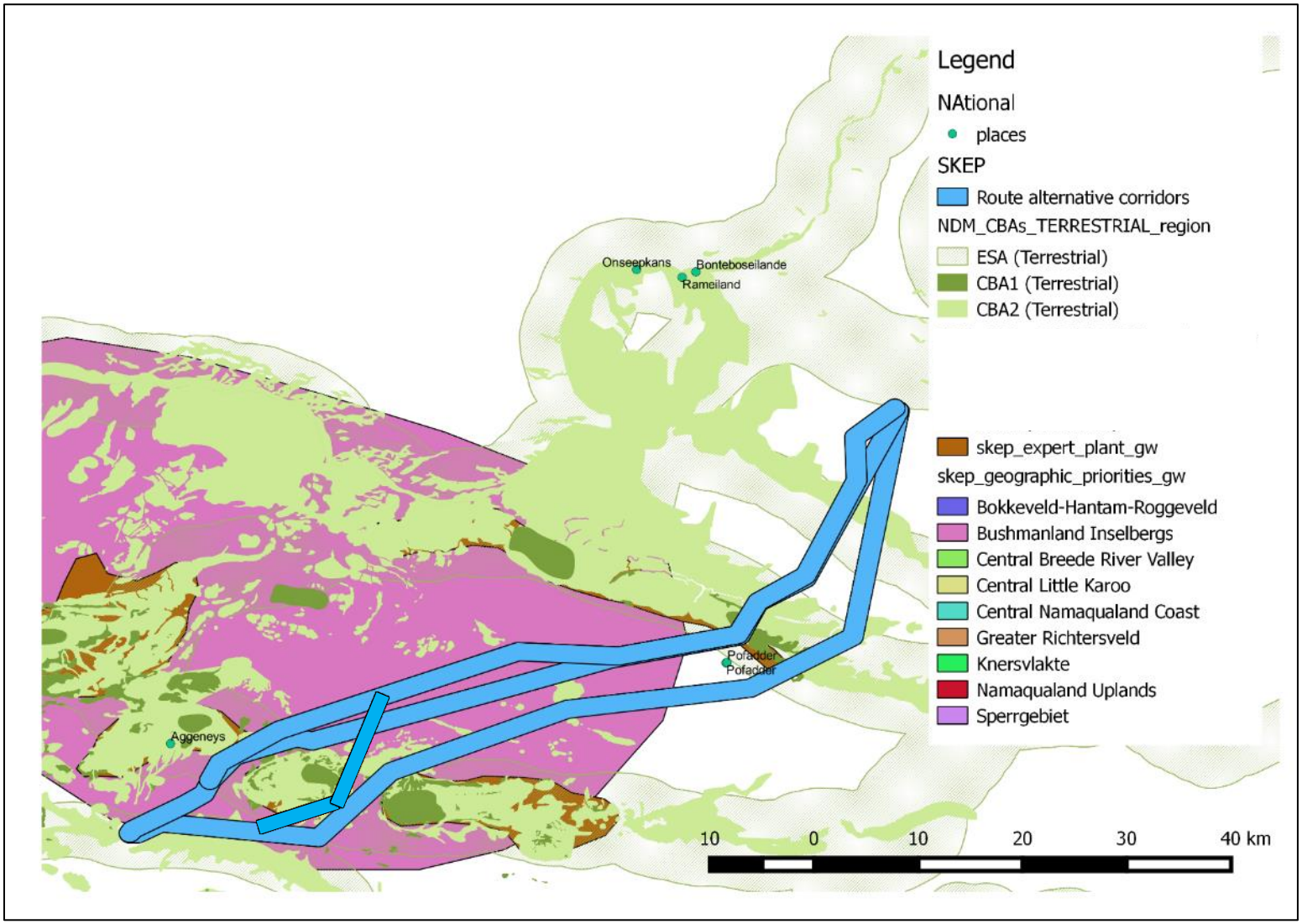


Figure 9: The Bushmanland Inselberg Priority area (SKEP), important plant habitats (skep_expert_plan_gw), as well as the Namakwa CBAs and ESAs

3.9 Gariep Centre of Endemism

Endemic plants are species that are naturally only found in a particular- and usually restricted geographic area or region. These plants are therefore restricted in their distribution and vulnerable to habitat loss. The Gariep Centre of Plant Endemism includes about 2 700 species of plants of which 560 are endemic or near-endemic. Over 400 of these are succulent plant species and some are known to occur in the study area. In addition, areas associated with calcareous or quartzitic soils (e.g. the Aggeneys Gravel Vygieveld that occur mainly in Route 1 and 2 corridor) are likely to have high number of species limited to this habitat. The Gamsberg, situated about 12km north-east of the town of Aggeneys, is the largest inselberg located in the centre this Centre of Endemism. The inselbergs and associated rocky plains have very high levels of species diversity of which many are range restricted being associated with specific regionally rare habitats such as types of gravel patches (quartz, calcrete and feldspar).

3.10 Protected Areas and Protected Areas Expansion

3.10.1 Protected Areas

No national protected areas are present along the proposed route corridors. The Augrabies National Park is situated about 55km north-east of the Paulputs substation and the Goegab Provincial Nature Reserve about 75km south-west of the Aggeneis substation around the town of Springbok. The whole of the proposed development is situated within the Riemvasmaak Community Conservancy.

3.10.2 Protected Areas Expansion Strategy

South Africa's protected area network currently falls far short of sustaining biodiversity and ecological processes and therefore the National Protected Area Expansion Strategy (NPAES) are being implemented (DEA, 2009). The NPAES was commissioned by the Department of Environmental Affairs (DEA), co-ordinated by the South African National Biodiversity Institute (SANBI), and drafted in close collaboration with the South African National Parks (SANParks), other national conservation agencies and the Provincial conservation agencies. The goal of the NPAES is to achieve cost effective protected area expansion for ecological sustainability and increased resilience to climate change. The NPAES sets targets for PA expansion, provides maps of the most important areas for PA expansion, and makes recommendations on mechanisms for PA expansion. The NPAES uses two factors, importance and urgency, to identify priority areas for PA expansion in the terrestrial environment. Although not currently protected, these areas should be considered as being of high development constraint for infrastructure proposed to be located within or in close proximity to these areas.

The majority of the southern extent of all three proposed powerline corridors will traverse the Kamiesberg Bushmanland Augrabies Focus Area (Figure 10). This focus area represents the largest remaining natural area for the expansion of the protected area network and forms part of the planned Lower Orange River Trans-frontier conservation area. It provides an opportunity to protect twenty-two (22) desert and succulent karoo vegetation types, mostly completely unprotected, several river types that are still intact but not protected, and important ecological gradients and centres of

endemism. Therefore, it is advisable that any electrical infrastructure in this area be planned in consultation with the South African National Biodiversity Institute (SANBI) as well as the Department of Environmental Affairs (DEA).

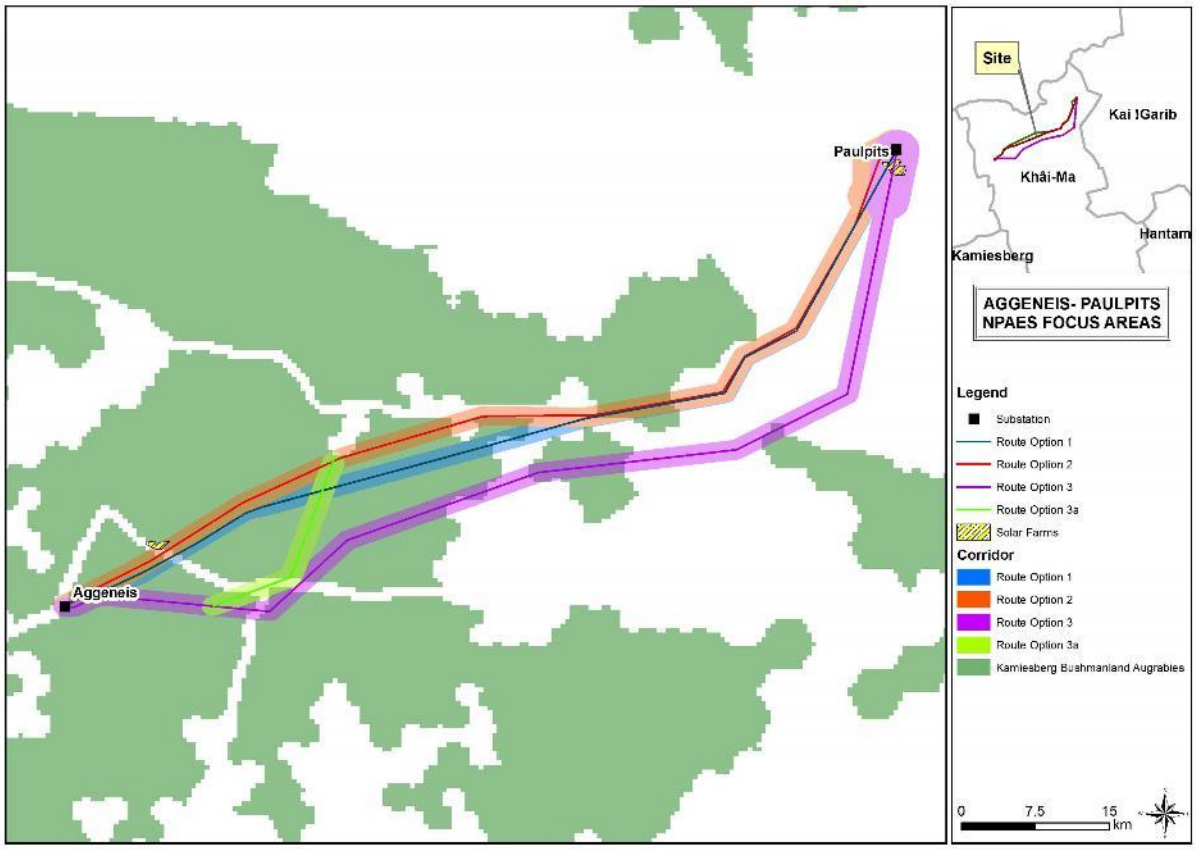


Figure 10: Much of the eastern section of the proposed powerline alternative corridors occurs within the Kamiesberg Bushmanland Augrabies Focus Area

3.11 Land Cover

The national land cover data set indicates that much of the area along the proposed route corridor alternatives are bare or non-vegetated, vegetated with low shrubland and small portions of grassland.

3.12 Historic Report for a 200kV line between the same substations

Bathusi Environmental Consulting undertook a fauna and flora study for a 200kV transmission line proposed between Aggeneis substation and the Paulputs substation in the year 2010 (Bathusi Environmental Consulting, 2010). This was to inform a Basic Impact Assessment (BIA) for the Aggeneis-Paulputs 2nd 220kV transmission power line in the years 2011 and 2012. Presently the line is planned to be upgraded to a 400kV and although the 400kV line route alternatives are slightly different than the originally planned 200kV line, much of this existing specialist information remains relevant.

The study found extensive areas of 'Grassland' and 'Shrubland', through-out the region with extremely limited transformation noted (Bathusi Environmental Consultants, 2010). Infrastructure

(e.g. roads) are limited and towns and urban areas are small. The vegetation was thus observed to be largely in a natural state. The following ecological sensitivities were estimated for the respective habitat types:

1. Aggeneys Gravel Vygieveld (High Ecological Sensitivity);
2. Bushmanland Arid Grassland (Medium Ecological Sensitivity);
3. Bushmanland Sandy Grassland (Medium Ecological Sensitivity);
4. Einiqua (Eastern Gariep) Plains Desert (Medium Ecological Sensitivity);
5. Einiqua (Eastern Gariep) Rocky Desert (Medium-high Ecological Sensitivity);
6. Outcrops/ Ridges/ Mountains (High Ecological Sensitivity); and
7. Rivers/ Streams (Medium-high Ecological Sensitivity).

The assessment noted very little difference between the expected impacts associated with the proposed 200kV line alternatives. However, areas of existing lines or degradation is present in the form of roads (N14) and an existing powerline. A preference for these areas where infrastructure already exist was recommended, provided that local sensitivities are avoided.

4 RESULTS OF THE FIELD ASSESSMENT

4.1 Land Use

The majority of the powerline route alternatives traverse farm land, mainly used for cattle and sheep grazing (Photograph 1). No cultivated areas were noted. Mining takes place on a portion of the Gamsberg and around the town of Aggeneys. Route alternatives 1 and 2 pass north of the town of Pofadder with an increase in grazing and trampling noted here within the corridors. An existing 400kV powerline and servitude road between Aggeneis and Paulputs substations are present and route alternative 1 and portions of route alternative 2 runs parallel to this line. For the majority of the route alternatives, the land remains in a natural state with the main impact being grazing and in some areas severe overgrazing. The routes cross some dirt and paved roads.

Photograph 1: Sheep grazing (left) and informal housing and grazing in the alternative 1 and 2 corridor, north-west of Pofadder (in the vicinity of the waste water treatment area).

4.2 Vegetation Survey Overview

At the time of the survey, the area was still extremely dry, and vegetation was poor as a result of the preceding drought. The majority of the expected species were either absent or grazed short and in some instances not identifiable. Similarly, many of the dwarf shrubs were without any foliage and only a few were flowering. It can thus be expected that several additional species, mostly annuals and species resprouting from underground storage organs, can emerge throughout the study area during the rainfall season.

Vegetation associations identified during this study are based on the overall similarity in vegetation structure, species composition, and abiotic features such as rivers, sand, inselbergs and quartz patches. However, phytosociological differences within each broadly grouped vegetation association is present. Vegetation associations occur in intricate mosaics throughout the study area, with edges of vegetation units generally very vague. Local species composition is primarily influenced by soil depth, soil surface texture and underlying geology. There is also a large degree of species overlap between the mapped edges of vegetation associations identified.

4.3 Description of vegetation associations and their habitats

The vegetation observed along the proposed alternative corridors was found to be representative of the biomes and the broad scale vegetation types as described in Section 3.5. Due to the drought at the time of the assessment, this assessment relied on existing vegetation reports for the area to ascertain likelihood of occurrence of certain species as well as typical species identified during preceding growing seasons (Bathusi Environmental Consulting, 2010, Pachnoda Consulting, 2010, Simon Todd Consulting, 2012, Desmet, 2013). Due to the arid nature of much of the surveyed area, the vegetation was found to be mainly used for grazing. Therefore, the natural species composition was observed to still be largely intact and as expected based on the literature review.

Six vegetation associations were grouped as follows (Figure 11):

1. Sandy grassland and desert plains
2. Arid gravelly grassland
3. Gravel and quartz veld
4. Rocky desert and outcrop vegetation
5. Inselberg vegetation
6. Drainage lines and riparian

Each vegetation association is mapped in Figure 11 and described below. The species recorded are listed in Appendix B. Due to the absence of good rains, the species list is limited and should be regarded as the minimum species present.

Note that deviation 3A as well as the wider corridors close to Paulputs substation was not ground-truthed and the mapped vegetation in Figure 11 are extrapolations of the data gathered at the time of the field survey and represent the likely vegetation occurring.

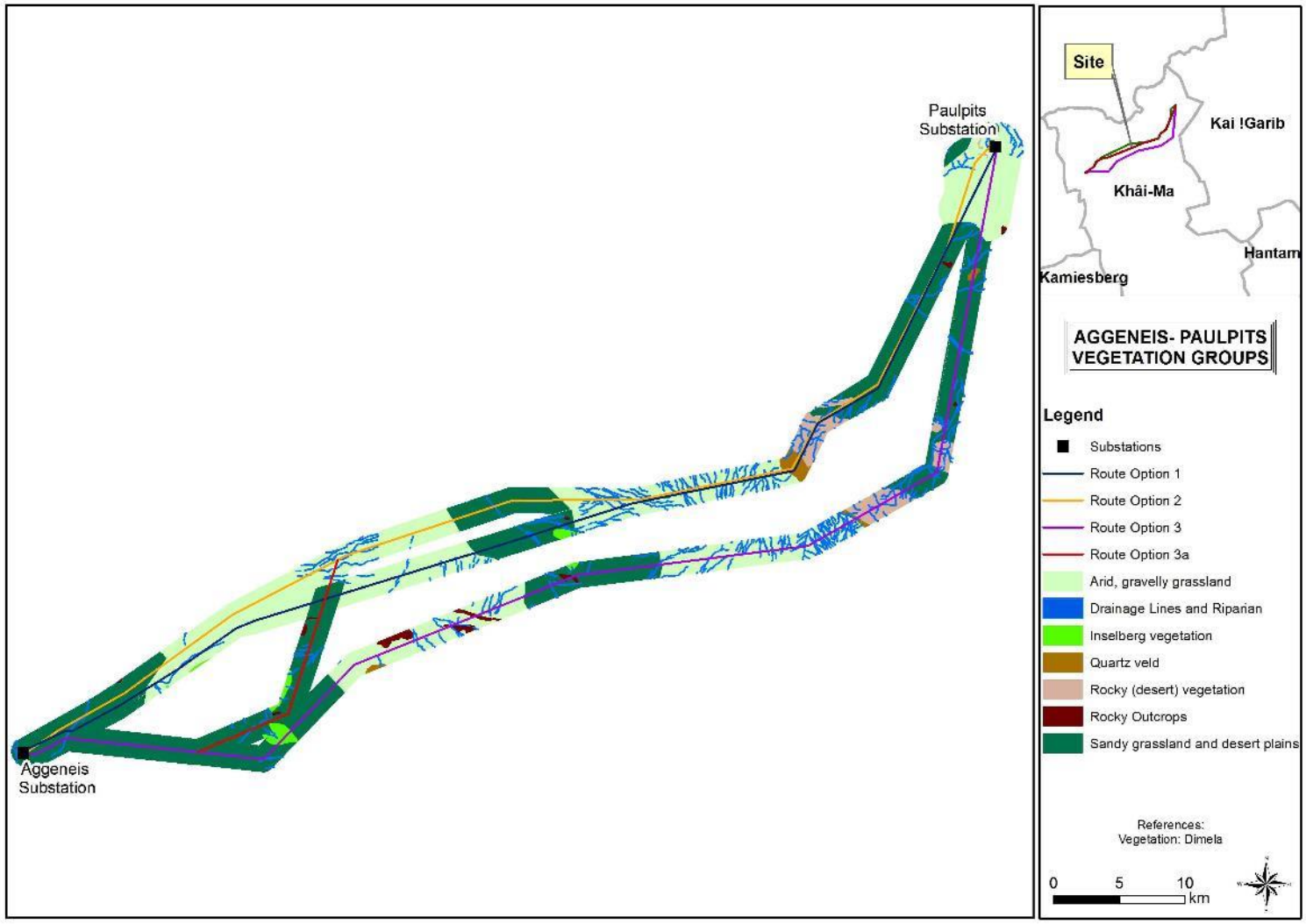


Figure 11: Broad vegetation associations within the route alternative corridors

4.3.1 Sandy grassland and desert plains

This vegetation association includes the Bushmanland Sandy Grassland and Eastern Gariep Plains Desert as described in Mucina and Rutherford (2006) and Bathusi Environmental Consulting (2010). The vegetation comprises grassland on sandy soils and in sandy plains, dominated by white grasses (*Stipagrostis* & *Schmidtia* species) and karroid shrubs. Annual herbaceous species were largely absent due to the drought, but would be more noticeable after good rains. The sand varied form deep red sands and dunes associated with the paleo Kao River valley (a former tributary of the Orange River), to whiter sands in the Eastern Gariep Plains Desert north and north-east of Pofadder. Deep red sands were also noted along the dry riverbeds e.g. T'Goob-se-loop and are interspersed with arid, gravelly grassland (Figure 11).

Land use and disturbances:

The grassland was grazed with severe overgrazing noted in some areas. Continuous grazing pressure resulted in a change in species abundance with limited grasses noted, and an increase of dwarf karoid shrubs (Photograph 2 & 3).

Photograph 2: Grassland on red sands north east of Aggeneis substation (left), with high grazing pressure recorded where cattle graze (right). The Vulnerable *Aloidendron dichotomum* in sandy grassland (right)

Photograph 3: Sandy grassland north of Aggeneis substation (left) and grazed sandy grassland 20km south of Pualputs substation (right)

Observed species:

The dominant and recognisable grass species were *Stipagrostis obtusa, S. ciliata, Schmidtia kalahariensis, Aristida* species and *Enneapogon desvauxii.* Small and dwarf shrubs most noted were *Rhigozum trichotomum, Peliostomum leucorrhizum, Salsola* species, *Brownanthus pseudoschlichtianus, Plinthus sericeus* (silverkaroo), *Lycium cinereum* and succulents observed included *Augea capensis, Ruschia* spp, *Aridaria* spp and *Sarcostemma verminale.* The tree layer was sparse and included protected species (Appendix B).

In between rocky and mountainous areas, additional shrubs and herbs were noted in the drainage lines or on more gravelly or loamy soil next to the mountains (Mucina & Rutherford, 2006) (Photograph 4). Where grazing pressure was high, the shrub *Rhigozum trichotomum* (driedoring) was particularly prominent in the sandy drainage lines (Photograph 5).

Photograph 4: Sandy grassland along drainage lines.

Photograph 5: *Rhigozum trichotomum* in the drainage lines (left) with gravelly bed of the drainage lines within parts of the sandy grassland (right)

Plants of conservation concern:

The Vulnerable *Aloidendron dichotomum (*was *Aloe dichotoma* (quiver tree / tree aloe) occurred scattered throughout the grasslands. Two protected tree species were noted. *Vachellia erioloba* (camelthorn) was recorded within the desert plains east of Pofadder, within the route alternative 3 corridor. This tree was most prominent in the deep sandy soils along the drainage lines or 'washes' between the mountainous rocky desert (Photograph 6). *Boscia albitrunca* subsp. *albitrunca* (witgat) grew scattered within the sandy grassland (Photograph 7). *Hoodia gordonii* (ghaap) was recorded in sandy grassland south of Paulputs substation.

Photograph 6: *Vachelia erioloba* within sandy grassland in route alternative corridor 3

Photograph 7: *Boscia albitrunca* in sandy grasslands

4.3.2 Arid gravelly grassland

This vegetation association occurred through most of the powerline route corridors and include the Bushmanland Arid Grassland as described by Mucina & Rutherford (2006) and Bathusi Environmental (2010) and calcrete gravel patches as described by Desmet (2013), as well as elements of the Aggeneys Gravel Vygieveld (Mucina & Rutherford, 2006). The vegetation comprises sparsely vegetated grassland dominated by white grass / bushman grass (*Stipagrostis* species) with open low shrubs - as opposed to the denser sandy grassland (4.3.1).

The sands are more gravelly than the sandy grassland with scattered gravel patches (Photograph 8). The sand is underlain by calcrete (also called hardpan) and where the sand eroded away, the white calcrete is exposed (Desmet, 2013). Calcrete pebbles or solid calcrete hardpan forms patches scattered throughout the grassland, and although common across Bushmanland, some calcrete patches associated with the Bushmanland Inselbergs are floristically rich and include endemic species (Desmet, 2013). Calcrete gravel are also discussed in 4.3.3 with quartz veld, however, the calcrete patches are not readily distinguishable from the arid grassland and are therefore mapped as one unit for the purpose and level of this investigation. It is however imperative that a walkdown of the final route identify and assess calcrete areas where they occur in the route corridor. Calcrete patches assessed included some species not recorded in the arid grassland, however, the species and diversity were not markedly different. The calcrete areas assessed were grazed and in proximity to access roads-other calcrete areas along the routes might support endemic species. Localised sensitivities can be present in the calcrete which must be recorded during a walk down of the final route alignment.

Land use and disturbance:

Most of the vegetation is used for grazing and a quarry was noted north of the N14 between Pofadder

and Aggeneys. Several existing dirt roads, as well as a bulk water pipeline to Pella, north of the N14, traverse this vegetation association in proximity to where route alternative 1 and 2 are proposed. Within these corridors, north and north-west of Pofadder, informal housing and grazing is impacting on the vegetation (Photograph 10).

Photograph 8: Gravelly grassland with gravel patches north of Gamsberg (visible in the background) (right)

Photograph 9: Calcrete areas embedded in the arid grassland

Photograph 10: Disturbed and grazed areas within the alternative 1 and 2 corridors

Observed species:

The grassland was dominated by *Stipagrostis* grasses with some *Aristida* species also recorded. Other grasses that could be identified include *Schmidtia kalahariensi* and *Enneapogon desvauxii.* Small and dwarf shrubs noted included *Salsola* species, *Rhigozum trichototum, Acanthopsis hoffmannseggiana, Euphorbia spinea, Sisyndite spartea, Antimima* spp, *Trianthema parvifolia,* and *Psilocaulon coriarium. Aloe claviflora* was noted particularly along route alternative corridor 3, while *Aloe dichotoma* occurs scattered through the area. Trees were limited to *Boscia foetida, B. albitrunca, Searsia burchelii* (kuni bush) and *Parkinsonia africana.* The calcrete areas included additional species such as *Euphorbia gariepina* subsp *gariepina, Sarcocaulon crassicaule, Drosanthemum* sp. and *Kleinia longiflora* (Appendix B).

Plants of conservation concern and endemic plants:

The Vulnerable and provincially protected *Aloidendron dichotomum* (quiver tree) occurred scattered throughout the grasslands as well as the protected tree *Boscia albitrunca* subsp. *albitrunca* (Photograph 7). A number of endemic species could be present, particularly in calcrete gravel patches.

The area is home to a number of endemics such as *Tridentea dwequensis, Dinteranthus pole-evansii, Larryleachia dinteri, L. marlothii, Ruschia kenhardtensis, Lotononis oligocephala* and *Nemesia maxii*. None of these were recorded within the sampling areas, but are likely present within the corridors.

4.3.3 Gravel and quartz veld

Gravel, calcrete and quartz veld as described here include the Aggeneys Gravel Vygieveld as described by Mucina & Rutherford (2006), Bathusi Environmental (2010) and Desmet (2013). This quartz veld is similar to that of the calcrete patches but has a high occurrence of white quartz on the surface, limited grass species and a higher abundance of small succulent plants. The quartz mostly occurs on undulating landscapes and footslopes and are known to provide habitat to unique dwarf succulents. The white quartz gravel reflects the sunlight, and is not as hot as the darker rocks and could support unique species not found in the surrounding sandy or gravelly grassland (Photograph 11). The quartz occurs on small patches or interspersed with larger gravel patches (Photograph 12). North of Pofadder, strips of quartz patches can be seen embedded in the rocky desert (Photograph 13).

The calcrete patches and some quartz patches are difficult to map from aerial imagery as it is embedded in the gravelly grassland. The gravel and quartz veld mapped here resembles the known distribution of the Aggeneys Gravel Vygieveld vegetation and some areas identified during the site visit. The walk-down phase would better distinguish between these and determine each patch's importance for species conservation.


Photograph 11: A quartz patch next to the N14. Despite past disturbances small succulents were observed such as *Dinteranthus microspermus*, *Anacampseros filamentosa*, *Avonia (Anacampseros) papyracea* subsp. *namaensis*, *Crassula columnaris* and *Crassula muscosa*


Photograph 12: Gravel with some quartz

Photograph 13: White quartz visible between rocky desert vegetation (see 4.3.4)

Land use and disturbance:

Most of the vegetation is used for grazing although the quartz areas investigated seem to be more impacted on by existing servitude road and powerline (Photograph 14). The invasive *Prosopis glandulosa* was recorded in previously disturbed areas.

Photograph 14: Pylons and tracks within the gravel and quartz veld

Observed species:

Despite past disturbances within the quartz veld, small succulents were observed such as *Dinteranthus microspermus, Anacampseros filamentosa, Avonia (Anacampseros) papyracea* subsp. *namaensis, Avonia (Anacampseros) quinaria, Crassula columnaris a*nd *Crassula muscosa.* Gravel areas included dwarf succulent shrubs such as *Euphorbia gariepina* subsp *gariepina, Sarcocaulon crassicaule, Drosanthemum* sp. *Ebracteola fulleri, Ceraria fruticulosa* and *Kleinia longiflora* (Appendix B). Tree species was absent, bar the invasive *Prosopis glansulosa* (Appendix B).

Plants of conservation concern:

Hoodia gordonii was recorded in a quartz patch. A high number of endemic and protected species may occur such as *Adromischus nanus*, species, *Dinteranthus microspermus* subsp. *puberulus, Dinteranthus vanzylii, Lapidaria margaretae, Anacampseros bayeriana* and *Lithops julii* subsp *fuller.*

4.3.4 Rocky desert and rocky outcrop vegetation

Rocky outcrops and rocky mountainous areas are present between Pofadder and the Paulputs substation. This vegetation association includes the Eastern Gariep Rocky Desert as described by Mucina and Rutherford (2006). Some rocky outcrops and ridges are also scattered eastward towards the town of Aggeneys and may be outliers of the Bushmanland Inselberg Shrubland. These rocky areas are sparsely vegetated or bare and are separated by the sandy plains or sheet-wash plains (Photograph 15). Different aspects can house different species assemblages.

Photograph 15: Rocky outcrops and rocky desert

Land use and disturbance:

Much of this vegetation is inaccessible due to the terrain and disturbances limited to existing linear infrastructure such as the existing 400kV powerline between Aggeneis and Paulputs substations. Limited to no alien invasive plant species are expected within this vegetation association.

Observed species:

Limited areas were sampled. Low growing trees and shrubs were recorded with limited grass and herbaceous species. Tree species such as *Commiphora gracilifrondosa*, *Boscia* species *and Ficus ilicina* were noted in higher lying areas with a limited occurrence of *Aloe dichotoma.* Succulents such as *Euphorbia*, *Aloe* and *Tylecodon* species are expected to grow here. Common species in soil pockets or at the base of these rocky areas include *Roggeria longiflora*, a *Berkheya* species, *Kleinia longiflora, Aptosimum spinescens*, *Rhigozum trichotomum* the grass *Schmidtia kalihariensis* and *Stipagrostis* species and the tree *Parkinsonia africana*.

Photograph 16: Sparsely vegetated rocky outcrops near the Paulputs substation

Plants of conservation concern:

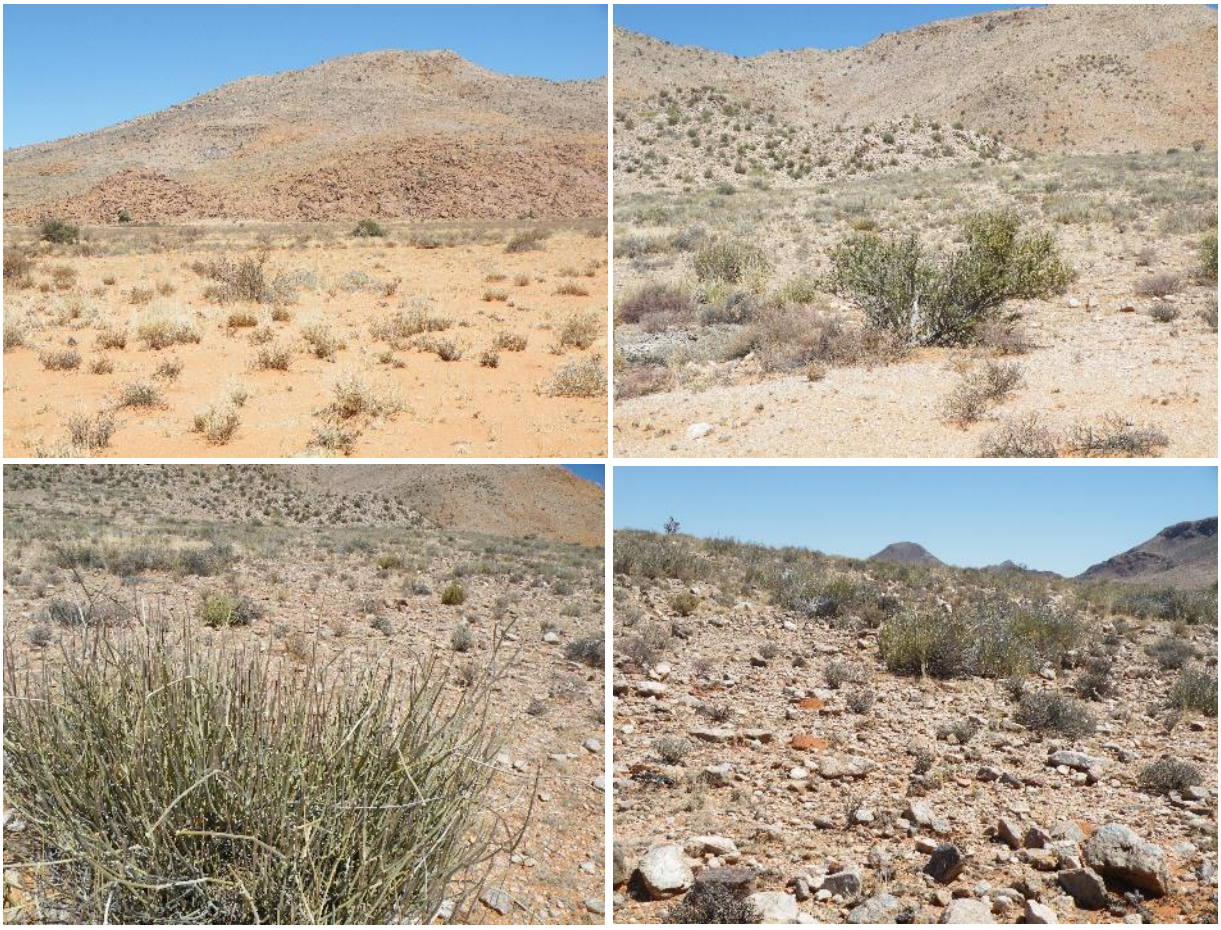
The Vulnerable and provincially protected *Aloidendron dichotomum* (quiver tree) and protected tree *Boscia albitrunca* were recorded on or in close proximity to the rocky areas. The endemic species *Ozoroa namaquensis* and *Tylecodon sulphurous* could occur within the corridors.

4.3.5 Inselberg vegetation

The inselbergs comprise a group of prominent solitary mountains (inselbergs) and smaller koppies towering over surrounding flat plains (Mucina & Rutherford, 2006). The vegetation is not as sparse as that of the rocky desert vegetation association discussed above. Vegetation on inselbergs is described as the Bushmanland Inselberg Shrubland by Mucina and Rutherford (2006), with more detailed information on the inselberg vegetation of the Gamsberg in Desmet (2013). Only route alternative 3 traverses an inselberg, south –east of Gamsberg (Photograph 17), whereas the corridor of deviation 3A passes through and over a number of inselbergs. The vegetation comprises shrubland with both succulent and non-succulent elements and with sparse grassy undergrowth on steep slopes of the inselbergs (Bathusi Environmental, 2010). Tree-like succulents such as *Ceraria namaquensis*; *Aloe gariepensis* and *Euphoria avis-montana* has been recorded on slopes, while the plateau of some inselbergs such as the Gamsberg is similar to the Aggeneys Gravel Vygieveld (Desmet, 2013). Similar vegetation as to that of the Gamsberg can be expected where route alternative 3 traverses the inselberg, with Bushmanland Inselberg shrubland on the slopes and the Bushmanland Inselberg Succulent Shrubland on the south facing slope (Desmet, 2013).

Land use and disturbance:

The inselbergs are largely intact; however, zinc mining is impacting on the Gamsberg. Alien invasive species numbers are low or absent.



Photograph 17: South-east of Gamsberg, an inselberg where the route alternative 3 is proposed to cross (top left) and typical vegetation on the slopes (remainder of images)

Observed species:

The Inselberg Shrubland also included gravel and quartz areas and succulent shrubs such as *Euphorbia gregaria, E. gariepina* and *Sarcostemma viminale* which dominated the area sampled. The leaf-succulents *Ruschia* and *Drosanthemum* species as well as *Psilocaulon coriarium* were observed and grasses included *Stipagrosis* and *Aristida* species.

Plants of conservation concern:

Of the vegetation associations delineated, inselbergs are of the most concern as it provides habitat to a number of species of conservation concern, including endemic species and protected trees. It is highly likely that the area traversed by the proposed route 3 alternative could impact on range restricted species.

4.3.6 Drainage lines

Numerous drainage lines cut through the sandy plains and arid grassland. These drainage lines are ephemeral and many originate in the rocky hills and inselbergs. The substrate varies from deep sandy

areas such as at T'Goob-se-loop to gravelly, rocky and coarse sand (Photograph 18). Due to the arid climate, no definite riparian vegetation are present, however, the tree layer are more prominent than in any other vegetation association observed and include species found only along the drainage lines.

Photograph 18: The drainage lines varied from small, narrow channels in gravelly grassland (top left), to wide and flat in sandy grassland soils e.g. T'Goop se Loop (bottom right)

Land use and disturbance:

No damming of the rivers was recorded. However, due to the dry and sometimes inconspicuous nature of these drainage lines, numerous dirt roads traverse the rivers. The alien invasive tree *Prosopis glandulosa* was recorded along many drainage lines, although not in dense stands. Smaller drainage lines were prone to encroachment form the indigenous shrub *Rhigozum trichotomum.*

Observed species:

The protected tree *Vachelia erioloba* (camel thorn) was conspicuous in sandy drainage lines north-east of Pofadder, while *Boscia albitrunca* occurred through much of the study area. The grasses *Stipagrostis brevifolia* and *S cilliata* dominated in sandy drainage lines with the shrub *Sisyndite spartea* (desert broom) occurring in patches. Heavily grazed gravelly drainage lines were prone to encroachment by *Rhigozum trichotomum* and *Lycium* species. The tree layer in gravelly drainage lines comprised of *Pappea capensis*

(jacket plum), *Diospyros lycioides* and *Schotia afra* var *angustifolia* (karoo boerbean). *Vachellia karoo* (sweet thorn) was also recorded, particularly where disturbances to the drainage line was noted.

Plants of conservation concern:

The protected trees *Vachelia erioloba* (camel thorn) and *Boscia albitrunca* were recorded in or proximate to drainage lines.

4.4 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 12). Chapter 4, Part 2 of NEMA Biodiversity Act, 2004 (Act No. 10, 2004) provides for listing of species that are threatened or in need of protection to ensure their survival in the wild, while regulating the activities, including trade, which may involve such listed threatened or protected species and activities which may have a potential impact on their long-term survival.

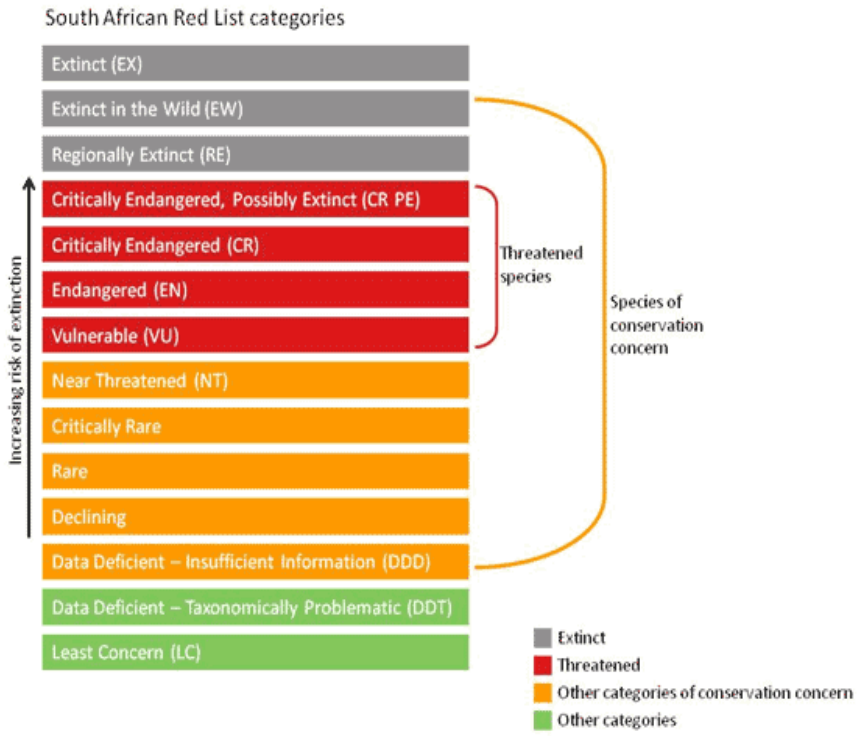


Figure 12 Threatened species and species of conservation concern

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

A list of plants of conservation concern was compiled using information from the South African National Biodiversity Institute's (SANBI) checklist on the Plants of Southern Africa Website (POSA)(SANBI, 2009), Raimondo *et al*, (2009) and literature pertaining to the area that the corridors are situated in. At least thirty (30) plant species of conservation concern could occur within the proposed corridor alternatives (Table 3). The report undertaken in 2010 confirmed three of these species in the area. All three has been confirmed by this investigation as well and are printed in **bold** in Table 3.

Table 3: Species of conservation concern that occur in the study area.

Species confirmed to occur is printed on **bold** and the species potential to occur in *italics.*

Specie	Conservation status	Suitable habitat on site / potential to occur
Anginon jaarsveldii	Endangered	Only known from one very isolated mountain, Pellaberg, near Pofadder. *Unlikely to occur as the known locality or similar habitat is not traversed by either of the corridors*
Aloidendron dichotomum	**Vulnerable**	**From Nieuwoudtville east to Olifantsfontein and northwards to the Brandberg in Namibia. On north facing rocky and sandy flats.** ***Confirmed to occur scattered throughout the alternative corridors.***
Avonia herreana	Vulnerable	Richtersveld, on quartz outcrops. Range restricted, endemic species. *Suitable habitat exists and therefore a potential to occur, albeit slight.*
Conophytum achabense	Vulnerable	Namiesberge, near Poffader. On thin scree in a quartz outcrops on the rocky, west facing slope. A highly restricted species and potentially threatened by mining. *Only route alternative 3 passes in close proximity to the Namiesberge, but is unlikely to impact on this species habitat.*
Lithops dinteri subsp. *frederici*	Vulnerable	Pella, in the Einiqua Plains Desert. Only known from one location, a small area near Pella (near Pofadder) in Northern Cape. *Unlikely to occur as the known locality is not traversed. However, similar habitat is traversed by all three corridors north and north-east of Pofadder*
Lithops olivacea	Vulnerable	Aggenys to Pofadder on quartzite. This species has a restricted habitat within Bushmanland. *Not observed in the areas sampled, however, it is highly likely to occur in quartzite patches, particularly north of Pofadder*
Strumaria massoniella	Vulnerable	Kamiesberg to Loeriesfontein Semiarid flats in deep sand. *Unlikely to occur as the known locality is not traversed. However, similar habitat is traversed by the corridors and therefore there is a slight possibility of occurrence*

Specie	Conservation status	Suitable habitat on site / potential to occur
Conophytum limpidum	Near Threatened	Inselbergs in Bushmanland. Verticle crevices generally preferring shaded situations. Known from fewer than 10 locations this species is potentially threatened by mining. *Highly likely to occur on inselbergs within the study area. Only route alternative 3 will traverse this species habitat directly.*
Bulbine striata	Critically Rare	Amongst quartz pebbles and rocks in well-drained soil on the upper and middle slopes below sheer rock faces. Pellaberg, inaccessible. *Unlikely to occur as the known locality is not traversed by either of the corridors, however, similar habitat is present north of Pofadder*
Adromischus diabolicus	Rare	Quartzite inselbergs on south-facing aspects or steep, inaccessible cliff faces. Vioolsdrift to Pofadder *Suitable habitat is present on inselbergs in the study area. However, only route alternative 3 will traverse such habitat directly.*
Aloe dabenorisana	Rare	Occurs on two mountains along the Orange River valley, northern Cape. Steep vertical south-west facing upper slopes in crevices of quartz rock at an altitude of 900 - 1000 m. *Suitable habitat within the rocky desert and rocky outcrops, although the known distribution is more northward than the study area.*
Cephalophyllum fulleri	Rare	Occurs in the Pofadder area in quartz pebble fields overlaying sandstone or dolerite. Known from less than 5 records. *Highly likely to occur in the quartz patches along all three corridors*.
Conophytum vanheerdei	Rare	Exposed quartzite formations in Bushmanland Inselburg Shrubland. *Suitable habitat on inselbergs within the study area. However, only route alternative 3 will traverse such habitat directly.*
Crassula sericea var. *velutina*	Rare	Rock crevices on quartzite outcrops mainly on the south or south-western aspect. Restricted to high peaks of the western mountains on both sides of the Orange river in high altitude rock crevices so unlikely to be threatened. *Suitable habitat is present on mountainous areas between Pofadder and Paulputs substation and therefore a likelihood of occurrence.*
Crassula thunbergiana subsp. *minutiflora*	Rare	Sandy soils between Aus in Namibia and Springbok in the Northern Cape. *Suitable habitat is present within all three corridors, and therefore a likelihood of occurrence.*
Eriospermum ernstii	Rare	Bushmanland: Dabenoras and Pellaberg. Lower south facing mountain slopes, amongst hard quartzite rocks. *Suitable habitat is present within all three corridors, although the known localities are not traversed.*
Eriospermum pusillum	Rare	Springbok to Aggeneys. Steep shaded areas amongst rocks. This species is very small it is likely to be overlooked *Suitable habitat is present within all three corridors, and therefore a likelihood of occurrence.*

Specie	Conservation status	Suitable habitat on site / potential to occur
Lachenalia polypodantha	Rare	Sandy areas in Namaqualand Broken Veld. A naturally rare dwarf species known for a long time from only two collections made near Springbok in Namaqualand. The species was later also discovered near Vioolsdrif further to the north. *Suitable habitat is present within all three corridors, and therefore a likelihood of occurrence.*
Monechma saxatile	Rare	South facing slopes of rocky gneiss hills in the Pofadder area. Range restricted endemic. *Suitable habitat is present within all three corridors, and therefore a likelihood of occurrence.*
Schwantesia pillansii	Rare	Bushmanland, Namies Mountain. Bushmanland Inselberg Shrubland, well-drained, sandy soil, mostly in crevices of quartzite, steep slope 1000m. A range restricted endemic. *Suitable habitat on inselbergs within the study area. However, only route alternative 3 will traverse such habitat directly.*
Tylecodon sulphureus var. *armianus*	Rare	Orange River Valley in Northern Bushmanland, Dabenorisberg to Pellaberg. Steep, often sheer, north-facing quartz cliffs, shaded for most of the day. 700-1100 m. A range restricted endemic. *Unlikely to occur as the known locality is not traversed by either of the corridors, however, similar habitat is present in the corridors north of Pofadder*
Vachelia (Acacia) erioloba	**Declining (recently reclassified to Least Concern, nationally)**	**Widespread in the drier areas of the northern provinces of South Africa, deep sandy soils and drainage lines** ***Confirmed to occur within deep sand along drainage areas – mostly recorded within route alternative 3.***
Dinteranthus vanzylii	Data deficient (Taxonomic problems)	*Endemic to the study area and highly likely to occur in gravel and quartz patches.*
Drosanthemum godmaniae	Data deficient (Taxonomic problems)	Inselberg vegetation and quartz patches. *Suitable habitat on inselbergs within the study area and therefore a likelihood to occur.*
Trichodiadema obliquum	Data deficient (Taxonomic problems)	Bushmanland Inselberg vegetation. *Suitable habitat on inselbergs within the study area. However, only route alternative 3 will traverse such habitat directly.*
Wahlenbergia divergens	Data deficient (Taxonomic problems)	Unknown
Hoodia gordonii	**Data deficient (insufficient information)**	**Occurs in a wide variety of arid habitats from coastal to mountainous, also on gentle to steep shale ridges, found from dry, rocky places to sandy spots in riverbeds.** ***Was recorded in sandy and gravelly grassland south of the Paulputs substation as well as within a quartz patch investigated.***

Specie	Conservation status	Suitable habitat on site / potential to occur
Avonia recurvata subsp. *minuta*	Data deficient (Taxonomic problems)	Bushmanland arid grassland. Known only from the type collection at one site in Bushmanland. Not enough is known about the distribution, specific habitat or population status of this subspecies to assess it. *Suitable habitat is present within all three corridors, and therefore a likelihood of occurrence.*
Phyllopodium maxii	Data deficient (Taxonomic problems)	*Suitable habitat on inselbergs within the study area. However, only route alternative 3 will traverse such habitat directly.*
Ruschia aggregata	Data deficient (Taxonomic problems)	Unknown

4.4 Protected plants

4.4.1 NEMBA Threatened or Protected Plant Species (TOPS)

Chapter 4, Part 2 of the National Environmental Management: Biodiversity Act (No. 10 of 2004), (NEMBA) provides for listing of plant and animal species as threatened or protected. If a species is listed as threatened, it must be further classified as Critically Endangered, Endangered or Vulnerable. These species are commonly referred to as TOPS listed. The Act defines these classes as follows:

- Critically endangered species: any indigenous species facing an extremely high risk of extinction in the wild in the immediate future.
- Endangered species: any indigenous species facing a high risk of extinction in the wild in the near future, although it is not a critically endangered species.
- Vulnerable species: any indigenous species facing an extremely high risk of extinction in the wild in the medium-term future; although it is not a critically endangered species or an endangered species.
- Protected species: any species which is of such high conservation value or national importance that it requires national protection. Species listed in this category will include, among others, species listed in terms of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

Certain activities, known as 'Restricted Activities', are regulated on listed species using permits by a special set of regulations published under the Act. Restricted activities regulated under the act are keeping, moving, having in possession, importing and exporting, and selling. The first list of threatened and protected species published under NEMBA was published in the government gazette on the 23rd of February 2007 along with the Regulations on Threatened or Protected Species.

Hoodia gordonii, observed within the study area, are listed as Protected in TOPS.

4.4.2 Protected Trees

A number of trees indigenous to South Africa are nationally protected under the National Forests Act, 1998 (Act No 84 of 1998). The removal or pruning of these protected trees will require a permit from the Department of Agriculture Forestry and Fisheries. Two of these species were confirmed to occur namely *Boscia albitrunca* (witgat / sheppard's tree) and *Vachellia (Acacia) erioloba* (camel thorn). *Boscia albitrunca* occurs in semi-desert areas and bushveld, often on termitaria, but is common on sandy to loamy soils and calcrete soils. This species was recorded mainly in the arid, gravelly grassland. *Vachellia erioloba* usually occurs in deep sandy soils or along watercourses in arid areas and was recorded in route alternative 3 corridor, east of Pofadder.

4.4.3 Provincially Protected Plants

Provincially, a number of plants are protected by the Northern Cape Nature Conservation Act No.9 of 2009. The removal or pruning of these plants will require a permit from the Northern Cape Department of Environment and Nature Conservation. Table 4 lists provincially protected species that were confirmed to occur. However, it is thought that during favourable conditions, more protected plant species may be identified to occur along the powerline route alternatives.

Table 4: Some provincially protected species confirmed to occur. It is assumed that more species occur that would be recorded after sufficient rain.

Species	Protection
Aloidendron dichotomum (quiver tree)	specially protected, schedule 1
Anacampseros filamentosa	All *Anacampseros* species, schedule 2
Boscia albitrunca and *B foetida*	All *Boscia* species, schedule 2
Crassula columnaris and *C.muscosa*	The whole Crassulaceae family, schedule 2
Euphorbia gariepina subsp *gariepina, E. gregaria, E. mauritanica* and *E.spinea*	The whole Euphorbiaceae family, schedule 2

4.5 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 are 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 National Environmental Management: Biodiversity Act (NEMBA) is the most recent legislation pertaining to alien invasive plant species. In August 2014 the list of Alien Invasive Species was published in terms of the National Environmental Management: Biodiversity Act (Act 10 of 2004) (Government Gazette No 78 of 2014). The Alien and Invasive Species Regulations were published in the Government Gazette No. 37886, 1 August 2014. The legislation calls for the removal and / or control of alien invasive

plant species (Category 1 species). In addition, unless authorised thereto in terms of the National Water Act, 1998 (Act No. 36 of 1998), no land user shall allow Category 2 plants to occur within 30 meters of the 1:50 year flood line of a river, stream, spring, natural channel in which water flows regularly or intermittently, lake, dam or wetland. Category 3 plants are also prohibited from occurring within close proximity to a watercourse.

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.

Invasion by alien plant species in the study area was low, with *Prosopis glandulosa* the most common in drainage lines. Species identified in the study are listed in Table 5 below. Note that according to the regulations, a person who has under his or her control a category 1b listed invasive species must immediately:

(a) notify the competent authority in writing

(b) take steps to manage the listed invasive species in compliance with

(i) section 75 of the Act;

(ii) the relevant invasive species management programme developed in terms of regulation 4; and

(iii) any directive issued in terms of section 73(3) of the Act.

Table 5: Alien invasive plant species identified within the corridors

Species	Common name	Category
Atriplex lindleyi subsp *inflata (A. inflata)*	Australian Saltbush	Category 1b
Atriplex nummularia	Old Man Salt Bush	Category 2 (NEMBA). Can replace indigenous vegetation
Prosopis glandulosa	Honey Mesquite	Category 3 in Northern Cape
Tamarix chinensis	Tamarisk	Category 1 and 1b invader of riparian areas, especially in dry Northern Cape

5 VEGETATION VULNERABILITY AND IMPORTANCE

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.

5.1 Rating and Analysis of Vegetation Importance

To determine the vegetation condition and importance along the proposed route alternatives, weighting scores as listed below (Table 6) were applied. Vegetation of conservation importance were classified based on the findings of the study and the criteria as listed above and in Appendix A. The sensitivity analysis results were classified as per Table 7, geographically represented in Figure 13 and discussed below.

Table 6: Weighting scores

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

Table 7: Scoring of vegetation that occur within the study area

Broad vegetation community	Conservation Status of regional Vegetation	Predominant state	Reversibility of degradation	Plants of conservation concern	Ecological Function	Conservation Importance / unique habitat	Total Score out of max of 18	Importance and vulnerability
Sandy grassland and desert plains	0	3	1	2	3	2	**11**	**medium**
Arid gravelly grassland, including calcrete areas	0	3	1	2	3	2	**11**	**medium**
Gravel (also calcrete) and quartz patches	0	2	3	3	3	3	**14**	**high**
Rocky desert and outcrops	0	3	2	2	2	3	**12**	**medium high**
Inselberg vegetation	1	3	3	3	3	3	**16**	**high**
Vegetation associated with waterbodies– areas with a high potential for erosion	0	2	2	2	3	2	**11**	**medium**

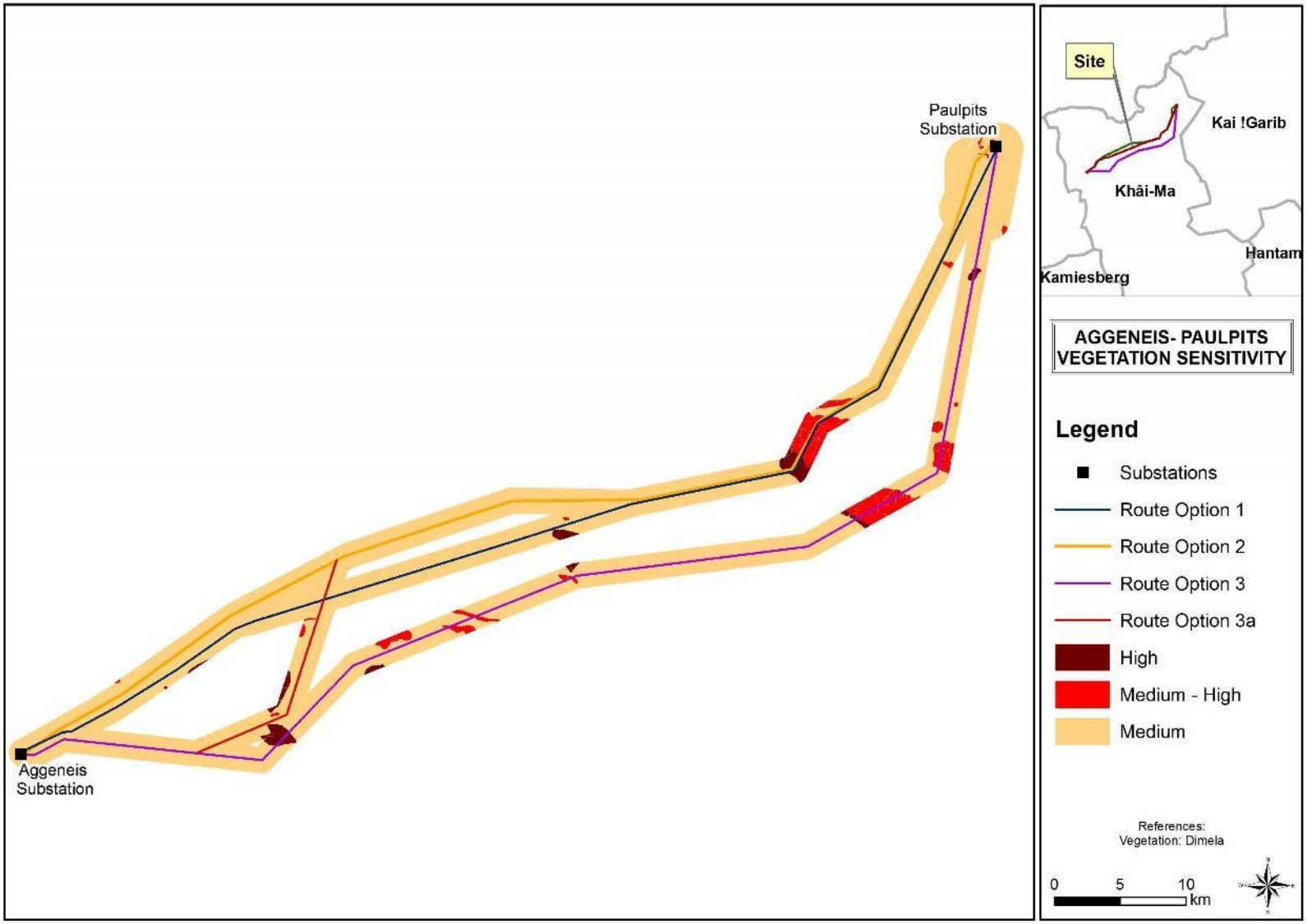


Figure 13: Vegetation sensitivity map

5.2 Discussion of Vegetation Vulnerability and Importance within the Corridors

5.2.1 Vegetation of high importance and vulnerability

Inselberg vegetation as well as those inhabiting gravel and quartz patches are regarded as vulnerable to any impacts and are also classified as CBA 1's in the Namakwa Biodiversity Sector Plan. These habitats provide suitable habitat for threatened, protected species and habitat restricted species. These plants could be very cryptic and small and can usually only be positively identified in the growing season. These plants are also restricted in their distribution (endemic). Inselbergs and quartz patches are important topographical features that usually support higher species diversity and are considered valuable features in the natural landscape that have the potential to support a large number of protected plant species. In addition, the vegetation observed here were in a natural state with disturbances noted only where the existing 400kV line traverse quartz veld. Quartz patches in particular does not recover after disturbances and are difficult if not impossible to rehabilitate. It is thus recommended that these areas be avoided or spanned.

Only alternative corridor 3 traverse inselberg vegetation and are therefore not a preferred route alternative. Alternative 1 and 2 runs parallel to an existing powerline through the quartz veld and if the existing disturbed footprint can be utilised for much of the construction, these routes are preferable.

5.2.2 Vegetation of medium-high importance and vulnerability

Rocky outcrops and mountainous areas are also important topographical features that could support higher species diversity due to the different aspects. In addition, the vegetation observed here were in a natural state with limited disturbances and falls within CBA 2's of the Namakwa Biodiversity Sector Plan. Although the potential occurrence of threatened species is low, the vegetation is unique and not easily rehabilitated.

All three corridors will traverse these habitats, however, route alternative 3 corridor include more free-standing outcrops, whereas the existing powerline through the mountains north of Pofadder disturbance footprint could be utilised for the construction of the line if route alternative 1 or 2 is selected.

5.2.3 Vegetation of medium importance and vulnerability

The majority of the vegetation along the route falls within the sandy and arid, gravelly grassland. The grasslands have intermediate to high levels of species diversity and likely include potential habitat for limited number of threatened species. The grasslands occur over a vast area and are not considered vulnerable to impacts from the powerline. However, cumulative impacts such as the increase in solar plants in the area, could pose a threat to these habitats in the long term. Within the grasslands, particularly the gravelly grassland, calcrete and quartz patches are found and are localised sensitivities that must be investigated during a walk-down.

Drainage lines are protected environments as all watercourses are protected by legislation and impacts on these areas as well as a regulated buffer zone should be avoided. Activities within and in proximity to watercourses (Regulation 1199 of the National Water Act, 1998 (Act 36 of 1998) are subjected to strict mitigation measures and authorisation from the competent authority in order to protect and sustainably utilise South Africa's water resources. Seasonal drainage lines should be valued as potential recharge zones or as discharge zones that sustain vegetation in a lusher state during dry seasons and extended dry periods (Esler *et al,* 2006). Any activities that lead to increased erosion and deterioration of the riparian areas can reduce the riparian areas potential to recharge groundwater (Esler *et al,* 2006).

All three proposed corridors will traverse vegetation of medium importance to a more-or-less equal extent.

6 ROUTE PREFERENCE

The proposed powerline corridors will impact on much of the same broad vegetation communities. All three proposed corridors will traverse vegetation of medium importance to a more-or-less equal extent. Only alternative corridor 3 traverse inselberg vegetation of a high conservation importance and are therefore not a preferred route alternative. The corridor of deviation 3A also include inselberg vegetation. Alternative 1 and 2 runs parallel to an existing powerline through the important quartz veld and if the existing disturbed footprint can be utilised for much of the construction, these routes are preferable. All three corridors will traverse rocky, mountainous areas, however, route alternative 3 corridor include more free-standing outcrops, whereas the existing powerline through the mountains north of Pofadder disturbance footprint could be utilised for the construction of the line if route alternative 1 or 2 is selected, whereas route alternative 1 aligns with an existing powerline, and thus servitude and access roads, for its entire extent.

The CBAs of the Namakwa Biodiversity Sector Plan was merged with the high vulnerability and importance vegetation of this assessment (Figure 14). The resulting area of the highest sensitivities, including the CBA's and vegetation of high and medium to high vulnerability and importance were calculated per route alternative corridor (Table 8). From the table it is clear that deviation 3A will traverse the largest section of High sensitivity, followed by Corridor 3. In total Corridor 3 traverse the largest area of high and medium to high sensitivities.

Table 8: Composite of CBA layer and result of this assessment

Composite Sensitivity	Corridor 1 (Ha)	Corridor 2 (Ha)	Corridor 3 (Ha)	Deviation 3A
High	4 354.52	3 621.79	4390.86	6 157.62
Medium - High	271.39	227.02	15 255.80	231.30
Total ha of high and med to high	**4 625.91**	**3 848.81**	**19 646.66**	**6 388.92**

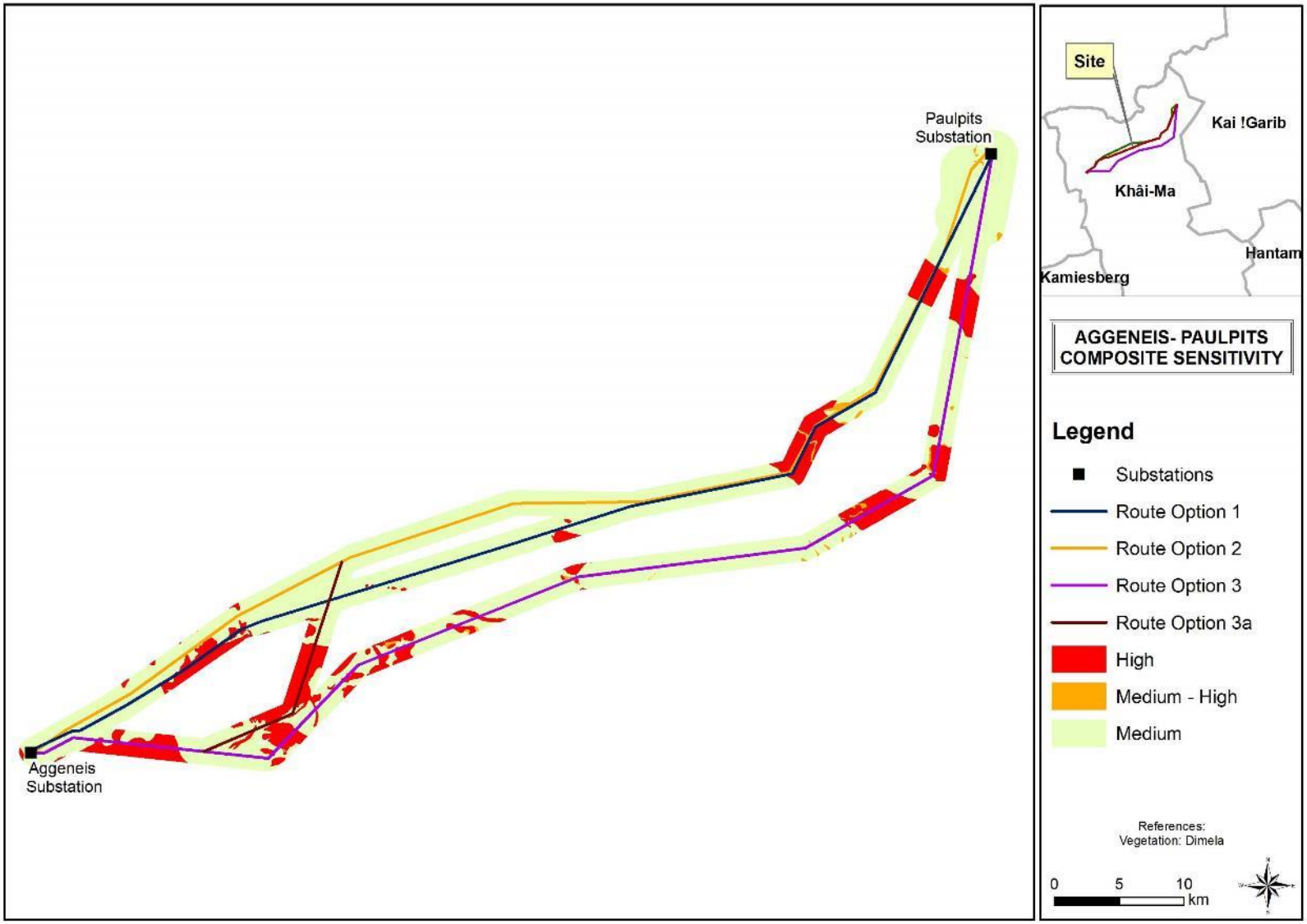


Figure 14: Composite vegetation map, including T1 and T2 CBA's classified as high sensitivity

Route alternative corridor 2 traverses the smallest area of high and medium to high sensitivity, followed by alternative corridor 1.

From Table 8 it is deduced that route alternative corridor 2 will likely have the least impact on vegetation of concern and is the preferred route, particularly as existing servitudes roads through sensitive areas can be utilised. However, route alternative corridor 1 also aligns with an existing powerline route for much of its extent and if existing infrastructure can be utilised, this route is also preferred.

7 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.

Fragmentation manifests when ecosystems are divided or separated by development. The more fragmentation, the smaller the patch or natural habitat and the greater the edge effects on such a habitat or ecosystem. Edges seldom contain species that are rare, habitat specialists or species that require larger tracts of undisturbed core habitat. Fragmentation reduces core habitat and increases edge habitat, which causes a shift in the species composition, which in turn puts great pressure on the dynamics and functionality of ecosystems (Perlman & Milder 2005). Therefore, if developments can be concentrated, rather than spread out, impacts can be reduced. Thus, new power lines should follow routes of existing servitudes if such exist, and if several developments are planned within close proximity, these developments should be situated as close together as possible, not scattered throughout the landscape or built adjacent to more sensitive habitats.

7.1 Impact statement

The most significant impact of electrical powerlines are expected to occur during the construction phase. Once in use, the powerlines have relatively contained impacts on the vegetation and can successfully be mitigated to limit or even negate the negative impacts. In the areas assessed, the greatest threat is the erodibility of sands on slopes and in proximity to drainage lines, as well as the passage of heavy machinery, vehicles and pedestrian traffic in areas where the vegetation is of high conservation importance and vulnerable to such disturbances e.g. quartzite patches and rocky outcrops and slopes.

While the excavation of soil for the base of pylons would remove vegetation, the vegetation could be replanted after the construction and its re-establishment monitored to ensure that the soil and vegetation rehabilitated. The greatest threat to the rehabilitation of the land disturbed by construction, is the potential of invasive plant species rapidly establishing on the disturbed soil and spreading into adjacent natural areas. If remedial measures and monitoring is properly implemented, most of the vegetation that will be disturbed during construction could rehabilitate well over time, and long term impacts on vegetation could thus be minimal.

Furthermore, the presence of proximate access roads and dirt roads as well as the presence of several smaller tracks and other servitudes in the area, will greatly reduce the impacts of the proposed development. Another way impacts can be reduced is if proposed developments are planned to be aligned as much as possible to existing servitudes and roads/tracks, whilst where feasible, power lines of the new projects be aligned to combined servitudes as much as possible.

7.2 Impact Assessment Criteria

The possible impacts, as described in the next section, were assessed based on the Significance Rating Matrix in Tables 9 and 10 below. Details of the assessment are given in Appendix A.

Table 9: Significance rating matrix

RANKING	MAGNITUDE	REVERSIBILITY	EXTENT	DURATION	PROBABILITY
5	Very high/ don't know	Irreversible	International	Permanent	Certain/inevitable
4	High	Partial Reversibility with major human intervention	National	Long term (impact ceases after operational life of asset	Almost certain
3	Moderate	Partial Reversibility with moderate human intervention	Provincial	Medium term	Can occur
2	Low	Completely reversible with major human intervention	Local	Short term	Unusual but possible
1	Minor	Completely reversible with little human intervention	Site bound	Immediate	Extremely unlikely
0	None		None		None

The Significance of the impact is calculated as follows

Significance = Consequence *(Magnitude+ Duration+ Extent + Reversibility)* **X Probability**

Table 10: Description of significance rating

RANKING	65-100	64-36*	35-16*	15-5	1-4
SIGNIFICANCE	Very High	High	Moderate	Low	Minor

* The score of 36 was regarded as medium-high and 16 was regarded as medium-low

7.3 Assumptions

The following is assumed

- Existing access roads and tracks will be used as much as possible and upgraded where applicable, whilst new access roads, servitudes, or power lines will coincide as far as possible with existing infrastructure (e.g. follow fence lines or existing power line servitudes). Access roads will be suitably reinforced and maintained, but not covered with tar or concrete.
- A thorough ecological investigation of all footprint areas will be conducted to detect and relocate all plant species of conservation concern by a suitably qualified botanist prior to commencement of activity.
    - Such investigation must be carried out at a time when the maximum amount of species are actively growing and thus visible.
    - Such survey should also note as far as possible the presence of burrowing fauna
    - Results of this investigation must be made available to the contractor and the EO/ECO and be incorporated into the construction EMPr.
- Prior to development, after construction and up to decommissioning the footprint area will be routinely cleared of all alien invasive plants as well as indigenous invasive high shrubs
- The construction phase itself will be associated with localised clearing of vegetation as needed on the footprint area.
- All removal of vegetation for construction purposes will be done manually or mechanically, with the use of herbicides *only* where other options will not be successful and in such case with the approval of the relevant Agricultural and Conservation Departments

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7.4 Impact Assessments

Table 11 and 12 list the activities that could impact on the vegetation as a result of the construction of the 400kV line (Table 11), as well as impacts that may be associated with the operation and maintenance thereof (Table 12). The impacts are also assessed in the tables below and suitable mitigation measures are given in Section 7.5.

7.5 Impacts Assessment

Scoring Without Mitigation = (number)
Scoring With Mitigation = (number)

Table 11: Impact assessment for the construction of the proposed powerline

Impact	Source	Magnitude	Reversibility	Extent	Duration	Probability of occurrence	Ranking	Significance	
								Without mitigation	With mitigation
1. Clearing of vegetation of medium to high and high importance and vulnerability will occur. The aim is to limit the footprint and prevent deterioration	• Clearing of and damage to vegetation in construction footprint for or by -substation expansion -towers -access roads -construction camps - vehicle / machinery traffic (crushing small and cryptic plants) - pedestrian traffic (stepping on small plants) • Illegal disposal and dumping of construction material such as cement or oil as well as maintenance materials during construction;	High (4) Moderate (3)	Partial (4) Partial by natural agents (3)	Local (2) Local (2)	Long term (3) Moderate term (2)	Highly probable (4) Can occur (3)	52 30	High	Moderate

Impact	Source	Magnitude	Reversibility	Extent	Duration	Probability of occurrence	Ranking	Significance	
								Without mitigation	With mitigation
	• Edge effects e.g. heavy vehicles turning in adjacent areas; and • Storage of pylon structures within vegetation								
2. Exposure of the soil to erosion	• Removal of vegetation without proper rehabilitation or failure of rehabilitation • Destruction of intact soil crusts • Access roads, especially on slopes, channels rainfall and causes erosion	High (4) Low (2)	Partially reversible (4) Partially reversible (4)	Local (2) Local (2)	Long term (4) Medium term (3)	Can occur (3) Unusual but still possible (2)	42 22	High	Moderate
3. Destruction of plants of conservation concern, protected and endemic species	• Construction activity where these plants potentially occur, e.g. quartz patches	Very high (5) Medium (3) **Only if plants can be relocated or Low (2) completely avoided**	Irreversible (5) **None (destruction must be avoided, thus nothing to reverse) (0)**	National (4) None (0) Only if these pants are completely avoided	Perm (5) Short term (1)	Almost certain (4) Can still occur (3) e.g. a rescue and rehabilita-tion plan is implemented but some	76 12	Very high	Low

Impact	Source	Magnitude	Reversibility	Extent	Duration	Probability of occurrence	Ranking	Significance	
								Without mitigation	With mitigation
						species are overlooked			
4. Spread of alien invasive vegetation	• Contaminated construction vehicles and tools; and • Alien invasive species spread from current infestation into disturbed soils	Low (2) Low (2)	Reversible with human intervention (3) Reversible with human intervention (3)	Provincial (3) Site (1)	Short term (2) Short term (2)	Can occur (3) Unusual but can occur (2)	30 16	Moderate	Moderate to low
5. Disturbance to drainage lines	• Construction activities within the buffer areas • Linear development such as access roads through the non-perennial rivers	Moderate (3) Low (2)	Reversible with human intervention (3) (3)	Local (2) Local (2)	Medium term (3) Short term (2)	Can occur (3) Unusual but can occur (2)	33 18	Moderate	Moderate to low
6. Soil compaction / disruption of quartz fields / gravel areas	• The movement of heavy machinery will result in soil compaction and disruption of gravel areas that will modify habitats, destroy vegetation and inhibit re-vegetation.	High (4) Low -only if quartz/gravel areas are avoided or spanned (2)	Irreversible (5) Reversible (3)	Local (2) Local (2)	Long term (4) Short term (2)	Almost certain (4) Can still occur (2)	60 18	High	Moderate

Table 12: Assessment of impacts associated with the operational phase of the proposed powerline

Impact	Source	Magnitude	Reversibility	Extent	Duration	Probability of occurrence	Ranking	Significance	
								Without mitigation	With mitigation
7. Erosion and bare soils	• Lack of rehabilitation or failed rehabilitation • Maintenance vehicles disturbing rehabilitated areas	High **(4)** Low **(2)**	Reversible with human action **(3)** Reversible with human action (3)	Local **(2)** Local **(2)**	Long term **(3)** Short term (2)	Can occur **(3)** Unusual but can occur (2)	**36** **18**	**High**	**Moderate to low**
8. Destruction of natural vegetation	• Maintenance vehicles driving within natural vegetation / quartz fields	High **(4)** Low **(2)**	Irreversible **(4)** Reversible with human action (3)	National **(4)** Local **(2)**	Long term **(3)** Short term (2)	Can occur **(3)** Unusual but can occur (2)	**45** **18**	**High**	**Moderate to low**
9. Possible invasion by exotic vegetation	• Alien vegetation spreading into disturbed soil, especially in the absence of successful rehabilitation	Moderate **(3)** Low **(2)**	Reversible with human intervention **(3)** **(3)**	Local **(3)** Site (2)	Short term **(2)** Short term (2)	Can occur **(3)** Unusual but can occur (2)	36 18	**High**	**Moderate to low**

7.6 Mitigation Measures

A. Construction Phase

7.6.1 Destruction of natural vegetation

The construction of the powerline would inevitably require the removal / destruction of vegetation for the purpose of access, and the tower footprint. This is of particular importance in the vegetation classified as being of medium to high and high vulnerability and importance. Areas where pylons components and equipment are stored could 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. Heavy vehicles and machinery will crush succulents, so too will trampling by workers.

Mitigation measures

- The route alternative 2, which will impact on a smaller area of vulnerable and important vegetation must be constructed. This route can also utilise existing access roads and servitudes, thereby limiting fragmentation. Route alternative 1 could also be considered due to the presence of existing servitudes and access roads, if the section west of the Gamsberg could move further west or align within alternative corridor 2.
- A walk down should be undertaken within the growing period of plant species in the area and after good rains, prior to commencement of construction. The walk down should focus on identifying localised sensitivities and protected plant species that must be avoided (*in situ* conservation is preferred) or relocated. The walk down should also identify sensitive habitats such as quartz patches with a high diversity and threated, endemic or protected species that should be circumvented.
- The final route alignment should thus be flexible within the corridor to avoid sensitivities as identified during the walk-down.
- An independent Ecological Control Officer (ECO) should be appointed to oversee construction.
- A protective 200m buffer from any vulnerable and important vegetation should be respected, and include features such as quartz patches and rocky outcrops.
- Limit clearing of indigenous vegetation to pylon positions only.
- Aim to minimise the destruction of indigenous large trees.
- Wood may not be sold as firewood.
- During construction: create designated servitude areas and strictly prohibit any off-road driving or parking of vehicles and machinery outside designated areas.
- Restrict the impact on vegetation: 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 and adjacent environs.
- Prohibit vehicular or pedestrian access into natural areas beyond the demarcated boundary of the construction area.

- Formalise access roads and make use of existing roads and tracks where feasible, rather than creating new routes through naturally vegetated areas.
- Maintain as much vegetation cover as possible.
- A vegetation rehabilitation plan should be implemented. Due to the dry climate, natural colonisation will take a long time, in which vegetation may degrade further. In addition, relying on the seed bank in the soil will be bias towards short lived annuals instead of long-lived, succulent perennials. Therefore, these species should be included in rehabilitation, preferably collected from the site prior to disturbances (note that the removal of plants will require authorisation (permit) from the provincial conservation authorities). A diversity of plant species, resembling the composition prior to disturbance should be attained during rehabilitation. Timeous rehabilitation is imperative. Even in the event of good rains, annual pioneer plants are short-lived and therefore an effort must be made to keep as many shrubs in place as possible or to replace these as part of rehabilitation. As a start, runoff water needs to be trapped by either the mechanical breaking of the soil surface to trap water, packing of stones, tyres or brush along contours to trap mulch, slow down water movement and reduce the impact on bare soil (Esler, *et al,* 2006). Pitter basins work well on fine textured soil and must be orientated and shaped to face upslope. The basins trap seeds, organic matter and water which could lead to rapid colonisation after rains (Esler, *et al,* 2006). Locally collected seeds of *Stipagrostis* grass and *Salsola* species could be used to hasten establishment.
- 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.
- Ideally, an on-site ecologist should be present when excavation takes place to ensure that any uncovered species are protected from destruction. Note that threated, endemic and some protected species are cryptic and could be dormant until favourable climatic conditions arise.
- It is advised that environmental audits be undertaken by an independent party during this construction period, especially in sensitive areas.

7.6.2 Exposure to erosion

Much of the soils comprise sand and are prone to erosion. The removal or destruction of surface vegetation will expose the soils, which in the event of rain could cause erosion. In addition, indigenous vegetation communities are unlikely to colonise eroded soils successfully.

Mitigation measures

- Do not allow erosion to develop before taking action.
- Make use of existing roads and tracks where feasible, rather than creating new routes through naturally vegetated areas.
- Retain vegetation and soil in position for as long as possible, removing it (preferably with intact plants) immediately ahead of construction / earthworks in that area (DWAF, 2005).

Rehabilitation should take place continuously, as a section of line is completed. Rehabilitation should be undertaken in accordance to an approved rehabilitation plan, specific to the area.

- 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.
- Runoff water needs to be trapped by either the mechanical breaking of the soil surface to trap water, packing of stones, tyres or brush along contours to trap mulch, slow down water movement and reduce the impact on bare soil (Esler *et al,* 2006). Pitter basins work well on fine textured soil and must be orientated and shaped to face upslope. The basins trap seeds, organic matter and water which could lead to rapid colonisation after rains (Esler, *et al,* 2006). Locally collected seeds of *Stipagrostis* grass and *Salsola* species could be used to hasten establishment.
- Mulch and brush also reduces the force of raindrops, limiting the dispersion of clay and the extent of mineral crusting (Esler *et al,* 2006). It also traps dust, sand and seeds to ensure plant establishment (Esler *et al,* 2006).
- 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.
- Shred all woody material cleared and use the chips as mulch for dust and erosion control.
- Where topsoils need to be removed, store such in a separate area where such soils can be protected until they can be re-used for post-construction rehabilitation (never mix topsoils with subsoils or other spoil materials).

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

The construction could result in the removal or irreversible deterioration of plant species of conservation concern, impact on their habitat, pollinators and inevitably the persistence of these. This could put further strain on the already declining or scare and range restricted populations.

Mitigation measure

- A suitably qualified person (botanist) must survey the final route during a walk down and specifically the proposed tower positions. The walk down must be undertaken during the growing season of the plants in order to identify endemic, threatened and protected plants that will be impacted on by the proposed construction. This must take place prior to the finalisation of tower positions and the commencement of construction.
- Where possible, construction activities must be restricted to previously disturbed areas.
- Slight deviations of access tower positions must be permitted, so as to avoid plant populations of conservation concern (DWAF, 2005).
- Implement a Plant Rescue and Rehabilitation Plan: Where the plants of conservation concern are deemed to be under threat from the construction activity and the impact cannot be avoided, 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). These plants could also be relocated to other suitable and conserved habitats.

- Ideally, an on-site ecologist should be present when excavation takes place to ensure that any species not identified during the EIA phase, or the final walk down are protected from destruction. Note that the species could be dormant for some time until favourable conditions arise.
- The Eskom staff, contractor and construction crew must be educated about the sensitivities involved along the route as well as the potential sensitive species they could encounter.
- 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 (e.g. quartz patches) that house the protected plant species and the plants of conservation concern and protect from construction activities and vehicles.
- Protected tree species should rather be pruned instead of removed. For removal or pruning, a permit must be obtained from the North West Department of Agriculture, Forestry and Fisheries (DAFF).
- A permit for the removal or relocation of plant species of conservation concern must be obtained from the Northern Cape

7.6.4 Potential increase in invasive vegetation

Limited alien invasive plant species were observed at the time of the field survey. However, some annuals may be present, but were dormant at the time. The seed of alien invasive plant species could spread into the disturbed soils. 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

- 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.

7.6.5 Disturbance to drainage lines

Removal of vegetation surrounding, drainage lines could soil conditions. In addition, all watercourses (including non-perennial rivers and pans) in South Africa are protected by legislation and must be classified as no-go areas along with protective buffer zones. Note that any activities within the watercourses are subject to authorisation by the Department of Water Affairs (DWA) by means of a Water Use License.

Mitigation Measures

- Avoid placing pylons within 32 m of active riverbank or riparian area where feasible
- The powerlines should span the drainage lines and rivers. Where it is unavoidable to place the tower footprint within a recommended minimum protective buffer zones, the construction activities must be restricted to as small a footprint possible and rehabilitation undertaken as soon as construction is complete.
- No construction / activities can be undertaken within the riparian area unless a Water Use License was granted by the Department of Water Affairs.
- Where access through drainage lines and rivers is unavoidable, only one road is permitted, constructed perpendicular to the drainage line. Avoid roads that follow drainage lines within the floodplain.
- Roads should be elevated above the non-perennial rivers so as to minimise the destruction of the drainage bed.
- Roads and tracks should not cause erosion within these systems.
- After construction, compacted soil access roads should be rip, mechanically break the surface to increase water infiltration.
- Construction should take place outside of the rainy season when the flow of the non-perennial rivers is at a minimum.
- Do not permit vehicular or pedestrian access into natural areas beyond the demarcated boundary of the construction area.
- It is advised that environmental audits be undertaken by an independent party during this construction period, especially in sensitive areas.

7.6.6 Soil compaction, disruption of quartz fields / gravel / calcrete areas

The movement of heavy machinery will result in soil compaction that will modify habitats, destroy vegetation, sterilise quartz and inhibit re-vegetation. Soil compaction as a result of construction vehicles and traffic, could lead to a decrease of water infiltration and an increase of water runoff.

Mitigation measures:

- Construction and stringing (and maintenance) vehicles may not veer from the dedicated roads.
- Sensitive ecological features such as the quartz and gravel patches, rocky areas and drainage lines should be cordoned off and no activities be allowed to impact on these.
- Once construction is complete, obsolete roads should be obliterated by breaking the surface crust and erecting earth embankments to prevent erosion, while vegetation should be re-established. This should be done in accordance with a vegetation rehabilitation plan written by an expert on rehabilitation in these areas.

B. Operational Phase

7.6.7 Erosion and bare soils

Lack of rehabilitation or failed rehabilitation after construction, can result in erosion after construction was completed. The vegetation occurring along the bypass route could degrade over time if suitable rehabilitation of the disturbed soils did not take place. In addition, maintenance vehicles could disturb rehabilitated areas 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

- Leave as much natural vegetation as intact as possible during construction.
- Do not disturbed soil unnecessary during maintenance.
- 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.
- Monitor rehabilitation and ensure that alien invasive species are dealt with in accordance to the EMP.
- 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.
- Monitor rehabilitation and delay the re-introduction of livestock (where applicable) to all rehabilitated 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.

7.6.8 Destruction of natural vegetation

During the operational phase, maintenance vehicles could impact on rehabilitated and natural vegetation e.g. maintenance vehicles driving within natural vegetation / quartz fields.

Mitigation measures

- 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.
- Maintenance vehicles must not veer from dedicated access roads and activities should be restricted to the previously disturbed footprint.
- To prevent the necessity for random vehicle deviations from existing tracks into surrounding veld, ensure that all maintenance tracks are routinely cleared of shrubs and alien invasive species and ensure that maintenance tracks are in good condition.

- It is advised that environmental audits be undertaken by an independent party during the operational period, especially in sensitive areas.

7.6.9 Possible increase in exotic vegetation

If rehabilitation of the indigenous vegetation along the bypass route is unsuccessful or is not enforced, exotic and invasive vegetation may invade the area.

Mitigation measures

- Implement an alien invasive plant monitoring and management plan whereby the spread of alien and invasive plant species into the areas disturbed by the construction are regularly removed and re-infestation monitored.

8 CONCLUSION

The proposed powerline corridors will impact on much of the same broad vegetation communities. All three proposed corridors will traverse vegetation of medium importance to a more-or-less equal extent. Only alternative corridor 3 and deviation 3A traverse inselberg vegetation of a high conservation importance and are therefore not preferred route alternatives. Alternative 1 and 2 runs parallel to an existing powerline through the important quartz veld and if the existing disturbed footprint can be utilised for much of the construction, these routes are preferable.

Alternative route 1 and 2 are similar in route alignment and vegetation associations traversed. However, route alternative 1 is situated parallel and within 100m of an existing 400kV powerline for most of its extent, except around the Gamsberg. Existing servitudes and access roads could therefore be used, limiting the clearing of natural vegetation. In its southern extent, prior to reaching Aggeneis substation, alternative corridor 1 passes closer to the Gamsberg and its associated sensitivities, which increases its potential impact on vegetation of concern. Therefore alternative corridor 2 traverses less areas of sensitivity and are the preferred route. Route alternative corridor 1 could also be considered if the section west of the Gamsberg is moved further west, or linked with the alternative corridor 2 for that section.

The unfavourable climate at the time of the assessment and limited access to the entire proposed footprint areas, means a pre-construction walkthrough survey is imperative and should be conducted between March – May, depending on rainfall. This must take place prior to commencement of activity to ensure that all protected, threatened and endemic species are marked to enable avoidance and/or rescue. The walk down should also identify local sensitivities such as quartz patches that should be spanned in order to conserve the habitat and species *in situ*.

In conclusion, the proposed development(s) could proceed provided that the mitigation measures a set out in this report are implemented as a minimum to limit the potential impacts on vegetation during construction and operation of the developments.

9 REFERENCES

Bathusi Environmental Consultants, (2010): Strategic Biodiversity Basic Assessment for the proposed 220kV Transmission Line between Aggeneys Substation & Paulputs Substation, Northern Cape. December 2010. Report drafted for Client: SSI Engineers and Environmental Consultants. BEC Project number: SSI - APL – 2011/12. Compiled by: Riaan A. J. Robbeson (Pr.Sci.Nat.), Bathusi Environmental Consulting

Bromilow, C, (2010): Problem Plants of Southern Africa. Third edition, first impression Briza Publications, Pretoria.

Court, D. (2010): Succulent Flora of Southern Africa, Third (revised) edition. Random House Struik. Cape Town.

DEAT & SANBI, (2008): National Protected Area Expansion Strategy for South Africa. Priorities for Expanding the Protected Area Network for Ecological Sustainability and Climate Change Resilience DRAFT FOR MINTECH. September 2008

Department of Environmental Affairs & South African National Biodiversity Institute (2009): National Protected Area Expansion Strategy Resource Document.

Department of Water Affairs and Forestry (2005): Environmental Best Practice Specifications: Construction for Construction Sites, Infrastructure Upgrades and Maintenance Works. Version 3

Desmet, P. and Marsh, A, (2008): Namakwa District Biodiversity Sector Plan. Available from BGIS http://bgis.sanbi.org/namakwa/project.asp

Desmet, P., (2013): Gamsberg Zinc Project Vegetation Baseline and Impact Assessment Report. Draft 5. Produced for ERM Southern Africa. April, 2013

Esler, K.j., Milton, S.J. and Dean W.R.J, (2006): Karoo Veld. Ecology and Management. Briza Publications CK 90/11690/23. Pretoria

Gauteng Department of Agriculture, Conservation, Environment and Landcare (2001): Development guidelines for ridges. Updated April 2006.

Government Gazette No 32689, (2009): Draft National List of Threatened Ecosystems in terms of the National Environmental Management Act, 2004 (Act 10 of 2004). Department of Environmental Affairs Notice 1477 of 2009 in Government Gazette No 32689, 6 November 2009.

Government Gazette No 32689, (2009): Draft National List of Threatened Ecosystems in terms of the National Environmental Management Act, 2004 (Act 10 of 2004). Department of Environmental Affairs Notice 1477 of 2009 in Government Gazette No 32689, 6 November 2009.

Henderson, L., (2001): Alien Weeds and Invasive Plants. A complete guide to declared weeds and invaders in South Africa. Plant Protection Research Institute Handbook No. 12. Agricultural Research Council, South Africa.

Kremen, C. (2005): Managing ecosystem services: what do we need to know about their ecology? Ecology Letters 8: 468-479.

Low, A.B. & Robello, A.G. (1996): Vegetation of South. Africa, Lesotho and Swaziland. Pretoria. Department of Environmental Affairs and Tourism, South Africa

Mucina, L. & Rutherford, M.C. (2006): The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia 19. South African National Biodiversity Institute*, Pretoria.

Mucina, L. & Rutherford, M.C. (2006): The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia 19. South African National Biodiversity Institute*, Pretoria.

Mucina, L., Bredenkamp, G.J., Hoare, D.B. & McDonald, D.J. (2000): A National vegetation database for South Africa. South Africa Journal of Science 96:497-498.

Namakwa District, (2008): Namakwa District Biodiversity Sector Plan 2008

Pachnoda Consulting CC, (2010): The Proposed Paulputs – Aggeneys 200kV Transmission Line. Pofadder, Northern Cape. Report drafted for SSI. December 2010.

Perlman, D.L., and Milder, J.C. (2005): Practical ecology for planners, developers and citizens. Island Press, Washington.

Raimondo, D., von Staden, L., Foden, W., Victor, J.E., Helme, N.A., Turner, R.C., Kamundi, D.A. & Manyama P.A., (eds) (2009): Red List of South African plants 2009. *Strelitzea* 25, South African National Biodiversity Institute.

Raimondo, D., Von Staden, L., Foden, W., Victor, J.E., Helme, N.A., Turner, R.C. Kamundi, D.A. & Manyama, P.A. (Eds.). (2009): Red list of South African plants 2009. Strelitzia 25:1-668.

SANBI, (2009a): Updating National Land Cover. SANBI (South African National Biodiversity Institute), Pretoria 13/10/2009. http://bgis.sanbi.org/landcover/Landcover2009.pdf

SANBI, (2009b): Plants of Southern Africa. POSA version 3. June 2009. http://posa.sanbi.org. (Accessed in September 2016)

SANBI, (2015): Threatened Species Programme. Red List of Southern African Plants. http://redlist.sanbi.org/? (Accessed November 2015).

Simon Todd Consulting, (2012): Suurwater 62, Boesmanland 75mw Solar Farm, Aggeneys. Fauna & Flora Specialist Report for Impact Assessment. Produced For Cape EAPRAC, September 2012.

Van Oudtshoorn, F., (2002): A Guide to Grasses of Southern Africa. Briza Publications,

Van Wyk, B., Van Oudshoorn B., & Gericke N., (2005): Medicinal Plant of South Africa. Briza Publications, Pretoria.

Websites:

BGIS: http://bgis.sanbi.org/website.asp

SANBI databases: http://posa.sanbi.org/searchspp.php

http://SIBIS.sanbi.org

Climate: http://weatheronline.com

https://www.meteoblue.com/en/weather/forecast/modelclimate/pofadder_south-africa_3362755

http://www.weathersa.co.za/images/climate/pdf/CLS-CI-Drought%20Monitoring-2016-09.pdf

10 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
Azonal	Water-logged and salt-laden habitats require specially adapted plants to survive in these habitats. Consequently the vegetation deviates from the typical surrounding zonal vegetation and are considered to be of azonal character (Mucina & Rutherford, 2006)
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	An 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 neighbouring 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

Suffrutex	Low-growing woody shrub or perennial with woody base, sometimes referred to as underground trees
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 Association	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: METHODOLOGIES

Sample point map

Vegetation Sensitivity Evaluation

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. Predominant state or condition of the vegetation

Vegetation condition	Scoring
Primary state	3
Sub-climax state	2
Secondary state	1
No natural vegetation remaining	0

3. Reversibility of degradation, ability to rehabilitate

Ability to rehabilitate	Scoring
Irreversible or very difficult to attain	3
Partially reversible, will require relevant mitigation effort and management, as well as rehabilitation structures e.g. gabions	2
Reversible by active rehabilitation and revegetation	1
Resilient, vegetation can rehabilitate well by natural agents given rehabilitation of landscapes	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 of red listed species (Threatened)	3
Confirmed presence of Orange listed (Near threatened, Declining), 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

Ecological function	Scoring
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

Weighting scores

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

APPENDIX B: PLANT SPECIES LIST

The table below lists the plant species that were observed within the broad vegetation associations sampled at the time of the field survey (September 2016). Note that this list represents the minimum number of species and that finer scale sampling during the growing seasons will result in a more comprehensive species list.

M=plants known to be used medicinally
P=plants protected provincially or nationally protected trees
D= plant indicated to be nationally declining in numbers and thus of conservation concern
DD-data deficient the conservation status of this plant is not fully established
1 = species recorded in this habitat

Species	Common name	Habitat notes	Sandy grassland	Arid gravel grassland	Gravel and quartz	Rocky desert	Inselberg	Drainage lines
Grasses								
Aristida species				1			1	
Cenchrus ciliaris	Foxtail Buffalo Grass	Grows in dry areas and is an excellent grazing grass. However difficult to establish.	1	1		1	1	
Centopodia glauca	Gha Grass	Deep sandy soils, duneveld and gravelly soils. Indicator of good Kalahari-veld when abundant	1	1				1
Cladorahpis spinosa	Spiny Love Grass	Sandy soils	1					
Enneapogon devauxii	Eight Day Grass	Mainly in shallow calcerous soils, abundant in overgrazed veld	1	1				
Enneapogon scaber	Klipgras	Rocky areas				1	1	
Eragrostis nindensis	Wether Love grass	Disturbed or shallow soils, often on granite hills. Increaser II		1	1	1	1	

Species	Common name	Habitat notes	Sandy grassland	Arid gravel grassland	Gravel and quartz	Rocky desert	Inselberg	Drainage lines
Schmidtia kalihariensis	Kalahari Sour Grass	Disturbed soils in dry areas (Kalahari, Karoo)	1	1				
Stipagrostis brevifolia		shrublike grass, sandy and gravel areas	1	1		1		1
Stipagrostis cilliata	Tall bushman grass	Sandy soil, gravel and riverbeds. Associated with a veld in good condition	1	1				1
Stipagrostis obtusa	Small Bushman Grass	Coarse sandy soil, indicator of good condition veld		1				
Stipagrostis obtusa	Small Bushman Grass	Coarse sandy soil, indicator of good condition veld		1				1
Forbs, small shrubs, succulents								
Acanthopsis hoffmannseggiana				1	1			
Aloe claviflora	Kanonaalwyn / Kraalaalwyn	Arid inetrior of SA		1	1			
Aloe dichotoma ***(D)***	Tree Aloe	Arid areas in the Mixed Karoo, mostly on rocky hills	1	1		1		
Anacampseros filamentosa		Quartz, gravel			1			
Antimima spp				1				
Aptosimum spinescens	Doringviooltjie	Dry areas, karoo-veld		1	1	1	1	
Arctome inflata	Tumble Weed	Sandy areas	1					1
Arctotis leiocarpa	karoo arctotis	Inland western parts of South Africa and southern Namibia	1	1				
Aridaria noctiflora		Sandy soils	1	1				

Species	Common name	Habitat notes	Sandy grassland	Arid gravel grassland	Gravel and quartz	Rocky desert	Inselberg	Drainage lines
Asparagus retrofractus		Usually found growing in a tree or shrub		1				1
Augeia capensis	Boesmandruiwe	Dry areas, usually abundant in disturbed areas	1	1				
Brownanthus pseudoschlichtianus (d)		Can be dominant in sandy areas	1	1				
Avonia (Anacampseros) papyracea subsp. namaensis	Nama gansmis	Quartz, Northern Cape			1			
Avonia (Anacampseros) quinaria		Rocky outcrops in Nama Karoo and Succulent Karoo			1	1		
Barleria rigida	Scorpion thistle	Plains and hills	1			1		
Berkheya glabrata	Yellow Thistle	Seasonal streams, mountain sides and disturbed areas				1		1
Berkheya heterophylla	geelwortel	Arid rocky areas				1	1	
Blepharis capensis		Rocky areas in the Karoo 1		1		1		
Brownanthus pseudoschlichtianus		Can be dominant in sandy areas	1	1				
Ceraria fruticulosa		Gravel			1			
Cheridopsis species		Gravelly plains		1				
Chrysocoma ciliata	Bitterbos	Widespread, proliferate in overgrazed areas	1	1				
Crassula sp					1			
Crassula columnaris	Sentkannetjie	Slight slopes in between quarts stones in Bushmanland and Namakwaland			1			

Species	Common name	Habitat notes	Sandy grassland	Arid gravel grassland	Gravel and quartz	Rocky desert	Inselberg	Drainage lines
Crassula muscosa	Veterbos	Common throughout the Karoo, usually in the shade of other shrubs		1				
Dinteranthus cf microspermus		gravel / quartz			1			
Dimorphotheca cuneata	wit bietou	Plains, rocky areas	1	1				
Drosanthemum species							1	
Drosanthemum hispidum		Sandy areas, calcrete	1	1				
Dyerophytum africanum		Palatable plant, Namakwaland and Boesmanland		1				
Eberlanzia species			1	1				
Ebracteola fulleri				1	1			
Eriocephalus species				1			1	
Eriocephalus spinescens	Doringkapok	Karoo, often found in hollows where water accumulates		1				1
Euphorbia gariepina subsp gariepina		Arid, gravelly and sandy flats		1				
Euphorbia gregaria	milk bush		1	1		1	1	
Euphorbia mauritanica	Geelmelkbos	Common in the karoo, often an indicator of overgrazing	1	1				
Euphorbia spinea	spiny milkbush	Namakwaland, western Boesmanland and Namibia		1	1		1	
Exomis microphylla	Brakbossie	Grows in brakish soils		1				
Felicia filifolia	Fine-leaved Felicia	Bushveld and grassland, usually in sandy soil	1	1				
Foveolina albida			1	1				
Galenia sarcophylla	Vanwyksbrak	Widespread in Karoo	1	1			1	

Species	Common name	Habitat notes	Sandy grassland	Arid gravel grassland	Gravel and quartz	Rocky desert	Inselberg	Drainage lines
Gaillonia crocyllis								
Gazania lichtensteinii	yellow gazania	Arid, gravelly and sandy flats		1				
Hermannia affinis								
Hermannia cuneifolia	Agt-dae-geneesbos	Common in shallow and stony soil						
Hermannia grandiflora	Klokkiesbos / Ouma-se-kappie	Karoo. Palatble and presensce is indication of good veld condition					1	
Hernannia stricta	desert rose	Koppies. Inselbergs in Namakwaland and Boesmanland		1		1	1	
Hermannia trifurca	koerasie	Arid habitats	1					
Hermbstaedtia glauca	bokhout	Sandy areas in Namakwaland and Boesmanland	1	1			1	
Hoodia gordonii (DD)	Ghaap	Arid habitats, on gentle to steep shale ridges, found from dry, rocky places to sandy spots in riverbeds	1	1	1		1	
Hypertelis salsoloides	Volstruisbrak / skaapsuurtjie	Widely distributed in dry areas						
Ihlenfeldtia spp	(mesem)			1				
Kleinia longiflora	Sjambokbos	Hot, dry areas, under trees						
Lycium cinereum	Krie doring	Wide distribution	1	1	1			
Mesembryanthenum guerichianum	Ice Plant	Sandy plains and disturbed areas	1	1				
Mesembryanthemum inachabense				1		1		
Monechma incanum	Skaapbloubossie	Sandy areas, often along streams	1	1				1
Monechma mollissimum		Sandy areas, Namakwaland and Boesmanland	1	1				

Species	Common name	Habitat notes	Sandy grassland	Arid gravel grassland	Gravel and quartz	Rocky desert	Inselberg	Drainage lines
Osteospermum species			1					
Pegolettia retrofracta	Geelbergdraaibos	Aromatic leaves, distributed in dry areas		1				
Peliostomum leucorrhizum	veldviooltjie	Sandy or moist areas throughout the Karoo.						
Pentzia incana	Ankerkaroo	Wide distribution throughout the Karoo and encroach into dry grassland if overgrazed	1	1				
Phaeoptilum spinosum	Brittle Thorn / Brosdoring	Karoo		1				
Phyllobolus species				1	1			
Plinthus sericeus	silver karoo	Dry, semi-arid areas	1	1				
Prenia tatragona	vygie	Sandy/gravel karoo	1	1				
Psilocaulon coriarium	Asbos	Seasonal streams, floodplains and disturbed areas		1			1	1
Pteronia pallens	witgatbos	Usually in calcium rich soils and valley bottoms		1				
Radyera urens	Wildekalbas	Flats and disturbed areas	1					
Requienia sphaerosperma								
Rhigozum trichotomum	Driedoring	Plains and drainage areas. Spiny shrub, could become invasive and displace valuable grazing plants in over utilised veld						
Rogeria longiflora	witblom	Sandy areas	1			1	1	
Ruschia intricata (was Eberlanzia ferox)	Doringvy	Dry areas	1	1		1		

Species	Common name	Habitat notes	Sandy grassland	Arid gravel grassland	Gravel and quartz	Rocky desert	Inselberg	Drainage lines
Ruschia sp					1			
Salsola aphylla	Rivierganna / Lye ganna bush / blomkoolganna	In depressions, riparian veld and sometimes in plains. Indicates saline soil. Drainage lines and rivercourses		1				
Salsola tuberculata	rivierganna		1	1				
Sarcocaulon cf crassicaule	Boesmanskers	Dry areas in the north-western Cape		1				
Sarcostemma viminale	Melktou	Variety of habitats, mainly in rocky areas	1			1		
Seriocoma avolans	Gras-bo-bas-onder / katstert	Drier, arid areas, resembles a grass	1					
Sesasum capense	Aprilbaadjie	Usually in disturbed areas	1	1				
Sisyndite spartea	desert broom	Along dry rivers and gravelly plains. Occasionally found in sandy plains and common in road verges		1				1
Sutherlandia fructescens	kankerbossie	Throughout dry parts of southern Africa. It shows remarkable variation within its distribution	1	1				
Tetragonia fructicosa	Klappiebrak	Common in karoo, plains and rante	1			1	1	
Tetragonia sarcophylla	kinkelbos		1					
Trianthema parvifolia	Rooi-rankvygie	Mixed karoo and karoo grassland	1	1				
Tribulus pterophorus		Disturbed areas	1					1
Trichodesma africanum	desert borage	Dry grassland, fallow land and sandy desert plains	1					
Tylecodon rubrovenosus		Rocky slopes				1	1	
Tylecodon wallichii	krimpsiektebos	Koppies and rante				1		

Species	Common name	Habitat notes	Sandy grassland	Arid gravel grassland	Gravel and quartz	Rocky desert	Inselberg	Drainage lines
Zygophyllum sp		Succulent annual. Swampy and moist grassland	1					
Zygophyllum microphyllum				1				
Trees, shrubs								
Vachelia (Acacia) erioloba (P)(D)	Camel-thorn	Bushveld and grassland, usually in deep sandy soil along watercourses in arid areas. Protected tree.	1					1
Acacia (Vachellia) karroo (M)	Sweet Thorn	Widespread, often proliferate in overgrazed areas	1					1
Acacia (Senegalia) mellifera subsp *detinens*	Black Thorn	Very thorny shrub to small tree occurring in bushveld and semi-desert areas, often on Kalahari sand and forming impenetrable thickets				1		
Aloe dichotoma (D)	Tree Aloe	Arid areas in the Mixed Karoo, mostly on rocky hills	1	1		1		
Boscia albirtrunca (M)(P)	Shepherds' Tree	Occur in semi-desert areas and bushveld, often on termitaria	1				1	
Boscia foetida subsp.*foetida*	Stink Shepard's Tree	Dry areas	1	1		1	1	
Cadaba aphylla	Leafless Cadaba	Dry bushveld, scrub and semi-desert, often associated with limestone formations	1					
Commiphora gracilifrondosa	suikerkan	Occurs in arid rocky mountains in Northern Cape and Richtersveld				1	1	
Diospyros lycioides	Bluebush	Wide variety of habitats						1

Species	Common name	Habitat notes	Sandy grassland	Arid gravel grassland	Gravel and quartz	Rocky desert	Inselberg	Drainage lines
Ficus ilicina	laurel rock fig	Cremnophyte				1		
Nymania capensis	Lantern Bush / Klapperbos	Rocky areas					1	
Pappea capensis	jacket-plum	Bushveld and wooded grassland or scrubveld.					1	1
Parkinsonia africana	Green hair tree	Deep red sand and dunes, Bushmanland	1				1	
Rhigozum trichotomum	Three thorn Rhigozum	Lower hillslopes, rocky areas, dune street, can invade degraded veld	1	1			1	1
Schotia afra var *angustifolia*	karoo boer-boon	Hot semi-desert area, along dry watercourse						1
Searsia lancea	Sour Karee	Grassland and bushveld						
Searsia burchelii	Karoo Kuni Bush	Arid grassland and karroid vegetation		1				
Searsia undulata	Namaqua kuni-bush	Semi-desert and Karoid places, rocky areas		1				1
Alien invasive plant species								
Atriplex lindleyi subsp *inflata (A. inflata)*	Australian Saltbush	Category 1b		1	1			
Atriplex nummularia	Old Man Salt Bush	Category 2 (NEMBA). Can replace indigenous vegetation			1			
Prosopis glandulosa	Honey Mesquite	Category 3 in Northern Cape		1	1			1
Tamarix chinensis	Tamarisk	Category 1 and 1b invader of riparian areas, especially in dry Northern Cape						1

APPENDIX C: SPECIALIST CV

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Curriculum Vitae and abbreviated Company Profile

Antoinette Eyssell-Knox
Pr Sci Nat (400019/11) Ecological Science

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EMPLOYMENT RECORD

I am currently self-employed and am the sole proprietor of Dimela Eco Consulting. I have been working in the field of environmental impact assessment since 2007 (9 years) (Table 1).

Table 13: Employment record: Environmental Assessments

Time frame	Title	Company
Nov 2011 - current	Sole proprietor, vegetation specialist	Dimela Eco Consulting
Sep 2007 – Nov 2011	Terrestrial Ecologist, specialising in vegetation	Strategic Environmental Focus (SEF)

Prior to working in the environmental impact assessment field, my main work experience was gained at the Pretoria National Botanical Gardens where I have developed much of my knowledge on indigenous plants.

Table 14: Employment record: Other

Time frame	Title	Company
Aug 2003 – Sep 2007	Snr Environmental Education Officer	Environmental Education Centre, Pretoria National Botanical Garden, South African National Biodiversity Institute (SANBI)
Jun – Jul 2003	Horticultural Trainer	17 Shaft Training Centre, Johannesburg
May 1997 – Mar 2002	Horticulturist	Pretoria National Botanical Garden (then NBI, now SANBI)

QUALIFICATIONS

- M.Sc Environmental Science, University of Pretoria (2010)

Dissertation: *Land cover change and its effect on future land uses*

- B. Sc (Hons) Horticulture, University of Pretoria (1999-2000)

Dissertation: *Horticultural uses of the indigenous Barleria species*

- B. Sc (Agriculture) Horticulture, University of Pretoria (1993-1996)

Proof of MSc – Appendix A

PROFESSIONAL MEMBERSHIP: SACNASP

Registered as a Professional Natural Scientist with the South African Council for Natural Scientific Professionals (SACNASP)

SACNASP Reg no 400019/11 *Proof of certificate – Appendix B*

SPECIALIST WORK EXPERIENCE

Dimela Eco Consulting is an independent consultancy which offers a range of services pertaining to the integration of vegetation, vegetation ecology, protected plants and other ecological concerns into the development and land use process. In support of sustainable development, green infrastructure and socially responsible progress, Dimela Eco Consulting provides clients with quality, unbiased and reliable reports to help minimise the impact on the receiving natural environment and to inform effective decision making by providing the following services:

- Vegetation assessments;
- Vegetation overviews or scans;
- Strategic ecological assessments, including wetland input;
- Mitigation measures to reduce impacts on the natural environment;
- Ecological management and biodiversity action plans (including alien vegetation management);
- Specialist input: ecological conditional requirements for Green Star rating;
- Ground-truthing of vegetation related data; and
- Review of ecological reports.

In addition, Antoinette Eyssell has 4 years' experience in Environmental Education and Greening Projects at the South African National Biodiversity Institute (SANBI) (2003-2007). In this time, she mentored four students over two year period as part of an internship programme.

She currently writes the ecology feature for the bimonthly Supernova Kids Magazine and welcome opportunities to stay involved in environmental education and related community programmes.

The table below list some of Dimela's projects, since 2012.

Table 15: Project experience

PROJECT NAME	INDUSTRY / CLIENT	DATE	ADDITIONAL INFORMATION
Schmidsdrift, Northern Cape Vegetation Assessment for Solar Panels	V & L Landscape Architects	January 2012	Delineation of vegetation communities, determine vegetation sensitivities and survey for plants of conservation concern. Report on potential impacts and mitigation measures to limit impacts.
Kranspoort road upgrade Protected tree identification	Lidwala	March 2012	Identify and record localities, species and numbers of protected trees along an area earmarked for road upgrade.

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Vegetation base line study and input into Biodiversity Action Plan	Kumba Iron Ore (Anglo) via Lidwala	April-May 2012	Undertake a gap analysis and review of existing information and update by assessing the vegetation during the summer months and suggesting monitoring plots, information to be collected and areas where sensitive vegetation should be avoided and managed.
Rietfontein Open Cast Vegetation assessment	Cabanga Concepts	April 2012	Delineation of vegetation communities, determine vegetation sensitivities and survey for plants of conservation concern. Report on potential impacts and mitigation measures to limit impacts.
Eskom: Perseus to Gamma Vegetation assessment	Mokgope Environmental Consultants	October 2012	Survey the proposed route options and compare the floral assemblages that are expected to occur within the area to the actual vegetation found to be present along the route options. 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 impacts and determine route alignment that is likely to have the least impact on sensitive vegetation
Vierfontein Colliery Vegetation assessment and EMP input	Cabanga Concepts	January 2013	Assess the current impacts of the open cast mine on the vegetation and provide input into the EMP to conserve and limit impact on conservation worthy vegetation that persist on the site
Diepsloot Eskom line and substation, Johannesburg (Gauteng	Envirolution	March 2013	Survey the preferred and alternative route alignments and compare the floral assemblages that are expected to occur within the area to the actual vegetation found to be present along the routes. Map the vegetation / habitat types according to structurally distinct vegetation units as well as transformed areas, as well as the localities of threatened plant species. Recommend mitigation measures to aid the conservation of vegetation during construction and operation and indicate the route that will have the least impact on the vegetation.
Komati Power Station – Coal stockyard *Vegetation opinion*	ESKOM	May 2013	Assess the potential plant species and vegetation communities that could be impacted by the proposed increase in capacity of the coal stockyard. Recommend mitigation measures to avoid or limit the

PROJECT NAME	INDUSTRY / CLIENT	DATE	ADDITIONAL INFORMATION
			potential negative impacts that the proposed activity could have on the surrounding vegetation.
Tshepong Mine, assessment and Biodiversity Action Plan (BAP)	Harmony	November 2013 – Feb 2014	• Undertake baseline assessments for fauna, flora and wetlands; • Compile a Biodiversity Action Plan (BAP) based on the baseline assessments • Compile an alien invasive plant management plan for the site
Eskom: Northern Alignments (Perseus in the Northern Cape to Juno in the Western Cape)	Mokgope Consulting	2013	Survey the proposed route options and compare the floral assemblages that are expected to occur within the area to the actual vegetation found to be present along the route options. 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 impacts and determine route alignment that is likely to have the least impact on sensitive vegetation
Masa Ngwedi 750kV and 400kV lines (Limpopo and North West Provinces) Section D & E *Vegetation Input for EMP*	Mandara Consulting	November 2013	Walk down with specific reference to plants of conservation concern that could occur along the proposed powerline route. A report detailing the pylons in proximity to intact and likely sensitive vegetation as well as measures to aid conservation / rehabilitation of this vegetation along the powerline routes as input into the EMP; and localities of plants of conservation concern will be mapped and used to apply for permits for the removal/destruction/pruning of these species where they might be impacted on by the powerline.
Marakele Bush Camp	NuLeaf	December 2013	• Site visit and meeting with the park manager with regards to the area proposed for the development • An opinion with regards to the suitability and ecological sensitivity of the proposed area as well as the likelihood for protected plant species occurring within the development footprint.
Meteor substation, as well as the 88kV line between the Pulsar, Meteor and	Nsovo Environmental Consulting	February 2014	• Survey the preferred and alternative route alignments and substation locality; • Compare the floral assemblages that are expected to occur within the area to the actual vegetation found to be present along the routes;

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Sonland substations, Sebokeng area, Gauteng			• 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 an substation could have on the vegetation; • Recommend mitigation measures to aid the conservation of vegetation during construction and operation; and • Indicate the route that will have the least impact on the vegetation
Blesboklaagte & Leeupoort Township development	Shangoni	April 2014	• Undertake a field survey and assessment of the biophysical environment and current status of natural features on the proposed site and compare the findings to the expected natural state as listed in the national vegetation map; • Field survey with specific reference to plants of conservation concern ("red data" and provincially protected species) that could occur within the study site or immediate surroundings; • Sensitivity mapping, including possible or confirmed localities of plants of conservation concern; and • Report on the potential impacts that the proposed township could have on vegetation and recommend mitigation measures to limit or negate the potential negative impacts where possible.
Goldi Farm Composting Site, Section 24G Fauna and Flora assessment and Summary document	Shangoni	May 2014	Due to secondary state of the vegetation on site, the reports comprised an opinion with regards to the fauna and flora: • describing the vegetation communities and fauna habitats that likely occurred on site prior to the commencement of the illegal activity, as well as natural vegetation surrounding the site; • reference to the occurrence or possible occurrence of plants of conservation concern and threatened fauna (vertebrates) that might inhabit the site and immediate surroundings; • map indicating confirmed or potential habitat for plant and fauna species that are of conservation

PROJECT NAME	INDUSTRY / CLIENT	DATE	ADDITIONAL INFORMATION
			concern as well as ecologically sensitive vegetation communities / fauna habitats; and • assessing the impacts that the activities is likely to have on vegetation and fauna of conservation concern.
Upgrading of Internal Roads in Stinkwater, Hammanskraal (Gauteng)	Glad Africa	December 2014	• Map the location and extent of all plant communities on the study site as well as the ecological sensitivity of each plant community • A plant species list were provided for each plant community with medicinal and invasive/exotic species indicated. • A Red List plant survey was undertaken and the site visit determined whether any of the national protected tree species occurred on or around the site • The potential impacts, based on a supplied methodology and the proposed development, were assessed and the report recommended mitigation measures to limit the perceived impacts on sensitive vegetation.
Environmental management Plan for the Krugersdorp Nature Reserve – vegetation section	Nu Leaf and Mogale City Council	November 2014-January 2015	• Determine the baseline vegetation communities present within the reserve • Recommend management activities to improve deteriorated vegetation and to conserve areas of high vegetation sensitivity. • Recommend management strategies to eradicate and control alien invasive plant species in the reserve.
Rietspruit Residential (Ekhurhuleni)	Naledi Consulting	• May 2015	• Compare the vegetation that are expected to occur as per the National Vegetation Map, Gauteng Conservation Plan and the Ekhurhuleni Bioregional Plan, with the information gathered on site during the field survey; • Map and discuss the vegetation groups recorded on the site and their sensitivity to the proposed development; • Map the localities of plants of conservation concern that was identified during the field survey (if any) or suitable habitat where these plants could potentially occur; • Assess the possible impacts that the proposed development could have on sensitive vegetation; and

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			• Recommend mitigation measures to aid the conservation of vegetation during construction and operation thereof.
City of Joburg Linbro Park and Bassonia Open Space Plans	Iggdrasil Scientific Services via Royal HaskoningDHV	• Sept-Nov 2015	• Background information pertaining to vegetation within the proposed open spaces. • Status quo of vegetation within open spaces. • Input into open space planning
The proposed Kaalspruit Open Space Project, Thembisa, Gauteng Kaalspruit River Rehabilitation Biodiversity Scan: Vegetation and vertebrate report (in collaboration with vertebrate specialists Dr N Rautenbach, Dr A Kemp and Jaco van Wyk	NuLeaf Planning and Environmental	• November 2015	A biodiversity scan was requested to ascertain if any habitat for threatened plant or faunal species may be present and what the impact of the proposed rehabilitation will be on their persistence. The biodiversity scan will involve sample plots and/or transects within accessible areas and areas likely to support threatened species (areas still comprising natural vegetation). • Carry out a high level scan for vegetation and fauna within the area proposed for rehabilitation; • List any threatened or protected fauna and flora species found or suitable habitats that may be present; • Map the vegetation and habitats on the basis of potential areas of concern; and • Assessment of the impacts that the proposed rehabilitation could have on the fauna and flora (particularly sensitive assemblages if present), as well as recommendations to limit or negate these perceived impacts
N4 - Additional lane	Environamic	• February 2016	• Research the regional background information pertaining to this section of the N4 route; • List the threatened or protected plant and tree species that were historically recorded in the area and that have a likelihood of colonising or persisting in the servitudes; • Undertake a site survey of the servitude; • Map the potential sensitivities and recommend management objectives to protect and conserve potential sensitive areas / species; and • Provide the coordinates of protected trees species / threatened species recorded in the sample areas in tabulated format.

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Tharisa Mine Railway Line – Vegetation rehabilitation plan	Limosella Consulting	• January 2016	• Providing guidelines for the re-establishment of vegetation cover with suitable plant species;

APPENDIX A_CV: MSC

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SUID-AFRIKAANSE POLISIEDIENS
FORENSIESE WETENSKAP
LABORATORIUM
2010 -11- 01
PRETORIA
FORENSIC SCIENCE LABORATORY
SOUTH AFRICAN POLICE SERVICE

University of Pretoria

The Council and Senate hereby declare that
at a congregation of the University the degree

Magister Scientiae

with specialisation in
Environmental Education

with all the associated rights and privileges
was conferred on

ANTOINETTE EYSSELL

in terms of the Higher Education Act, 1997 and the Statute of the University

On behalf of the Council and Senate

Vice-Chancellor and Principal

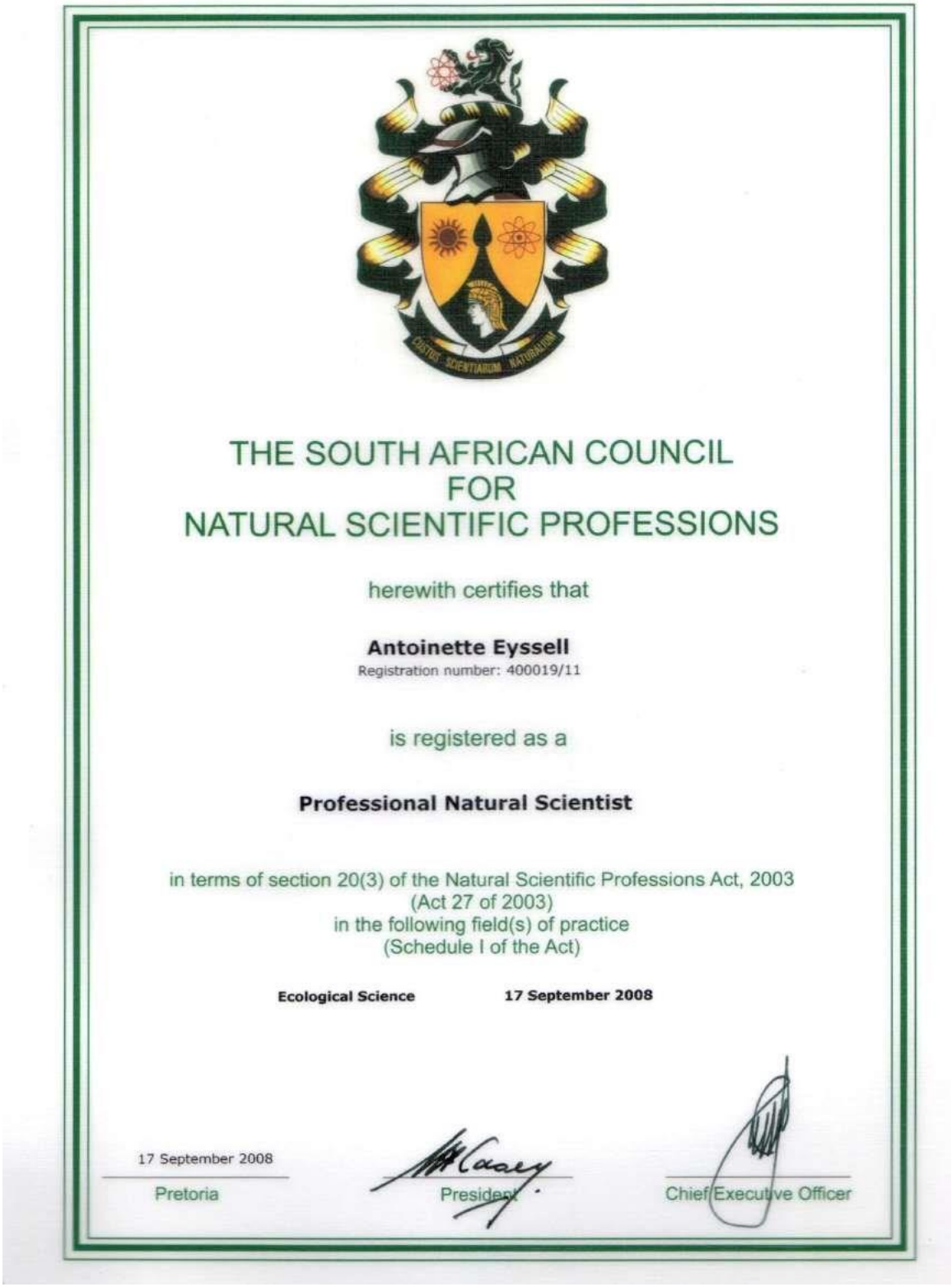
On behalf of the Faculty of
Natural and Agricultural Sciences

Dean

Registrar

2010-09-02

APPENDIX B-CV: SACNASP



THE SOUTH AFRICAN COUNCIL
FOR
NATURAL SCIENTIFIC PROFESSIONS

herewith certifies that

Antoinette Eyssell
Registration number: 400019/11

is registered as a

Professional Natural Scientist

in terms of section 20(3) of the Natural Scientific Professions Act, 2003
(Act 27 of 2003)
in the following field(s) of practice
(Schedule I of the Act)

Ecological Science **17 September 2008**

17 September 2008
Pretoria

President

Chief Executive Officer