PLANT ECOLOGY REPORT

SAN SOLAR ENERGY FACILITY NEAR KATHU, NORTHERN CAPE

NORTHERN CAPE PROVINCE

September 2012

Prepared for:

Ventusa: San Solar Energy Facility (Pty) Ltd

Prepared by:

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EXECUTIVE SUMMARY

Large tracts of the southern African savannas have lost their grazing value and hence agricultural potential to extensive bush encroachment over the past decades. The study area is also severely affected by this form of degradation and hence it is understandable that, from an economic point of view, possibilities of increasing economic returns on this piece of land are desirable. Extensive mining operations in the close vicinity are in need of electricity, and it should be encouraged that at least a portion of this electricity is contributed through clean, renewable resources.

Four plant communities could be identified:

1. The ***Acacia mellifera – Stipagrostis uniplumis*** **bushlands** occur on the majority of the plains where topsoils are sands, and surface calcrete and patches of accumulated loams are relatively limited

» Conservation status: Least Concern with small area of Medium-Low*

» Ecosystem function: Grazing and browsing, denser stands of larger trees provide additional niches and habitats for other plants as well as for animals

» Stability: the current degraded state is a relatively stable state, hence improvement can only occur with costly human intervention in the form of de-bushing
» Reversibility of degradation: the herb layer can be rehabilitated to an acceptable level of productivity as lower substrate levels will not be disturbed by the development, and the sandy topsoil has a good water infiltration. However, the re-establishment of large trees may need some initial assistance until established, and then will take decades before reaching the former size and functionality
» **Sensitivity rating: Least Concern with small area of Medium-Low[1]***

2. The ***Pentzia calcarea – Cynodon dactylon*** **grasslands** are limited to the small pan-like depressions
» Conservation status: Low
» Ecosystem function: Seasonal preferential grazing, short-lived surface water, support of surrounding vegetation types, seasonal wetland functionality
» Stability: easily invaded by weeds and alien invasive species, cover may vary significantly from one year to the next, easily degraded by excessive trampling and overgrazing
» Reversibility of degradation: the rehabilitation of the herb layer will only be possible if the existing micro topography and topsoil characteristics of this and the immediately surrounding environment is maintained
» **Sensitivity rating: Medium-Low**

3. The ***Ziziphus mucronata – Acacia mellifera*** **bushlands** are restricted to narrow but dense bands around pan-like depressions or watering holes
» Conservation status: Medium-Low
» Ecosystem function: Niches and source of food for animals
» Stability: easily invaded by weeds and alien invasive species, herbaceous cover may vary significantly from one year to the next, once encroached by shrubs, this state is very stable
» Reversibility of degradation: the rehabilitation of the herb layer will only be possible if the existing micro topography and topsoil characteristics of this and the immediately surrounding environment is maintained, clearing of excessive shrub may aid in an improved herb layer
» **Sensitivity rating: Medium-Low**

[1] Medium-Low rating is due to the presence of a grove of Camelthorn trees

4. The ***Pentzia incana – Enneapogon desvauxii*** **dwarf shrublands** are restricted to areas with prominent surface calcrete

» Conservation status: Low

» Ecosystem function: Specialised habitat for species, thus increasing overall biodiversity of the area

» Stability: due to more arid nature of soils degradation due to overgrazing and trampling will become an issue, easily invaded by alien and indigenous invasive species

» Reversibility of degradation: herb and low shrub layer can be rehabilitated to some degree, but this may be slow and dependent on sufficient rainfall

» **Sensitivity rating: Least concern[2]***

The following plants encountered on the study site are protected according to provincial and national legislation:

[2] It is regarded at a project site as least concern due to the extreme degradation state of this vegetation. Under less degraded conditions, these habitats usually have a higher sensitivity rating

Acacia erioloba
Boscia albitrunca
Jamesbrittenia atropurpurea

Impact statement

The extent to which the vegetation will be impacted will not greatly affect the survival of the species concerned, even if taking the additional developments (Kathu and Sishen Solar) adjacent to San Solar into consideration. Whilst some protected trees will be sacrificed, the layout has been planned to avoid the larger groves of Camelthorn trees that were observed on site, as well as the small pan-like areas. The study area does not fall within critical biodiversity areas (BGIS 2012). The soils are not very erodible at present due to their texture and negligible slope, and the re-establishment of a somewhat denser forb- , grass- or low shrub layer between or surrounding the development will greatly avoid soils becoming prone to wind erosion. No ecological reason therefore exists for the development not to proceed.

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1. GENERAL INFORMATION

1.1. Applicant

Ventusa: San Solar Energy Facility (Pty) Ltd is proposing the establishment of a commercial solar energy facility

Project

San Solar Energy Facility

Location

A 500 ha portion (the remaining extent) of the farm Wincanton 472 that lies approximately 16 km south east of Kathu within the Gammagara Local Municipality in the Northern Cape.

Proposed Activity

- A single substation and overhead power line to facilitate the connection between the solar energy facility and the Eskom electricity grid.
- Array of PV panels to generate 75 MW
- Internal access roads
- Gate house and security
- Warehouse
- Canteen and change rooms
- Office and Control centre
- Total area to be developed is about 500 ha

1.2. Specialist Investigator

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An abridged *Curriculum Vitae* of the compiler is attached as Appendix B

Specialist affiliation

South African Council for Natural Scientific Professions (SACNASP) (PrSciNat; Registration no. 400079/10, Botanical Science, Ecological Science).

South African Association of Botanists (www.sabotany.com)

Desert Net International (www.european-desertnet.eu)

1.3. Declaration of Independence

A signed declaration of independence for Marianne Strohbach is attached in Appendix A.

1.4. Conditions of this report

Observations, findings, recommendations and conclusions provided in this report are based on the authors' best scientific and professional knowledge and information available at the time of compilation. The author, however, accepts no liability for any actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, and by the use of the information contained in this document. No form of this report may be amended or extended without the prior written consent of the author. Any recommendations, statements or conclusions drawn from or based on this report must clearly cite or make reference to this report. Whenever such recommendations, statements or conclusions form part of a main report relating to the current investigation, this report must be included in its entirety.

Scope and Purpose of Report

To conduct an ecological study for an impact assessment of the 800 ha area where the establishment of a Solar Energy Facility is proposed and provide a professional opinion on issues listed under the terms of reference, to aid in future decisions regarding the proposed project.

1.5. Terms of reference

- A description of the environment - habitat, general ecology and vegetation of the area that may be affected by the activity
- A description of the manner in which the environment may be affected by the proposed project
- A description of all environmental issues that were identified, i.e. direct, indirect and cumulative impacts
- An assessment of the significance of direct, indirect and cumulative impacts
- Recommendations regarding practical mitigation measures for potentially significant impacts
- An indication of the extent to which an impact can be addressed by the adoption of mitigation measures
- An environmental impact statement

1.6. Legislation

This study and resultant report has been conducted and compiles in accordance with the following legislation:

1.6.1. *Provincial*

- Northern Cape Nature Conservation Act (NCNCA) (Act No. 9 of 2009)

1.6.2. *National*

- National Environmental Management Act / NEMA (Act No 107 of 1998), and all amendments and supplementary listings and/or regulations
- Environmental Conservation Act (ECA) (No 73 of 1989) and amendments
- National Environmental Management Act: Biodiversity Act (NEMA:BA) (Act No. 10 of 2004) and amendments
- Draft National list of ecosystems that are threatened and in need of protection (Government Notice 1002 of 2011)
- National Veld and Forest Fire Act (Act No. 101 of 1998)
- Conservation of Agricultural Resources Act (CARA) (Act No. 43 of 1983) and amendments

1.6.3. *International*

- Convention on International Trade in Endangered Species of Fauna and Flora (CITES)
- Convention on Biological Diversity, 1995

2. INTRODUCTION

South Africa is committed to the Convention of Biological Diversity, and has since introduced several legislative mechanisms to ensure that the preservation and sustainable use of all biological diversity, including ecosystem, species and genetic diversity, is guaranteed for the benefit of current and future generations in South Africa and beyond. Still, the impact of past and present conversion of natural habitat types by cultivation, grazing, urban developments, forestation, mining, dams, industries and alien plant invasions continues to have a substantial impact on South African biodiversity, with significant portions of South Africa's flora and fauna being threatened (Wynberg 2002). Arid, semi-arid and dry sub-humid areas, covering an estimated 91% of South African land area (Hoffman and Ashwell 2001), including the study area, are particularly prone to degradation arising from human activities, leading to the acceleration of soil erosion, deterioration of the biotic, abiotic and economic properties of soil, and the long-term loss of natural vegetation (UNCCD 1995). Rapid recovery of degradation is inhibited by the harsh climate, particularly low rainfall regimes, and the unpredictability of rainfall events. When examining veld degradation in terms of severity and rate of degradation, Hoffman and Ashwell (2001) found that the Northern Cape ranks as third-most degraded province in South Africa.

Given the overall low agricultural potential, both for cropping and livestock carrying capacity of the Northern Cape (AGIS 2007), alternative sources of income are often welcome. One such source is an abundance of sun-radiation and clear days, lending itself to the development of solar energy facilities. However, against the backdrop of a relatively fragile biological environment, such developments need to be done in accordance with environmental limitations.

Savannah Environmental (Pty) Ltd has been appointed by San Solar Energy to initiate investigations regarding the potential impacts that may be associated with the creation of a Solar Energy Facility near Kathu in the Northern Cape.

This report lists the findings of an evaluation of the ecology, focusing on vegetation, of the site selected for the proposed San Solar Energy Facility.

3. STUDY AREA

3.1. Locality

The proposed photovoltaic (PV) solar energy facility is located on the remaining portion of the farm Wincanton No 472, approximately 16 km south east Kathu, in the Northern Cape (Figure 1). The R380 cuts across a portion of the farm Additional existing infrastructure in close vicinity of the selected site includes a railway line, gravel road to an old railway siding and some smaller vehicle tracks.

- The approximate corners of the 800 ha site were derived from the satellite image supplied by San Solar Energy and were taken from Google Earth as:

Northwest	S 27° 33' 42.44"; E 22° 56' 00.64"
Northeast	S 27° 33' 20.00"; E 22° 57' 15.07"
Southwest	S 27° 36' 11.98"; E 22° 56' 26.25"
Southeast	S 27° 35' 44.66"; E 22° 57' 49.55"

The extent of the site is approximately 8 km², but only about 1.5 – 2 km² will be necessary for the proposed development with all associated infrastructure. Therefore, the area SW of the R380 was not surveyed and assessed at this stage, as the area will not be developed at this time. The final placement of the facility and associated infrastructure has been based on the recommendations of the ecological survey.

3.2. Surrounding environment

3.2.1. *Climate and rainfall*

Kathu and Dibeng normally receive about 240 mm of rain per year, with most rainfall falling between December and March, whilst winters are dry. The emergence and abundance of species in semi-arid systems does not only depend on the rainfall of the current growing season, but also on rainfall and disturbances of at least 2-3 years prior to date, as that will influence the seed banks and other dormant regenerative material available for growth (Motzkin *et al.* 1999, Chase 2003). The average daily maximum temperatures for Kathu range from 18°C in June to 33°C in January. The region is the coldest during July when temperatures drop to 0.2°C on average during the night (www.saexplorer.co.za). According to Sishen records, frosts are common in winter (Mucina and Rutherford 2006).

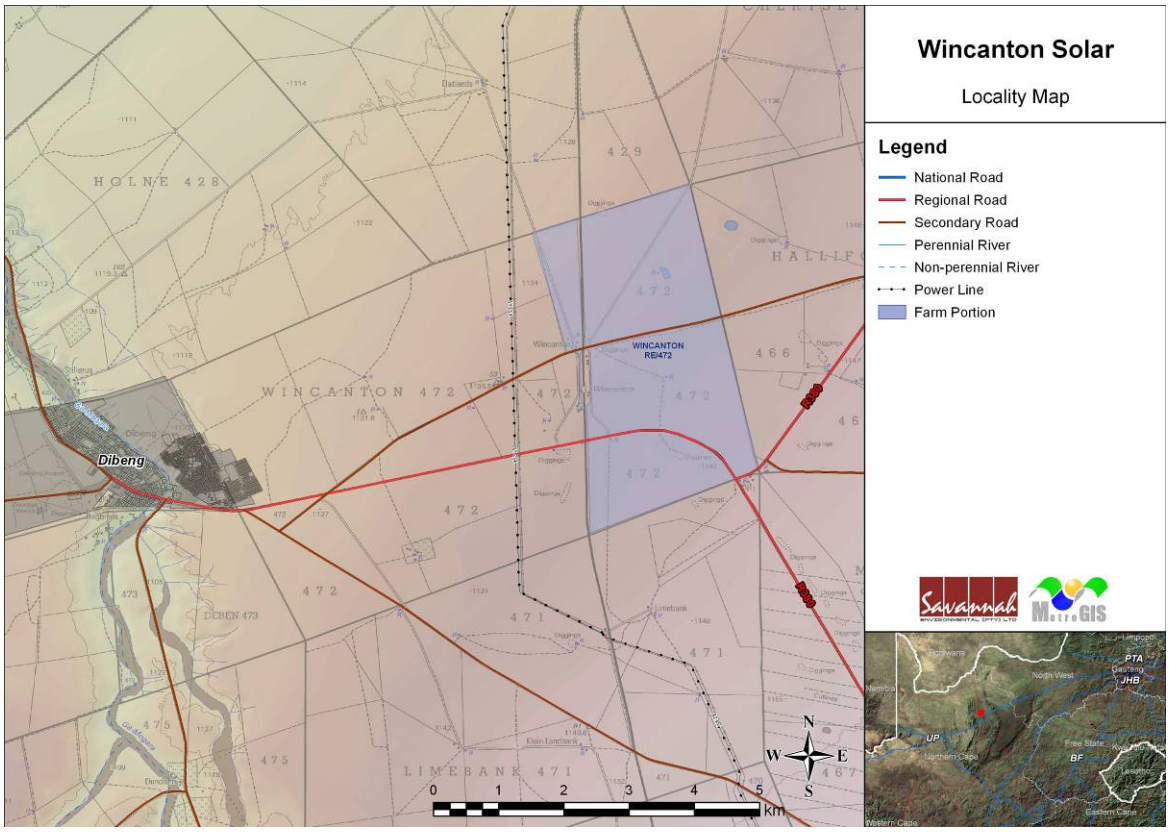

Figure 1: Locality map of the study area

3.2.2. *Topography, substrate and drainage*

The site is relatively flat and hence does not have any noteworthy drainage lines. Instead, due to the flatness and the generally shallow sandy soils over calcrete, small ephemeral pans have formed where water accumulates due to the micro topography of the underlying substrates. Over time these pans have become somewhat depressed; one contributing factor could be increased wind erosion of fine particles as well as increased trampling from animals to access seasonal water or more palatable herbage during moist season. These pans are, however, relatively small in diameter, with the largest pan having a diameter of about 150 to 200 m.

Soils show minimal development, consisting of red unconsolidated sand of 30 cm to 75 cm depth over limestone / calcrete (AGIS 2007).

3.2.3. *Land use*

The site itself as well as most of the surrounding areas is used extensively for livestock and –game farming. Close-by are mines such as Sishen, predominantly mining for iron ore.

3.2.4. *Vegetation overview*

The study site falls within the expanses of the Kalahari, and is covered entirely by the Kathu Bushveld vegetation type as described by Mucina and Rutherford (2006, Figure 2). Kathu Bushveld stretches from just south of Kathu and Dibeng northwards to the Botswana border. In general it is an open savanna with patches of *Acacia erioloba*, otherwise *Boscia albitrunca* as the most prominent tree species, whilst *Acacia mellifera*, *Diospyros lycioide*s, *Grewia flava*, *Gymnosporia buxifolia* and *Dichrostachys cinerea* are the most prominent high shrub species. Typical grasses that also form the backbone of the agricultural sector (livestock farming) are *Brachiaria nigropedata*, *Eragrostis lehmanniana*, *Schmidtia pappophoroides* and *Stipagrostis* species.

None of this vegetation type is at present conserved in statutory conservation areas. Despite no formal conservation up to date, it is regarded as least threatened. Due to the relative flatness of the area and the aeolian red sand topsoils, erosion rates and thus the potential for rapid degradation upon disturbance is low. This vegetation type is, however, prone to degradation by shrub encroachment if the herbacous layer is significantly weakened, primarily by the indigenous species *Acacia mellifera* subsp *detinens*, *Rhigozum trichotomum* and *Tarchonanthus camphoratus*.

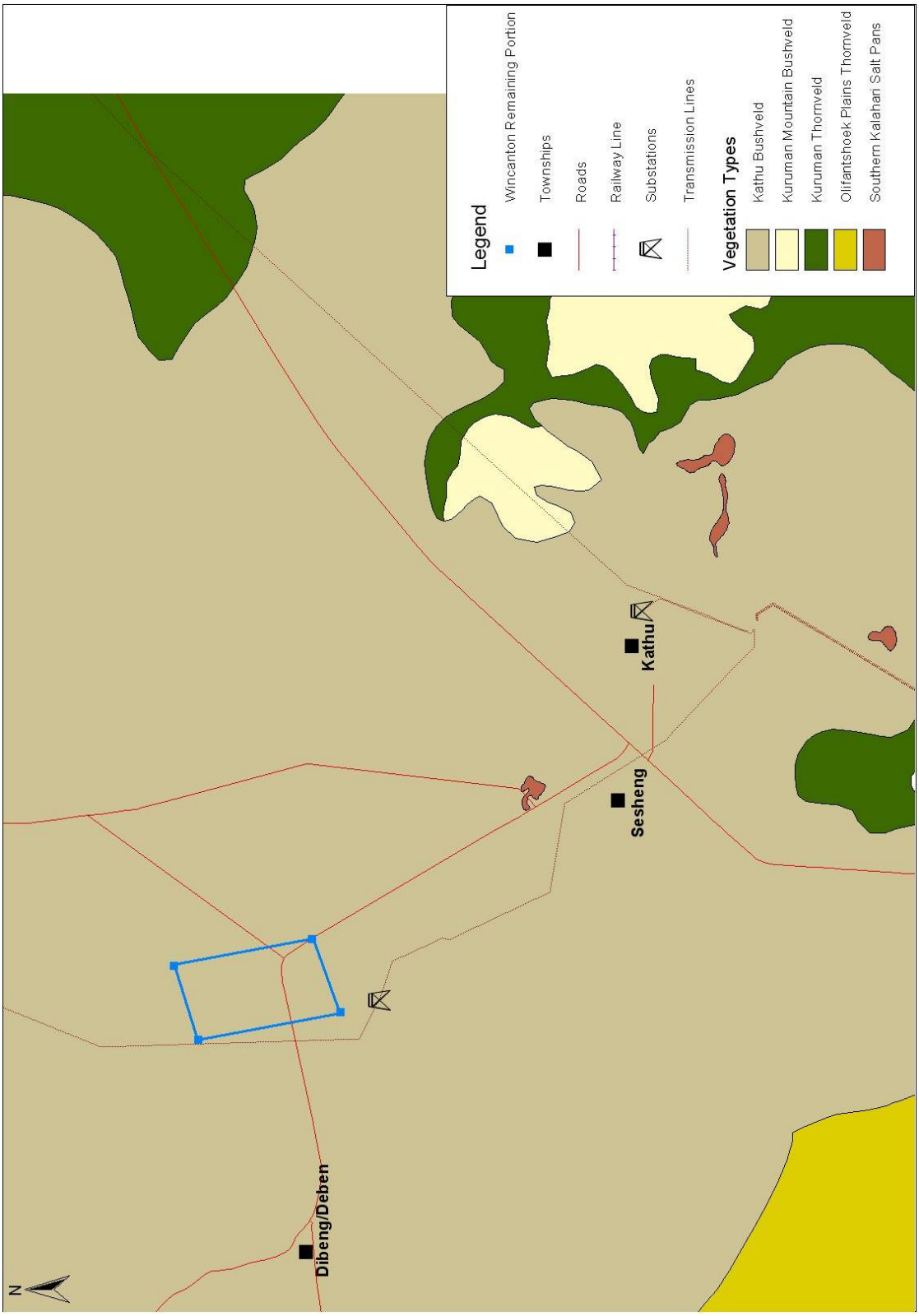

Figure 2: Map of the major vegetation types on and around the study area.

4. METHODS

4.1. Vegetation Survey

The site was visited on 9 May 2012 for a vegetation survey.

Prior to the site visit the vegetation was delineated into homogenous units on currently available Google Earth imagery. At several sites within each homogeneous unit a survey of total visible floristic composition and the relative cover percentage of each species were recorded, following established vegetation survey techniques (Mueller-Dombois & Ellenberg 1974; Westhoff & Van der Maarel 1978). These vegetation survey methods have been used as the basis of a national vegetation survey of South Africa (Mucina *et al*. 2000) and are considered to be an efficient method of describing vegetation and capturing species information. Notes were additionally made of the general habitat and any other features, biotic and abiotic, that might have an influence on the composition of landscape components and functioning of the landscape.

Vegetation analysis was carried out using the standard TurboVeg phytosociological database (Hennekens and Schaminée 2001) and TWINSPAN classification techniques with JUICE (Tichý 2002). Additional species richness calculations were done with the PcOrd package (McCune and Mefford 2006). Extrapolation of community types from survey sites to entire sample area was done using the Google Earth satellite data.

A species list from POSA (http://posa.sanbi.org, May 2012, Grid reference: 2722) containing the species that might occur in the area is listed in Annexure A. POSA generated species lists also contain Red Data species with updated threatened status according to the book Red List of South African Plants 2009 published by SANBI in *Strelitzia* 25 (Raimondo *et al.* 2009) as recorded up to date for the respective grid reference investigated. These lists were then evaluated in terms of habitat available on the site, and also in terms of the present development and presence of man in the area. It must be noted, that the POSA lists are not comprehensive as many locations within South Africa are still under-collected and a backlog with entering existing specimens onto the national species database remains a continuous challenge for SANBI.

Alien invasive species, according to the Conservation of Agricultural Resources Act (Act No.43 of 1983) as listed in Henderson (2001) and Bromilow (2010), are

indicated. Medicinal plants are indicated according to Van Wyk, Van Oudtshoorn & Gericke (1997) and Von Koenen (1996).

The status of plant species recorded in each plant community is indicated by using the following symbols:

A = Alien invasive species
W = Weed (indigenous invasive)
p = Provincial protected species
P = Nationally protected species
M = Medicinal plant species
end = endemic to South Africa
Red data listed plants are indicated by their status

Plant species nomenclature follows Germishuizen and Meyer (2003).

4.2. Sensitivity Analysis and Criteria

Determining ecosystem services and sensitivity of ecosystem components, both biotic and abiotic, is rather complex and no single overarching criteria will apply to all habitats studied. The main aspects of an ecosystem that need to be incorporated in a sensitivity analysis, however, include the following:

- Describing the nature and amount of species present, taking into consideration their conservation value as well as the probability of such species to survive or re-establish itself following disturbances of various magnitudes
- Identifying the species or habitat features that are 'key ecosystem providers' and characterising their functional relationships (Kremen 2005)
- Determining the aspects of community structure that influence function, especially aspects influencing stability or rapid decline of communities (Kremen 2005)
- Assessing key environmental factors that influence the provision of services (Kremen 2005) or the continued survival of a species
- Gaining knowledge about the spatio-temporal scales over which these aspects operate (Kremen 2005)

Hence, the following criteria have been used in the sensitivity analysis, and the relevance of the criteria is briefly explained:

4.2.1. *Sensitivity criteria relating to Conservation Value*

Species diversity

The number and abundance of species strongly influences key ecosystem processes such as pollination, air quality, primary production, nutrient and water cycling and soil formation and retention. All these processes provide ecosystem services such as shelter, potable water, and nutrients to higher trophic levels. The species composition, including dominant, minor and keystone species, is critical in maintaining ecosystem services (Chapin *et al.* 2000).

A higher number of species insures a stable supply of ecosystem goods and services as spatial and temporal variability increases, which typically occurs over longer time periods. Within a community several species may have similar functions, but react differently to environmental variables, thus can buffer ecosystem function to some degree during short-term environmental fluctuations (Hooper *et al.* 2005, Chapin *et al.* 2000). Further, coexisting plants with very different but complementary resource use strategies will use available resources more effectively, and a larger species pool is more likely to contain more groups of complementary species. Overall, productivity, nutrient retention and resistance to invasion tend to increase with increasing species number, especially in environments where overall species cover is relatively low.

Expected species diversity

Species diversity ranges enormously between habitats, thus what may seem low species diversity in one habitat, may in fact be maximal species diversity in another, hence a standardisation of number of species across large areas to rank conservation value of an area will be misleading. Added to this, most standard methods for collecting plant species data miss many species, especially species that are less common, patchily distributed or dormant – either in the form of seeds or underground storage organs – at the time of survey. To compensate for this, species-area curves are drawn from the data to estimate total species richness (Chong and Stohlgren 2007, Garrard *et al.* 2008). This is considered a useful tool in conservation biology, because information from the curves allows a comparison of different communities without the absolute knowledge of all species present in unsampled areas (Chong and Stohlgren 2007). Should the area surveyed differ considerably from surrounding areas, such surrounding areas should also be surveyed to obtain a more realistic measure of expected species diversity. The expected species diversity for a study area is calculated with PcOrd

(McCune and Mefford 2006), using the second-order jack-knife estimate derived from the species-area curve.

Species that are less common or endemic

It is often difficult to identify what exactly limits the distribution of a species. Factors that have been identified as playing a major role, either on their own or together, are habitat limitation and dispersal limitation (Münzbergová 2006), as well as minimum number of individuals required to enable a viable population. Rare taxa often have specialised habitat requirements and are thus restricted to rare environmental conditions, of which rock outcrops and narrow water channels are typical (Keith 1998). A restricted availability of a habitat may also reduce the dispersal capability of a species. Species of conservation concern, be it due to their restricted numbers, decreasing habitat availability and/or exploitation are protected from provincial to international level, and hence their Red Data and protection status can be used as a surrogate to assess the sensitivity of an area to man-made disturbances.

Within a community, the species composition is often as or more important than the species number in affecting ecosystem processes. Changes in species compositions can occur indirectly by an altered resource supply due to anthropogenic influence e.g. change of moisture flows. Although a reduction in the number of species may initially have small effects, even minor losses may indicate that the capacity of the ecosystem to adjust to a changing environment is being lost (Chapin *et al.* 2000, Hooper *et al.* 2005). Species are allocated an official conservation status to prevent their further decline due to identified threats (Keith 1998). Protected or red-data species, as well as endemic species, apart from their conservation status, are a first indicator of the health of an ecosystem. They will most probably be the first to show a sudden decline should their environment be changed beyond a specific threshold, e.g. by excessive erosion.

4.2.2. *Sensitivity criteria relating to ecosystem function*

Soil water availability

The most limiting factor in arid and semi-arid systems is moisture. Soil water availability is limited not only by timing and amount of rainfall events, but also by low infiltration rates of water into the soil. Vegetation itself, however, promotes

the rate of infiltration due to increasing soil surface roughness as well as soil surface porosity, providing a further positive feedback between increased infiltration and increased plant growth. Thus with increasing plant density, the rate of infiltration into the soil will increase significantly, instead of most water being lost as runoff during infrequent rain showers (Dekker *et al.* 2007). Soil surface roughness can also be provided by various degrees of surface rockiness, living soil crusts and micro topography - including the fertile-island effect created by shrubs in the Karoo (Esler *et al.* 2006), which aid as resource traps for runoff and nutrients. Compacted, denuded soils are often prone to surface capping – even more so if the soils have a fine texture due to higher clay or loam contents. Such capped soils are prone to ever increasing erosion, creating a leaky ecosystem that rapidly loses soil, nutrients and seeds from the ecosystem (Tongway and Hindley 2004).

Niches

Relief, topography, and micro-topography are important features of the habitat, because evapotranspiration and photosynthesis correlate with the resultant solar radiation and temperatures, and the variability of in soil attributes and water flows highly depend on these features (Dirnböck *et al.* 2002). Topography has a major influence on the redistribution of rainfall, affecting moisture limitations for plant present, and the effect of this on vegetation increases significantly with aridity, but is also coupled to the geology of the terrain (Dirnböck *et al.* 2002).

Habitat

Several studies have shown that the vegetation units contributing the most to regional species diversity cover the smallest areas because these species are concentrated on and some also limited to particular habitats (Chong and Stohlgren 2007, Keith 1998). However, these communities or habitats may contain species that are of high importance to the entire ecosystem, and an extinction of such a local plant population, or their reduction to a point where they become functionally extinct, can have dramatic consequences on the regulation and support of ecosystem services. The diversity and size of a landscape unit also influences ecosystem services – species on the edges of a habitat are more vulnerable to environmental stresses, and the more a habitat is fragmented, the higher this stressful edge effect becomes, in addition to habitat loss. Habitat loss and/or fragmentation can thus have disproportionately large effects on ecosystem services.

Overall, the properties of species, together with the species composition is often more critical in retaining the function of an ecosystem than species numbers or total cover (Chapin *et al.* 2000). Many of these species will, however, only establish if the habitat is suitable (Carrick and Krüger 2007). Added to that, rehabilitation in arid and semi-arid zones has been difficult either due to difficulties in establishment because of low, erratic and unpredictable rainfall or the lack of available seed material (Le Houérou 2000).

4.2.3. *Sensitivity rating definitions*

Based on the above background, sensitivities were based on both community and habitat characteristics. Ratings are according to a combination or all of the criteria listed below:

Least sensitive community and habitat (low)

- Species diversity observed ≤ 50 % of expected observable species diversity
- No Red Data species present
- Species protected *due to possible overexploitation* may be present, but in low densities
- Majority of species present are short-lived (i.e. with a life-span of less than 20 years), with a very high cover of annual species, majority of species present reproduce and establish easily
- Habitat with relatively low niche diversity
- Particular type of habitat covering extensive areas beyond the study area
- The impact of a modified habitat will be limited to the site impacted only, and the probability of further degradation of and beyond that site will be low
- Habitat type can be recreated or improved and vegetation rehabilitated to an equally or more functional and productive system after disturbance. This may imply that the species composition after rehabilitation will be similar to the original (non-degraded) species composition or will be able to revert to such diversity over time, or that the composition of formerly degraded areas will be improved

Sensitive community and habitat (medium-low)

- Species diversity observed ≤ 50 % of expected observable species diversity
- Limited Red Data species may be present, but only if within the categories declining, vulnerable or data deficient, and only if in low densities
- Species protected *due to possible overexploitation* may be present, but in low densities

- Several of the species present are short to long-lived, with a moderate component of annual species, many of the species present reproduce and establish easily
- Habitat with low to moderate niche diversity
- Particular type of habitat covering extensive areas beyond the study area
- The impact of a modified habitat will be limited to the site impacted only, and the probability of further degradation of and beyond that site can be contained with suitable mitigation
- Habitat type can be largely recreated and vegetation rehabilitated to a similarly functional and productive system after disturbance, but it is likely that the resulting species composition will be altered due to the modification of habitat. Ecosystem function should, however, not be affected significantly.

Highly sensitive community and habitat (medium-high)

- Species diversity observed ≥ 50 % of expected observable species diversity
- Limited Red Data species present, but only if within the categories declining, vulnerable or data deficient, and only if in low densities
- Species protected *due to possible overexploitation* may be present in low to moderate densities – if moderate densities, then mostly short-lived species
- Most of the species present are short to long-lived, with a variable component of annual species, several of the species present may reproduce and establish with difficulty
- Some of the species present or the habitat itself significantly contribute to the functioning of surrounding habitats, e.g. providing micro-habitats necessary for particular plant or animal species to survive
- Habitat with moderate niche diversity
- Particular type of habitat with limited areas in and beyond the study area, may be a habitat of isolated occurrences (e.g. Outcrops) or part of a connected system (e.g. drainage lines or associated floodplains)
- The impact of a modified habitat may not be limited to the site impacted only, and the probability of further degradation of and beyond that site is likely, even with mitigation; system overall easily degraded
- Habitat type can be recreated only to a limited extent and vegetation rehabilitated to a functional system after disturbance, but it is likely that the resulting species composition will be significantly altered and have a much lower productivity due to the modification of habitat. Ecosystem function may be affected significantly.

Irreplaceable community and habitat (high)

- Species diversity observed ≥ 50 % of expected observable species diversity
- Red Data species present: if within the categories declining, vulnerable or data deficient then in high densities, else in categories indicating a higher threat status. The persistence of some of these species may depend on the nature of the habitat present.
- Species protected *due to possible overexploitation* may be present in more than average or even high densities. The persistence of some of these species may depend on the nature of the habitat present.
- Several of the species present are long-lived, with a variable component of annual species, several of the species present may reproduce and establish with difficulty
- Some of the species present or the habitat itself significantly contribute to the functioning of surrounding habitats, e.g. providing micro-habitats necessary for particular plant or animal species to survive
- Habitat with high niche diversity
- Particular type of habitat with limited areas in and beyond the study area, may be a habitat of isolated occurrences (e.g. Outcrops) or part of a connected system (e.g. drainage lines or associated floodplains)
- The impact of a modified habitat may not be limited to the site impacted only, and the probability of further degradation of and beyond that site is likely, even with mitigation
- Habitat type can *never* be recreated and vegetation rehabilitated will have a significantly altered species composition with a much lower diversity and productivity due to the modification of habitat. Ecosystem function may be affected significantly.

4.3. Assessment of Impacts

The Environmental Impact Assessment methodology assists in the evaluation of the overall effect of a proposed activity on the environment. This includes an assessment of the significant direct, indirect and cumulative impacts. The significance of environmental impacts is to be assessed by means of the criteria of extent (scale), duration, magnitude (severity), probability (certainty) and direction (negative, neutral or positive).

The **nature** of the impact refers to the causes of the effect, what will be affected and how it will be affected.

Extent (E) of impact

Local (site or surroundings)

Regional (provincial)

Rating = 1 (low) to 5 (high).

Duration (D) rating is awarded as follows:

Whether the life-time of the impact will be:

- Very short term – up to 1 year: Rating = 1
- Short term – >1 – 5 years: Rating = 2
- Moderate term - >5 – 15 years: Rating = 3
- Long term – >15 years: Rating = 4

The impact will occur during the operational life of the activity, and recovery may occur with mitigation (restoration and rehabilitation).

- Permanent – Rating = 5

The impact will destroy the ecosystem functioning and mitigation (restoration and rehabilitation) will not contribute in such a way or in such a time span that the impact can be considered transient.

Magnitude (M) (severity):

A rating is awarded to each impact as follows:

- Small impact – the ecosystem pattern, process and functioning are not affected.
  Rating = 0
- Minor impact - a minor impact on the environment and processes will occur.
  Rating = 2
- Low impact - slight impact on ecosystem pattern, process and functioning.
  Rating = 4
- Moderate intensity – valued, important, sensitive or vulnerable systems or communities are negatively affected, but ecosystem pattern, process and functions can continue albeit in a slightly modified way.
  Rating = 6
- High intensity – environment affected to the extent that the ecosystem pattern, process and functions are altered and may even temporarily cease. Valued, important, sensitive or vulnerable systems or communities are substantially affected.

Rating = 8

- Very high intensity – environment affected to the extent that the ecosystem pattern, process and functions are completely destroyed and may permanently cease.
  Rating = 10

Probability (P) (certainty) describes the probability or likelihood of the impact actually occurring, and is rated as follows:

- Very improbable – where the impact will not occur, either because of design or historic experience.
  Rating = 1
- Improbable – where the impact is unlikely to occur (some possibility), either because of design or historic experience.
  Rating = 2
- Probable - there is a distinct probability that the impact will occur (<50% chance of occurring).
  Rating = 3
- Highly probable - most likely that the impact will occur (50 – 90% chance of occurring).
  Rating = 4
- Definite – the impact will occur regardless of any prevention or mitigating measures (>90% chance of occurring).
  Rating = 5

Significance (S) - Rating of low, medium or high. Significance is determined through a synthesis of the characteristics described above where:
S = (E+D+M)*P

The **significance weighting** should influence the development project as follows:

- Low significance (significance weighting: <30 points)

If the negative impacts have little real effects it should not have an influence on the decision to proceed with the project. In such circumstances there is a significant capacity of the environmental resources in the area to respond to change and withstand stress and they will be able to return to their pre-impacted state within the short-term.

- Medium significance (significance weighting: 30 – 60 points)

If the impact is negative it implies that the impact is real and sufficiently important to require mitigation and management measures before the proposed project can be approved. In such circumstances there is a reduction in the capacity of the environmental resources in the area to withstand stress and to return to their pre-impacted state within the medium to long-term.

- High significance (significance weighting: >60 points)

The environmental resources will be destroyed in the area leading to the collapse of the ecosystem pattern, process and functioning. The impact strongly influences the decision whether or not to proceed with the project. If mitigation cannot be effectively implemented, the proposed activity should be terminated.

5. RESULTS

Plant communities identified during this study are based on the overall similarity in species composition, vegetation structure and biophysical attributes that are part of an ecosystem, but smaller phytosociological differences within each vegetation unit are present. This is attributable to the variable depth of the sands that overlie calcrete, and hence also the depth and size of soil moisture reserves as well as base-content of the soils; the latter strongly influencing the osmotic potential that plant roots have to compete with to absorb water. In general though, the majority of the study area is covered by one plant community that just differs in the density of trees present.

During the survey, 84 indigenous plant species were observed. The expected number of indigenous species was calculated as 131. Within the larger area, a total of 669 species have been recorded, but this also includes a variety of other habitats (see POSA list in Appendix C).

5.1. Description of vegetation units and associated habitats

Four plant communities could be identified:

- The *Acacia mellifera – Stipagrostis uniplumis* bushlands occur on the majority of the plains where topsoils are sands, and surface calcrete and patches of accumulated loams are relatively limited
- The *Pentzia calcarea – Cynodon dactylon* grasslands are limited to the small pan-like depressions
- The *Ziziphus mucronata – Acacia mellifera* bushlands are restricted to narrow but dense bands around pan-like depressions or watering holes
- The *Pentzia incana – Enneapogon desvauxii* dwarf shrublands are restricted to areas with prominent surface calcrete

The distribution of these plant communities is shown in Figure 3.

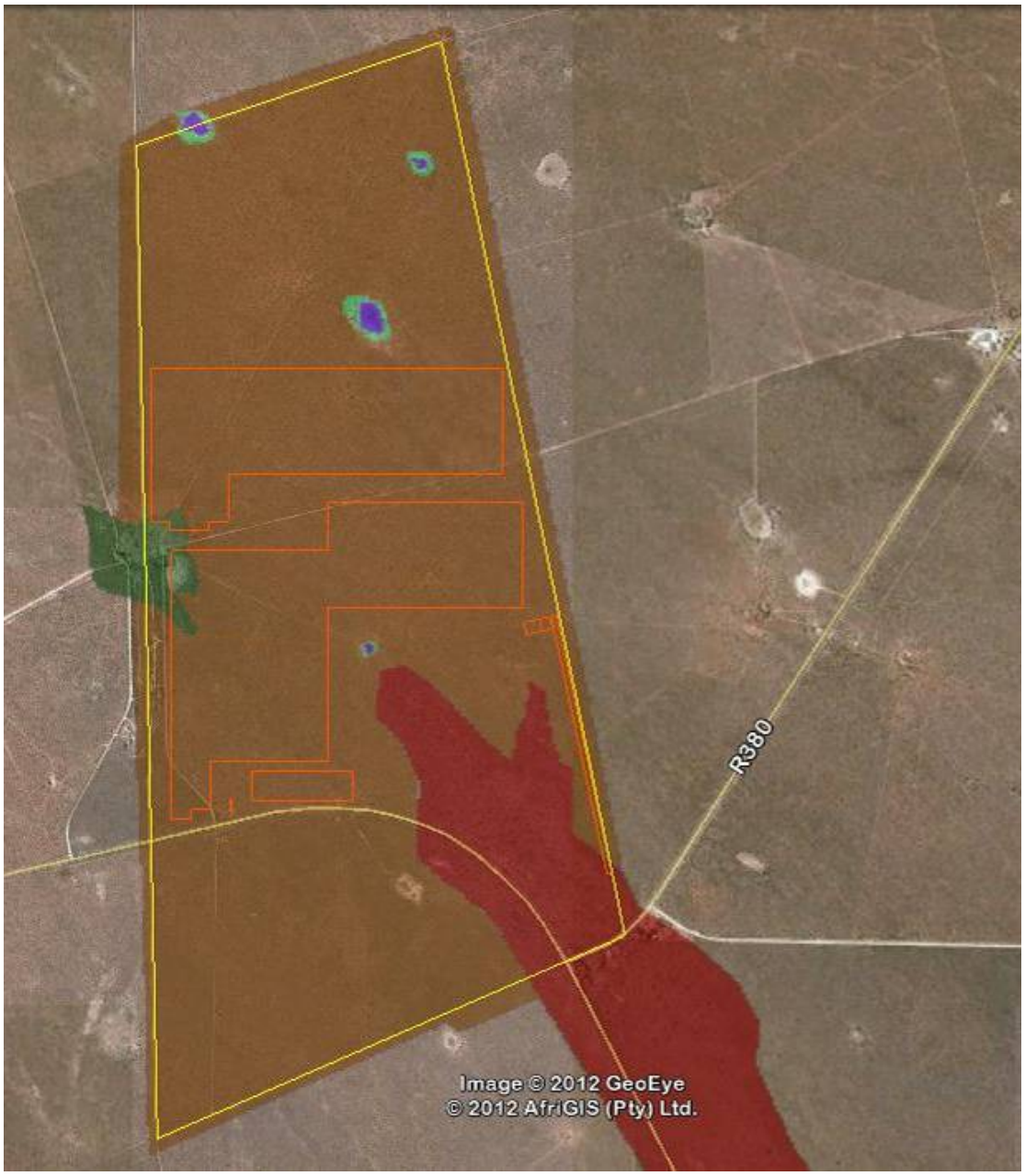

Figure 3: Map of the vegetation communities identified: Brown and red indicates the *Acacia mellifera-Stipagrostis uniplumis* bushlands, with the red area being the Camelthorn grove, which extends beyond the study area, blue represents the *Pentzia calcarea – Cynodon dactylon* grasslands surrounded by the *Ziziphus mucronata – Acacia mellifera* bushlands (light green). Dark green indicates the *Pentzia incana – Enneapogon desvauxii* dwarf shrublands. The layout of the solar energy facility is outlined in orange.

5.1.1. *Acacia mellifera – Stipagrostis uniplumis* bushlands

Habitat and Land use			
Substrate	Shallow sand over calcrete	**Disturbance**	Severe bush-encroachment
Species Richness	61 of 131 expected species recorded	**Conservation value:**	Medium-Low (patches of medium-high)
Ecosystem function	Grazing and browsing	**Sensitivity:**	Least concern (patches of medium-high)
Need for rehabilitation	De-bushing	**Agricultural potential**	Low grazing capacity due to density of bush

Vegetation structure		
Layer	**Height (m)**	**Cover (%)**
Trees	3 - 4	0 - 20
High shrubs	1 - 3	25 - 55
Low Shrubs	0.2 – 0.8	0.2 - 3
Grass	0.1 - 1	0 - 8
Forbs	0.1 – 0.8	0 - 2
Dominant species.	*Acacia mellifera (subsp detinens), Tarchonanthus camphoratus, Stipagrostis uniplumis*	

This community covers the bulk of the study area. The landscape consists of plains with relatively shallow red, aeolian sands over calcrete. Sand depth is variable, with small patches of surface calcrete visible, whilst in the south-eastern portions of the study area there are areas with deeper sands. These deeper sands, due to their larger soil-moisture reserves, also support a higher density of the Camelthorn, *Acacia erioloba*. These small areas then also have a higher conservation- and sensitivity value due to the presence of these 'Camelthorn-groves'. Clay- and loam content of the topsoils are low, occasionally an accumulation of loamier soils can be found in micro-depressions. These loamy soils have a slower water infiltration rate, may become waterlogged for short periods after heavy rainfalls (but are not wetlands), and then dry out excessively fast again due to the fine soil texture. These small patches are usually host to a larger number of geophytes as these plants have a short active growing cycle – thus able to make use for short times of water availability, and then becoming dormant or living off their stored reserves once the soils dry out again. Most of the other species common for the area are not able to persist on these loamier soils.

In a pristine state, this vegetation would have been a relatively open savanna with a rich grass layer interspersed with small patches of high shrubs with a maximum cover of 5% and occasional trees. However, at present this vegetation is highly encroached with *Acacia mellifera* subsp *detinens*, commonly referred to as Swarthaak. This encroachment is then also the main reason for a very poor herb layer. Occasional patches of palatable grasses still exist, but these patches are also excessively grazed where they are accessible to livestock. This absence of grasses is also reflected in the generally poor and excessively browsed state of individuals of *Boscia albitrunca* (Shepherd's tree) that could be located during the field study.

At present, the vegetation structure is a relatively uniform, dense shrub layer of about two to three meters height, with occasional occurrences of higher trees. Bush encroachment, where the woody layer of a savanna gradually increases at the expense of the herbaceous layer is relatively common in southern African savannas. As a result, the grazing capacity has declined, often to such an extent that many previously economically viable livestock properties are now no longer viable (Smit *et al.* 1999), and hence bush encroachment is regarded as one of the most threatening forms of rangeland degradation. The study area is one of the areas very badly affected by this type of degradation. In addition, past studies have found a sharp decline in the presence of small mammals and carnivores in Kalahari bushlands as soon as the shrub cover increases above 10%, as shown below by Blaum *et al.* (2007).

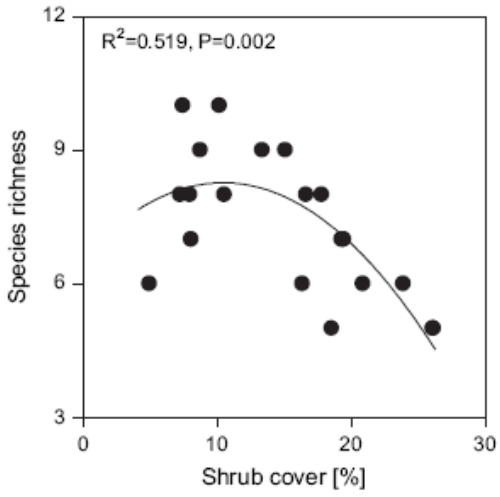

Fig. 2 – Effects of shrub encroachment on species richness of 10 small carnivore species in 20 southern Kalahari rangelands.

Reasons for this increase in shrub cover are varied and often attributable to a combination of factors. Fires are prevented by land users due to legal restrictions and need of grazing, variable rainfall and hence variable grass cover make it difficult for rangeland managers to optimally plan stocking densities, and marketing restrictions and limitations make it even more difficult to decrease stocking densities fast enough to prevent overgrazing if rainfall has been poor for the season, hence necessitating almost consistent overgrazing. The weakening of the palatable herb layer facilitates the thickening of thorny shrubs. An increase in CO_2 due to anthropogenic emissions has an added fertilizer effect on the shrubs, but not on the grasses, as these groups of plants use different metabolic pathways for photosynthesis (Archer *et al.* 1995). The denser shrub layer then also diminishes the amount and variability of niches available for other plants and animals, thus leading to an overall decline of biodiversity.

This is then also the reason why patches of denser stands of Camelthorn should be conserved: not only do these trees grow very slowly, but in the present environment will have difficulty to re-establish, but still provide important islands of resource and niche diversity for a multitude of other organisms.

Species composition and typical observed cover percentages:

Species	**Status**	**avg %**	**max %**
Trees			
Acacia erioloba	**Pp M**	**0.2**	**20**
High shrubs			
Acacia mellifera	W	35	55
Boscia albitrunca	**Pp M**	**0.1**	
Diospyros lycioides	M	0.1	
Ehretia rigida	M	0.1	
Grewia flava	M	0.5	
Lycium cinereum		1	
Rhus burchellii		0.2	
Tarchonanthus camphoratus	M	5	
Ziziphus mucronata		0.3	
Low shrubs			
Asparagus retrofractus	M	0.1	
Asparagus suaveolens	M	0.1	
Barleria rigida	M	0.1	

Species	**Status**	**avg %**	**max %**
Chrysocoma ciliata	M	0.1	
Hermannia comosa		0.1	
Jamesbrittenia atropurpurea	**p**	**0.1**	
Melhania virescens		0.2	
Monechma divaricatum		0.1	
Pavonia burchellii	M	0.1	
Pentzia calcarea		1	
Pentzia incana		0.1	
Pollichia campestris		0.1	
Pupalia lappacea	W M	0.1	
Thesium hystrix	M	0.1	
Herbs and forbs			
Alternanthera pungens	**A**	**0.1**	
Aptosimum lineare	M	0.1	
Chascanum pinnatifidum		0.1	
Chenopodium ambrosioides	M	0.1	

Species	Status	avg %	max %
Cucumis africanus	M	0.1	
Dicoma capensis	M	0.1	
Eriospermum species		0.1	
Felicia clavipilosa s. clavipilosa		0.1	
Felicia muricata		0.1	
Galenia meziana		0.1	
Geigeria ornativa	W M	0.1	
Helichrysum zeyheri	M	0.1	
Hermannia coccocarpa		0.1	
Indigofera vicioides		0.1	
Kohautia cynanchica		0.1	
Ledebouria species		0.1	
Leucas capensis		0.1	
Limeum sulcatum		0.1	
Peliostomum leucorrhizum		0.1	
Phyllanthus maderaspatensis	M	0.1	
Rhynchosia totta	M	0.1	

Species	Status	avg %	max %
Selago densiflora		0.2	
Senna italica	M	0.1	
Talinum arnotii		0.1	
Grasses			
Aristida adscensionis		0.2	3
Aristida congesta		0.1	1
Cenchrus ciliaris		0.1	
Enneapogon cenchroides		0.3	
Enneapogon desvauxii		0.5	
Eragrostis nindensis		0.2	
Eragrostis trichophora		0.1	
Melinis repens s. repens		0.1	
Oropetium capense		0.1	
Pogonarthria squarrosa		0.1	
Schmidtia pappophoroides		0.2	0.5
Sporobolus fimbriatus		0.1	
Stipagrostis uniplumis		5	8
Tragus racemosus	W	0.1	

General management recommendations:

For the purposes of the proposed development, a large amount of invasive shrub will have to be cleared. Swarthaak – *Acacia mellifera* – is most effectively cleared if this is done during early spring before the first rains. The species flowers and fruits just after winter, using up a considerable amount of reserves stored in its stem and belowground lignotuber. These reserves can only be replenished after the species has been able to sprout new leaves after first rains, thus by cutting the species when it is in full bloom or reaching the end of the bloom will damage it when it is most vulnerable. Cutting it before seed set will also ensure that seed banks are kept to a minimum, which will greatly reduce new emergence of seedlings. Generally the longevity of Swarthaak seed, once in or on the soil, is less than 5 years.

The clearing of Swarthaak and other dense shrub will also greatly contribute to increase the ecosystem functioning of the denser patches of Camelthorn that should be left intact. Depending on still available seed banks, it can be expected that after the clearance of Swarthaak and other shrubs, the herbaceous layer will first be dominated by weeds before a grass layer will re-establish. As several other invasive species, both alien and indigenous have been recorded on the

study area; a monitoring program will have to be put in place for the early detection and eradication or control of such species.

Figure 4: View of typical encroached veld of community 1. The thorny shrub is *Acacia mellifera* subsp. *Detinens*

Figure 5: View of one of the Camelthorns, *Acacia erioloba*, occurring within community 1.

5.1.2. *Pentzia calcarea – Cynodon dactylon* grasslands

Habitat and Land use			
Substrate	Greyish loamy sands, depressions with surrounding surface calcrete	**Disturbance**	Excessively trampled and grazed
Species Richness	12 of 131 expected species recorded	**Conservation value:**	Low
Ecosystem function	Seasonal grazing, short-lived surface water	**Sensitivity:**	Medium-low
Need for rehabilitation	Clearing of alien invasive weeds	**Agricultural potential**	Low

Vegetation structure		
Layer	**Height (m)**	**Cover (%)**
High shrubs		0
Low Shrubs	0.2 – 0.6	5 - 10
Grass	0.05 – 0.3	15 - 45
Forbs	0.02 – 1.5	1 - 5
Dominant species.	*Cynodon dactylon, Enneapogon desvauxii, Eragrostis lehmanniana, Pentzia calcarea*	

The extent of this vegetation type is limited to small pan-like depressions as found more in the northern extent of the study area. These depressions are about 50 – 200 m in diameter. Soils consist of loamy sands that have been enriched over time with lime from the surrounding surface calcrete, and hence are greyish in colour. At the time of the study no wetland species could be found, however, it is possible that during seasons of good rainfall these depressions will hold some standing water for a period of time, and then it is also possible that various sedges and other water-loving plant species may emerge from dormant underground organs. During such periods of higher moisture, grasses here will also be much more palatable, another reason why these depressions have been so trampled and overexploited by mammals. In general, these areas should be treated as wetlands. However, these wetland areas consist of water on a seasonal basis. There is a buffer zone of 500m for these areas. During periods of drought or during winter, vegetation will be reduced to the few perennial species here or areas may become bare.

The vegetation is overall low with a very low species diversity, dominated by the creeping grass *Cynodon dactylon* (couch grass) towards the centre, gradually being replaced by higher grasses and shrubs that are adapted to more basic soils, hence also the strong presence of *Enneapogon desvauxii* (Eight-day grass) here. Unfortunately, there is also a strong component of alien invasive species here, of which *Alternanthera pungens* (paper thorn) and *Datura stramonium* (common thorn-apple, malgif) are the most difficult to eradicate, but also the species that are distributed very easily.

These small habitats, albeit very small, provide not only seasonal grazing, but also seasonal moisture that can be utilised by a number of birds that will be able to nest in the surrounding dense fringe of bushes (community 3), but also mammals – particularly small mammals, that may still be in the area.

Species composition and typical observed cover percentages:

Species	Status	avg %	max %
Low shrubs			
Chrysocoma ciliata	M	2	
Pentzia calcarea		3	
Herbs and forbs			
Alternanthera pungens	**A**	**5**	
Argemone ochroleuca	**A M**	**1**	
Commicarpus pentandrus	M	0.1	
Datura stramonium	**A**	**1**	
Nidorella resedifolia	W	2	

Species	Status	avg %	max %
Selago densiflora		0.5	
Tagetes minuta	W M	0.5	
Grasses			
Aristida adscensionis		15	
Aristida congesta		3	
Cynodon dactylon	M	10	25
Enneapogon desvauxii		15	
Eragrostis echinochloidea		0.5	
Eragrostis lehmanniana		10	

General management recommendations:

These areas should be avoided by development as far as possible. It is recommended that a program be started to eradicate the alien invasives, as they are distributed from here into surrounding areas and may become a major problem for the development once the vegetation there has been cleared or disturbed. Seed banks of these species may be extensive and long-lived, burning may be beneficial, but only if the fire is hot enough to kill seeds in the upper soil layers. Movement of animals and humans to these areas should be restricted until these plants have been entirely cleared, as seeds of alien invasives are easily carried out by shoes and hooves, etc.

Figure 6: Typical view of community 2, the small grey shrub in the front being *Pentzia calcarea*. The larger shrubs on the horizon are part of community 3.

5.1.3. *Ziziphus mucronata – Acacia mellifera* bushlands

Habitat and Land use			
Substrate	Surface calcrete – gravel to small rocks	**Disturbance**	Bush encroachment
Species Richness	24 of 131 expected species recorded	**Conservation value:**	Medium-low
Ecosystem function	Niches and source of food for animals	**Sensitivity:**	Medium-low
Need for rehabilitation	Clearing of alien invasive vegetation	**Agricultural potential**	Low

Vegetation structure		
Layer	**Height (m)**	**Cover (%)**
High shrubs	2 – 4	50
Low Shrubs	0.2 – 0.6	3
Grass	0.1 – 0.4	5
Forbs	0.05 – 1	5

Dominant species	*Ziziphus mucronata, Acacia mellifera, Grewia flava, Diospyros lycioides*

This community forms a narrow band around the pan-like depressions, where it benefits from seasonally higher moisture levels; hence its occurrence in the study area is extremely limited. The substrate is mostly surface calcrete with fragment size ranging from gravel to about 15 cm diameter. The high base-content of the substrate is in general responsible for the lack of a strong grass layer here, as the upper soils are too dry for the persistence of larger perennial grasses. It consists of very dense, high shrubs with growth underneath limited to shade-adapted species. Many of these shade-loving species will be restricted to these kinds of habitats, and species diversity in these habitats can be very high. On the edges of the high shrubs, partially protected by the latter, are often dense and large tufts of palatable grasses such as *Sporobolus fimbriatus* (dropseed). This vegetation is relatively typical for riverine fringes and pan-edges, where it provides shelter and nesting habitat to mostly smaller mammals and birds. In addition, it is quite common that a multitude of shrubs flourish here that bear some kinds of berries – and although such species themselves are not of high conservation value, they do provide an important source of food for animals, thus again increasing its value in terms of ecosystem function. Examples of such berry-bearing shrubs are *Diospyros lycioides* (Bluebush), *Grewia flava* (Velvet Raisin) and *Ziziphus mucronata* (Buffalo Thorn). This habitat is prone to invasion by indigenous as well as alien invasive species, and excessive density of shrubs and weeds decreases its value as habitat for other organisms.

Species composition and typical observed cover percentages:

Species	**Status**	**avg %**	**max %**
High shrubs			
Acacia mellifera s. detinens	W M	15	30
Diospyros lycioides	M	5	
Grewia flava	M	5	10
Lycium cinereum		0.5	
Tarchonanthus camphoratus	M	3	
Ziziphus mucronata	M	20	30
Low shrubs			
Asparagus cooperi		0.2	
Melhania virescens		0.2	

Species	**Status**	**avg %**	**max %**
Melolobium candicans		0.1	
Monechma divaricatum		0.1	
Pentzia calcarea		0.5	
Herbs and forbs			
Bidens bipinnata	W M	0.2	
Nidorella resedifolia		0.5	
Pupalia lappacea	W M	0.2	
Selago densiflora		0.2	
Grasses			

Species	Status	avg %	max %
Aristida adscensionis		0.3	
Enneapogon cenchroides		0.2	
Enneapogon desvauxii		0.5	1
Eragrostis echinochloidea		0.1	
Eragrostis lehmanniana		0.5	

Species	Status	avg %	max %
Heteropogon contortus		0.2	1
Melinis repens s. repens		0.1	
Setaria verticillata		0.1	2
Sporobolus fimbriatus		0.3	2

General management recommendations:

This habitat should be avoided as far as possible during construction, and due to the likely higher presence of especially birds and smaller mammals here and the preceding vegetation type, it is recommended that a buffer zone of ideally at least 500 m be maintained around these habitats. A program to decrease and then monitor excessive invasive species and also monitor and eradicate all alien invasive species is highly recommended.

5.1.4. *Pentzia incana – Enneapogon desvauxii* dwarf shrublands

Habitat and Land use			
Substrate	Surface calcrete, mostly gravel and smaller fragments	**Disturbance**	Excessive grazing, burrowing by small mammals
Species Richness	42 of 131 expected species recorded	**Conservation value:**	Low
Ecosystem function	Specialised habitat for increasing overall biodiversity of the area	**Sensitivity:**	Least concern
Need for rehabilitation	Eradication of alien invasives	**Agricultural potential**	Low

Vegetation structure		
Layer	**Height (m)**	**Cover (%)**
High shrubs	1 - 2	1 - 3
Low Shrubs	0.2 – 0.8	10 - 15
Grass	0.05 – 0.6	5 - 15
Forbs	0.01 – 0.7	2 - 5
Dominant species.	*Pentzia incana, Chrysocoma ciliata, Enneapogon desvauxii*	

This vegetation type and habitat has a restricted occurrence throughout the savanna biome. The presence of surface calcrete in the otherwise more sandy savanna is considered a first indicator for the possible presence of groundwater.

Hence, many homesteads and additional watering points of farms have been built very close to – but not on – such areas of surface calcrete as boreholes sunk there yielded sufficient water to support the homestead or paddock. As a result, however, this is often the type of habitat that gets excessively trampled and grazed over time as livestock crosses it on a daily basis from and to the paddocks or watering points. The same applies to this habitat in the study area. It is restricted to a relatively small area just north of the remains of the railway siding, and on satellite imagery the fence line contrast caused by continued overgrazing is very clear.

In general, due to the high base content of the soil and the finer texture of soil particles between the rocky fragments, the substrate has a much more xeric (arid) nature than surrounding soils. Vegetation is thus typically distinctly different from the surrounding vegetation. Species that do manage to persist here are of a more karooid nature – being low shrubs and sparse, low grasses, and such species are much more abundant in the Nama-Karoo biome. On occasion these calcrete plains host a number of species of high grazing value and conservation concern, but on the study area this was not the case. Rather, there was a high presence of invasive and alien species such as *Aristida adscensionis* (annual bristle-grass) that typically invades as more palatable grasses become depleted, and the troublesome *Prosopis glandulosa* (Mesquite) and *Alternanthera pungens* (paper thorn).

Species composition and typical observed cover percentages:

Species	**Status**	**avg %**	**max %**
High shrubs			
Acacia hebeclada	M	0.3	
Acacia mellifera s. detinens	W M	0.3	
Gymnosporia buxifolia		0.3	
Lycium cinereum		0.3	
Prosopis glandulosa	**A**	**0.5**	
Tarchonanthus camphoratus	M	0.2	
Low shrubs			
Asparagus suaveolens	M	0.2	
Chrysocoma ciliata	M	5	
Hermannia comosa		0.1	
Melhania virescens		0.5	
Melolobium candicans		0.2	

Species	**Status**	**avg %**	**max %**
Pentzia calcarea		3	
Pentzia incana	M	8	
Solanum catombelense	M	0.2	
Zygophyllum incrustatum		0.2	
Herbs and forbs			
Alternanthera pungens	**A**	**1**	
Commicarpus pentandrus	M	0.1	
Cucumis africanus	M	0.1	
Eriospermum species		0.1	
Felicia muricata		1	
Geigeria ornativa	W M	0.2	
Helichrysum cerastioides		0.1	
Hermannia bicolor		0.1	

Species	Status	avg %	max %
Hermannia coccocarpa		0.1	
Limeum sulcatum		0.1	
Phyllanthus maderaspatensis	M	0.2	
Phyllanthus pentandrus		0.1	
Selago densiflora		1	
Senna italica	M	0.5	
Sesamum capense		0.1	
Tephrosia purpurea	M	0.1	
Trianthema parvifolia		0.1	
Tribulus terrestris	W M	0.2	

Species	Status	avg %	max %
Grasses			
Aristida adscensionis		3	
Aristida congesta		0.2	
Enneapogon cenchroides		0.5	
Enneapogon desvauxii		5	
Eragrostis nindensis		0.3	1
Melinis repens s. repens		0.1	
Oropetium capense		0.2	
Schmidtia pappophoroides		1	2
Stipagrostis uniplumis		0.3	5
Tragus koelerioides		0.1	
Tragus racemosus	W	0.2	

General management recommendations:

As a first priority, all alien invasive species must be cleared from this vegetation as well as from the surrounding remnants of the railway siding, where alien species such as *Opuntia ficus-indica* (prickly pear), *Melia azedarach* (Syringa) and *Schinus molle* (Brazilian pepper tree) have been observed in addition to the already listed alien species. Care must also be taken during construction to limit the spread of the paper thorn and *Tribulus terrestris* (dubbeltjie) or prevent it altogether. Ground squirrels that were found on these calcrete plains will most likely move during construction to other suitable habitats.

Figure 7: View of community 4, the yellow-flowering shrub is *Chrysocoma ciliata*. Note the surface calcrete.

5.2. Sensitivity Analysis

5.2.1. *Acacia mellifera – Stipagrostis uniplumis* bushlands

Species summary	Indigenous	Aliens, Weeds	Total	Red Data	Protected	Medicinal
Trees	1		**1**	1	1	1
High shrubs	9	1	**9**		1	7
Low shrubs	13		**13**			8
Forbs	24	3	**25**		1	10
Grasses	14	1	**14**			
Total	**61**	**4**	**62**	**1**	**3**	**26**

Conservation status: Least Concern with small area of Medium-Low*

Ecosystem function: Grazing and browsing, denser stands of larger trees provide additional niches and habitats for other plants as well as for animals

Stability: the current degraded state is a stable state; hence improvement can only occur with costly human intervention in the form of de-bushing

Reversibility of degradation: the herb layer can be rehabilitated to an acceptable level of productivity as lower substrate levels will not be disturbed by the development, and the sandy topsoil has a good water infiltration. However, the re-establishment of large trees may need some initial assistance until established, and then will take decades before reaching the former size and functionality

Rating: Least Concern with one area of Medium – low*

* Medium-low on a grove of Camelthorn trees towards the south-east of the study area.

5.2.2. *Pentzia calcarea – Cynodon dactylon* grasslands

Species summary	Indigenous	Aliens, Weeds	Total	Red Data	Protected	Medicinal
Trees			**0**			
High shrubs			**0**			
Low shrubs	2		**2**			1
Forbs	4	3	**7**			2
Grasses	6		**6**			1
Total	**12**	**3**	**15**	**0**	**0**	**4**

Conservation status: Low

Ecosystem function: Seasonal preferential grazing, short-lived surface water, support of surrounding vegetation types, seasonal wetland functionality

Stability: easily invaded by weeds and alien invasive species, cover may vary significantly from one year to the next, easily degraded by excessive trampling and overgrazing

Reversibility of degradation: the rehabilitation of the herb layer will only be possible if the existing micro topography and topsoil characteristics of this and the immediately surrounding environment is maintained

Rating: Medium-Low

5.2.3. *Ziziphus mucronata – Acacia mellifera* bushlands

Species summary	Indigenous	Aliens, Weeds	Total	Red Data	Protected	Medicinal
Trees			**0**			
High shrubs	6	1	**6**			
Low shrubs	5		**5**			5
Forbs	4	2	**4**			2
Grasses	9		**9**			
Total	**24**	**2**	**24**	**0**	**0**	**7**

Conservation status: Medium-Low

Ecosystem function: Niches and source of food for animals

Stability: easily invaded by weeds and alien invasive species, herbaceous cover may vary significantly from one year to the next, once encroached by shrubs, this state is very stable

Reversibility of degradation: the rehabilitation of the herb layer will only be possible if the existing micro topography and topsoil characteristics of this and the immediately surrounding environment is maintained, clearing of excessive shrub may aid in an improved herb layer

Rating: Medium-Low

5.2.4. *Pentzia incana – Enneapogon desvauxii* dwarf shrublands

Species	Indigenous	Aliens	Total	Red	Protected	Medicinal

summary		Weeds		Data		
Trees			**0**			
High shrubs	5	2	**6**			
Low shrubs	9		**9**			4
Forbs	17	3	**18**		0	7
Grasses	11	1	**11**			
Total	**42**	**4**	**44**	**0**	**0**	**11**

Conservation status: Low

Ecosystem function: Specialised habitat for species, thus increasing overall biodiversity of the area

Stability: due to more arid nature of soils degradation due to overgrazing and trampling will become an issue, easily invaded by alien and indigenous invasive species

Reversibility of degradation: herb and low shrub layer can be rehabilitated to some degree, but this may be slow and dependent on sufficient rainfall

Rating: Least concern*

* only in the study area it is regarded as least concern, and this is due to the extreme degradation state of this vegetation. Under less degraded conditions, these habitats usually have a higher sensitivity rating

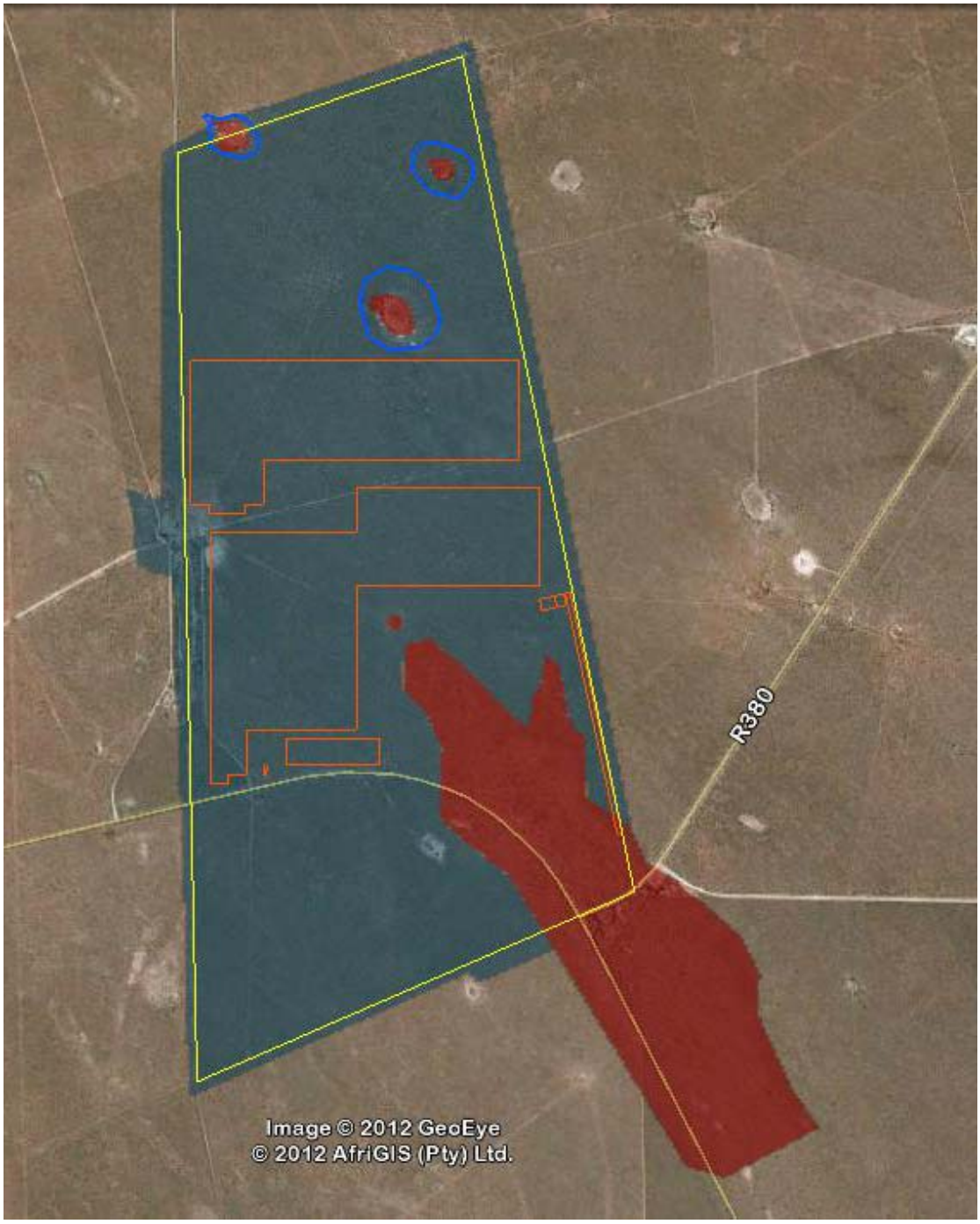

Figure 8: Sensitivity map for the study area (outlined yellow). Red indicates areas with *Medium-Low Sensitivity* that should be avoided as far as possible, the remainder of the study area, including the proposed layout (all infrastructure, including the power line route (orange outline) of the solar energy facility has a *Least Concern Sensitivity* where development can take place. The layout also avoids all wetlands with a minimum buffer zone of 500 meters around them, the latter indicated by a blue outline.

5.3. Species of conservation concern

The following red data plant species have been recorded from the area (2722) according to the new red data species list of SANBI

Species	RD Status	Suitable Habitat	Possibility of being present	Threat
Acacia erioloba E. Mey. Long-lived tree	Declining	deep sands	observed	harvesting
Boophane disticha (L.f) Herb. Geophyte – can be transplanted	Declining	variable	high	harvesting
Cleome conrathii Burtt Davy Annual herb	NT	variable	unlikely	Habitat destruction
Drimia sanguinea (Schinz) Jessop Geophyte – can be transplanted	NT	sands	low	Habitat destruction

Explanations of RD classes:

Declining: A taxon is declining if population numbers are decreasing continually due to over-exploitation or similar constant pressures.

NT: Near threatened – lower risk category of taxa being threatened, taxa are not currently the target of conservation efforts, but populations are low enough to be close to vulnerable

LC (Least Concern): A taxon is Least Concern when it has been evaluated against the five IUCN criteria and does not qualify for the categories Critically Endangered, Endangered, Vulnerable and Near Threatened, or the South African categories Critically Rare, Rare or Declining. Widespread and abundant taxa are typically listed in this category.

The following plants encountered on the study site are protected according to the Northern Cape Conservation Act (NCNCA) and the National Forestry Act (NFA)

Acacia erioloba (NFA)
Boscia albitrunca (NFA)
Jamesbrittenia atropurpurea (NCNCA)

A full list of plant species that have been recorded in the wider Kathu and Dibeng area is listed in Appendix C.

5.4. Alien invasive species

Alternanthera pungens	Paper thorn, creeper
Argemone ochroleuca	Mexican poppy, high annual forb
Datura stramonium	Malgif, common thorn-apple, high annual forb
Melia azedarach	Syringa
Opuntia ficus-indica	Prickly pear
Prosopis glandulosa	Mesquite, shrub or tree
Schinus molle	Brazilian pepper tree

Figure 9: Some of the alien invasives that will have to be eradicated. Many are concentrated around the old railway siding (above). These include *Melia azedarach* (Syringa, bottom left) and *Opuntia ficus-indica* (Prickly pear, bottom right).

5.5. Assumptions

The following is assumed:

- Development of the workshop and PV-footprint area can be entirely restricted to communities 1 and 4 and previously disturbed roads
- Existing access roads will be used and upgraded

5.6. Assessment of impacts

The proposed layout of the Solar Energy Facility and associated infrastructure (indicated in Figure 8) has been planned after the site visit, according to findings of the ecological investigation. This layout is thus considered the best option and only impacts of that layout will be discussed below.

Activity: Upgrading of existing external Access Road		
Environmental Aspect: Removal of vegetation, creation of runoff zone		
Environmental impact: disturbance of vegetation, increase in runoff, clearing of alien invasive vegetation (positive impact)		
	Without mitigation	**With mitigation**
Extent (E)	Local (1)	Local (1)
Duration (D)	Long-term (4)	Long-term (4)
Magnitude (M)	Minor (2)	Small (0)
Probability (P)	Highly Probable (4)	Highly Probable (4)
Significance (S = E+D+M)*P	**Low (28)**	**Low (20)**
Status (positive, neutral or negative)	Neutral	Positive
Reversibility	Partially reversible	Partially reversible
Irreplaceable loss of resources?	Sturdy access road already exists	Sturdy access road already exists
Can impacts be mitigated?	reasonably	
Mitigation: ▪ Reinforce portions of the track/road that are prone to erosion, create structures underneath the track/road where water would accumulate to allow free drainage where necessary		

- Prevent leakage of oil or other chemicals
- Clear all surrounding alien invasive vegetation, ensuring that no regenerative material is spread further
- Monitor the re-establishment of alien invasive species and remove as soon as detected, whenever possible before regenerative material can be formed
- After decommissioning, if access roads will not be of further use to the landowner, remove all foreign material and rip area to facilitate the establishment of vegetation

Cumulative impacts:

- possible spread and establishment of alien invasive species or prevention thereof

Residual impacts:

- improved vegetation composition and structure
- small potential for erosion

Activity: Fencing area and associated clearance strip for fire-break

Environmental Aspect: Removal of vegetation,

Environmental impact: loss of vegetation, loss of micro-habitat, window of opportunity for the establishment of alien invasive species, altered topsoil characteristics and possibility of erosion, positive: clearing of invasive shrub to provide corridors for small wildlife

	Without mitigation	**With mitigation**
Extent (E)	Local (2)	Local (2)
Duration (D)	Long-term (4)	Long term (4)
Magnitude (M)	Low (4)	Minor (2)
Probability (P)	Definite (5)	Definite (5)
Significance (S = E+D+M)*P	**Medium (50)**	**Medium (40)**
Status (positive, neutral or negative)	Neutral	Neutral and Positive
Reversibility	Largely reversible	Largely reversible
Irreplaceable loss of resources?	No	Reversible
Can impacts be mitigated?	reasonably	

Mitigation:

- Minimise area affected, especially during construction

- Wherever possible, avoid large Camelthorn trees
- Transplant bulbous species if present onto similar habitats
- Prevent leakage of oil or other chemicals
- Monitor the establishment of alien invasive species and remove as soon as detected, whenever possible *before* regenerative material can be formed

Cumulative impacts:

- possible erosion of cleared areas
- positive: reduced cover of invasive shrubs and hence new corridors for small wildlife

Residual impacts:

- altered vegetation composition

Activity: Construction of associated buildings and substation

Environmental Aspect: Removal of vegetation, compaction of soils, creation of runoff zone, possible contamination

Environmental impact: loss of vegetation, loss of micro-habitats, possibly altered chemistry of surrounding soils, window of opportunity for the establishment of alien invasive species
After decommissioning: altered topsoil characteristics and altered vegetation

	Without mitigation	**With mitigation**
Extent (E)	Local (2)	Local (2)
Duration (D)	Long-term (4)	Long-term (4)
Magnitude (M)	Moderate (6)	Low (4)
Probability (P)	Definite (5)	Definite (5)
Significance (S = E+D+M)*P	**Medium (60)**	**Medium (50)**
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Partially reversible	Largely reversible
Irreplaceable loss of resources?	Probable	Probable
Can impacts be mitigated?	Reasonably	

Mitigation:

- Keep areas affected to a minimum, however, clear out invasive shrub as far as possible between structures. This will enable the re-establishment of a grass layer

between structures that will also absorb excess runoff coming from new impervious surfaces
- Wherever possible, avoid large Camelthorns
- Clear out all invasive alien vegetation and take steps to prevent the spread of any regenerative material of such species
- Remove topsoils and redistribute to mimic the micro topography of the original vegetation to aid in revegetation
- Remove all succulent and bulbous plants and replant onto the redistributed topsoil
- Prevent leakage of oil or other chemicals or pollutants
- Monitor the re-establishment of alien invasive species and remove as soon as detected, whenever possible *before* regenerative material can be formed
- After decommissioning, remove all foreign material, rip to loosen topsoils, undertake active revegetation, monitor and prevent new bush-encroachment

Cumulative impacts:
- possible erosion
- possible contamination of surrounding areas
- possible spread and establishment of alien invasive species to wider areas

Residual impacts:
- altered (improved) vegetation composition
- altered topsoil characteristics
- very slow recovery of large trees

Activity: Construction and operation of PV panels

Environmental Aspect: Removal of vegetation, compaction of soils, creation of localised runoff zones, artificial shading of vegetation

Environmental impact: loss of vegetation, alteration of microhabitats, altered vegetation cover, altered distribution of rainfall and resultant runoff patterns, increase in runoff and possible erosion

	Without mitigation	**With mitigation**
Extent (E)	Local (2)	Local (1)
Duration (D)	Long-term (4)	Long-term (4)
Magnitude (M)	High (8)	Moderate (6)
Probability (P)	Definite (5)	Definite (5)
Significance (S = E+D+M)*P	**High (70)**	**Medium (55)**
Status (positive, neutral or negative)	Negative	Neutral

Reversibility	Partially reversible	Largely reversible
Irreplaceable loss of resources?	Probable	Probable
Can impacts be mitigated?	Reasonably	
Mitigation: ▪ Keep areas affected to a minimum, however, clear out all indigenous encroaching bush and alien invasive species ▪ Monitor the area below the PV panels regularly after larger rainfall events to determine where erosion may be initiated and then determine the most practical mitigation measure ▪ Transplant bulbous species to suitable surrounding habitat should they be negatively affected by the shading ▪ Aim to maintain a reasonable cover of indigenous perennial vegetation, preferably dwarf shrubs or grasses, but monitor the density as to not create a fire risk. Occasional mowing may be necessary if a dense high grass layer establishes ▪ Prevent leakage of oil or other chemicals ▪ Monitor the establishment of alien invasive species and remove as soon as detected, whenever possible before regenerative material can be formed		
Cumulative impacts: ▪ possible erosion of areas below the edges of the PV panels ▪ possible spread and establishment of alien or indigenous invasive species ▪ possible alteration of species composition after encroaching shrub has been cleared		
Residual impacts: ▪ altered topsoil characteristics ▪ altered (improved) vegetation composition		

Activity: Construction of power line		
Environmental Aspect: Removal of vegetation, compaction of soils		
Environmental impact: loss of vegetation, increase in runoff and erosion		
	Without mitigation	**With mitigation**
Extent (E)	Local (1)	Local (1)
Duration (D)	Long-term (4)	Long-term (4)
Magnitude (M)	Minor (2)	Small (0)
Probability (P)	Probable (3)	Probable (3)
Significance	**Low (27)**	**Low (15)**

(S = E+D+M)*P		
Status (positive, neutral or negative)	Neutral	Positive
Reversibility	Largely reversible	Largely reversible
Irreplaceable loss of resources?	Improbable	Improbable
Can impacts be mitigated?	reasonably	
Mitigation: ▪ Place pylons in a way to avoid the damage to large indigenous trees ▪ Clear out all alien invasive species and encroaching shrubs underneath the line and in close proximity thereof ▪ prevent spillage of construction material beyond area affected ▪ Monitor the re-establishment of alien invasive species and remove as soon as detected, whenever possible before regenerative material can be formed		
Cumulative impacts: ▪ Improvement of grass layer and source of grass seed for surrounding areas (positive) ▪ Creation of new corridors for movement of animals (positive)		
Residual impacts: ▪ Very localised alteration of soil surface characteristics ▪ Improved vegetation composition		

5.7. Limitations of study

There is a key difference between the approach of the ecological consultant and that of the ecological researcher. In consultancy, judgements have to be made and advice provided that is based on the best available evidence, combined with collective experience and professional opinion. The available evidence may not be especially good, potentially leading to over-simplification of ecological systems and responses, and do contain a considerable deal of uncertainty. This is opposed to ecological research, where evidence needs to be compelling before conclusions are reached and research is published (Hill & Arnold 2012). The best option available to the consulting industry is to push for more research to be conducted to address its questions. However, such research is often of a baseline nature and thus attracts little interest by larger institutions that need to do innovative research to be able to publish and attract the necessary funding. Clients in need of ecological assessments are used to funding such assessments,

but are seldom willing to fund further research to monitor the effects of developments. Furthermore, a review to test the accuracy of the predictions of an ecologist following completion of the development is very rarely undertaken, which means the capacity to predict the future is not tested and therefore remains unknown (Hill & Arnold 2012).

Predictions on future changes on ecosystems and populations once a development has happened are seldom straightforward, except in cases of such as the total loss of a habitat to development. However, most development impacts are indirect, subtle, and cumulative or unfold over several years following construction or commencement of the operation of the development. Whilst a possible mechanism for an impact to occur can usually be identified; the actual likelihood of occurrence and its severity are much harder to describe (Hill & Arnold 2012).

A closely related issue is that of the effectiveness of ecological mitigation which stems from ecological assessments, as well as in response to legal and planning policy requirements for development. Many recommendations may be incorporated into planning conditions or become conditions of protected species licences, but these recommendations are implemented to varying degrees, with most compliance being for the latter category, protected species, because there is a regulatory framework for implementation. What is often missing is the follow-up monitoring and assessment of the mitigation with sufficient scientific rigour or duration to determine whether the mitigation, compensation or enhancement measure has actually worked in the way intended (Hill & Arnold 2012).

6. DISCUSSION AND CONCLUSION

Large tracts of the southern African savannas have lost their grazing value and hence agricultural potential to extensive bush encroachment over the past decades. The study area is also severely affected by this form of degradation and hence it is understandable that, from an economic point of view, possibilities of increasing economic returns on this piece of land are desirable. Extensive mining operations in the close vicinity are in need of electricity, and it should be encouraged that at least a portion of this electricity is contributed through clean, renewable resources.

The four vegetation units identified on the study area are not unique occurrences, but part of a much larger distribution of similar habitats, although the aerial extent of the communities 2, 3 and 4 is in general limited. Communities 2 and 3 are relatively interconnected and close together. As mentioned, the vegetation is much degraded with low species diversity and immensely weakened herb layer. The clearing of bush alone, although the area will be developed, may improve the species composition of the immediate vicinity.

The extent to which the vegetation will be impacted will not greatly affect the survival of the species concerned, even if taking the adjacent developments (Kathu and Sishen Solar) into consideration. Whilst some protected trees will be sacrificed, the layout has been planned to avoid the larger groves of Camelthorn trees that were observed on site, as well as the small pan-like areas. The study area does not fall within critical biodiversity areas (BGIS). The soils are not very erodible at present due to their texture and near-absent slope, and the re-establishment of a somewhat denser forb- , grass- or low shrub layer between or surrounding the development will greatly avoid soils becoming prone to wind erosion. No ecological reason thus exists for the development not to proceed.

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8. APPENDIX A: DECLARATION OF INDEPENDENCE

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/
NEAS Reference Number:	DEAT/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010

PROJECT TITLE

San Solar Energy Facility

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4.2 The specialist appointed in terms of the Regulations_

I, declare that -- Marianne Strohbach

General declaration:

- I act as the independent specialists in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

Savannah Environmental (Pty) Ltd

Name of company (if applicable):

18 May 2012

Date:

9. APPENDIX B: ABRIDGED *CURRICULUM VITAE* OF SPECIALIST

ABRIDGED CURRICULUM VITAE

MARIANNE STROHBACH

SAVANNAH ENVIRONMENTAL (PTY) LTD

Profession : Specialist Scientist

Specialisation : Plant Ecology and Botany, with special reference to vegetation mapping, vegetation state assessment, dynamics of arid and semi-arid vegetation and population dynamics of harvested plants, conservation planning

Work experience: Twenty (20) years active in Plant Ecology

SKILLS BASE AND CORE COMPETENCIES

- Four years Plant Conservation (Namibia)
- 16 years active research in vegetation mapping, vegetation state assessment, vegetation and plant population dynamics, long-term vegetation monitoring
- Advisory to International Standards for plant species that are harvested for commercial purposes
- Research Project Management
- Ecological assessments for developmental purposes (BAR, EIA)
- Working knowledge of environmental planning policies, regulatory frameworks and legislation
- Identification and assessment of potential environmental impacts and benefits
- Development of practical and achievable mitigation measures and management plans and evaluation of risk to project execution
- Experienced in environmental monitoring
- Completed projects in several Provinces of South Africa, as well as Zimbabwe and Namibia

EDUCATION AND PROFESSIONAL STATUS

Degrees:

2003 M.Sc. in Botany, University of Pretoria, Pretoria, RSA

1991 B.Sc. Hons in Botany, Nelson Mandela Metropolitan University, Port Elizabeth, RSA

1990 B.Sc. in Biological Sciences, Nelson Mandela Metropolitan University, Port Elizabeth

Short Courses:

2008 Landscape Functional Analysis for vegetation condition and restoration monitoring

2002 Satellite Image Analysis for Vegetation Mapping, German Aerospace Centre (DLR) Cologne/Würzburg, Germany

Methods and Techniques of Environmental Management, Deutsche Stiftung für Internationale Entwicklung, Berlin, Germany

1993 Conservation Law Enforcement, Ministry of Environment and Tourism, Namibia

Professional Society Affiliations:

South African Association for Botanists

Association of Desert Net International

The South African Council for Natural Scientific Professions: Pr. Sci. Nat. Reg. No. 400079/10 (Botany and Ecology)

EMPLOYMENT

Current: Ecologist, Savannah Environmental (Pty) Ltd
2011: Lecturer, Plant Ecology, University of Pretoria
1997 onwards: working as vegetation ecologist on a freelance basis, involved in part-time positions and contractual research as outlined below
1995 to 1996: Agricultural Researcher at the National Botanical Research Institute, Windhoek, Namibia
1992 to 1995: Vegetation ecologist at the Ministry of Environment and Tourism, Namibia, Directorate of Scientific Services

Past Affiliations and Research

2001 – 2010: contractual work with BIOTA (BIOdiversity Transect analysis in Africa) as affiliate to the National Botanical Research Institute, Namibia.
Deliverables:
Project management, including research proposal, financial management and project implementation.

Modelling of Savanna Dynamics:
Collating and summarising available phytosociological data for ecological modellers to use in creating a generic savanna model for the Namibian savannas
Defining plant functional types to simplify vegetation data and to use as indicators in monitoring techniques by livestock farmers

Vegetation Patterns and Processes in Namibian Savannas:
Small scale monitoring of vegetation dynamics over a range of soil conditions and seasons
Determine ecological barriers to and best practice for rangeland restoration

Vegetation classification and mapping in Central Namibia:
Collection and analysis of phytosociological baseline data for the central Thornbush Savanna in Namibia, delineation of vegetation types with the aid of satellite imagery

2006: German Scientific Authority to CITES, Plants, Federal Agency for Nature Conservation
International Standard for the Sustainable Wild Collection of Medicinal & Aromatic Plants
Assisting in the compilation of a reference guide for minimum research standards necessary to ensure sustainable use of economically utilised plants (updated in FairWild Standard Version 2, 2010)

2004: contractual work for Desert Research Foundation of Namibia
Vegetation description and mapping of the Namibian Eastern Communal Areas and assess

possible development options using indigenous plant resources

1997 to 2010: contractual work with CRIAA-SADC as ecologist.
Deliverables:
The Sustainably Harvested Devil's Claw Project:
Annual surveys of Harpagophytum populations to determine harvesting quotas for rural communities
Determine and monitor impact of harvesting frequency and techniques on survival of Harpagophytum procumbens
Educate harvester communities on issues of resource management
In collaboration with the German Federal Agency for Nature Conservation
This work was extended in 2006 to the Hwange Area, NW Zimbabwe, together with Africa Now

Pilot Devil's Claw cultivation trials:
Increase available resources of Harpagophytum procumbens
Give communities ownership and better access of their resources to improve their income

Namibian National Devil's Claw Situation Analysis:
Design and implement a country-wide survey of Harpagophytum species to assess resource availability compared to annual export figure

1999 to 2001: Assistant curator at the Swakopmund Museum (part-time position)
Help maintain existing collections and exhibits , design and create new exhibits for the museum in collaboration with the Museum Hannover, Germany

Specialist Scientist Vegetation Surveys and related Impact Assessments were done for following clients:
Langer Heinrich Uranium Pty (Ltd): Central Namib Desert, Namibia
University of Namibia, Hentiesbay Research Centre: West Coast, Namibia
Sasol – Limpopo Province
EcoAgent – Northern Cape, Eastern Cape, Limpopo and Mpumalanga
Namwater – Karst aquifers, north-central Namibia
ENVASS (for AfriDevo) – Northern Cape

10. APPENDIX C: SUPPLEMENTARY INFORMATION

10.1. Plant species recorded in the wider area

Species	Threat status, SA endemic	Growth forms
Download from POSA (http://posa.sanbi.org) on May 25, 2012, 1:13 pm Grid: 2722		
Acacia erioloba E.Mey.	**Declining**	**Tree**
Acacia karroo Hayne	LC	Tree
Olea europaea L. subsp. africana (Mill.) P.S.Green	LC	Tree
Searsia lancea (L.f.) F.A.Barkley	LC	Tree
Tamarix parviflora DC.	NE	Tree
Terminalia sericea Burch. ex DC.	LC	Tree
Vangueria infausta Burch. subsp. infausta	LC	Tree
Adenia repanda (Burch.) Engl.	LC	Succulent
Aloe claviflora Burch.	LC	Succulent
Anacampseros filamentosa (Haw.) Sims subsp. filamentosa	LC, end	Succulent
Antimima lawsonii (L.Bolus) H.E.K.Hartmann	Rare	Succulent
Avonia albissima (Marloth) G.D.Rowley	LC	Succulent
Bulbine frutescens (L.) Willd.	LC	Succulent
Crassula campestris (Eckl. & Zeyh.) Endl. ex Walp.	LC, end	Succulent
Crassula lanceolata (Eckl. & Zeyh.) Endl. ex Walp. subsp. transvaalensis (Kuntze) Toelken	LC	Succulent
Crassula sarcocaulis Eckl. & Zeyh. subsp. rupicola Toelken	LC	Succulent
Crassula subaphylla (Eckl. & Zeyh.) Harv. var. subaphylla	LC	Succulent
Ebracteola wilmaniae (L.Bolus) Glen	LC, end	Succulent
Euphorbia caterviflora N.E.Br.	LC, end	Succulent
Euphorbia duseimata R.A.Dyer	LC	Succulent
Euphorbia mauritanica L. var. mauritanica	LC	Succulent
Euphorbia mundii N.E.Br.	LC	Succulent
Euphorbia pseudotuberosa Pax	LC	Succulent
Euphorbia rectirama N.E.Br.	LC	Succulent
Euphorbia wilmaniae Marloth	LC, end	Succulent
Haworthia venosa (Lam.) Haw. subsp. tessellata (Haw.) M.B.Bayer	LC	Succulent
Ipomoea simplex Thunb.	LC	Succulent
Kalanchoe brachyloba Welw. ex Britten	LC	Succulent
Kalanchoe lanceolata (Forssk.) Pers.	LC	Succulent
Kalanchoe rotundifolia (Haw.) Haw.	LC	Succulent
Kleinia longiflora DC.	LC	Succulent
Orbea lutea (N.E.Br.) Bruyns subsp. lutea	LC	Succulent
Pelargonium senecioides L'Hér.	LC, end	Succulent
Piaranthus decipiens (N.E.Br.) Bruyns	LC	Succulent
Portulaca hereroensis Schinz	LC	Succulent
Portulaca kermesina N.E.Br.	LC	Succulent

Portulaca quadrifida L.	LC	Succulent
Prepodesma orpenii (N.E.Br.) N.E.Br.	LC, end	Succulent
Sarcostemma viminale (L.) R.Br. subsp. viminale	LC	Succulent
Talinum tenuissimum Dinter	LC	Succulent
Tetragonia calycina Fenzl	LC	Succulent
Trianthema parvifolia E.Mey. ex Sond. var. parvifolia	LC	Succulent
Zygophyllum pubescens Schinz	LC	Succulent
Acacia haematoxylon Willd.	LC	Shrub, tree
Acacia hebeclada DC. subsp. hebeclada	LC	Shrub, tree
Acacia hereroensis Engl.	LC	Shrub, tree
Grewia occidentalis L. var. occidentalis	LC	Shrub, tree
Acacia mellifera (Vahl) Benth. subsp. detinens (Burch.) Brenan	LC	Shrub
Asparagus exuvialis Burch. forma exuvialis	NE	Shrub
Asparagus laricinus Burch.	LC	Shrub
Asparagus nelsii Schinz	LC	Shrub
Asparagus retrofractus L.	LC	Shrub
Asparagus suaveolens Burch.	LC	Shrub
Buddleja saligna Willd.	LC	Shrub
Calobota cuspidosa (Burch.) Boatwr. & B.-E.van Wyk	LC	Shrub
Chrysocoma ciliata L.	LC	Shrub
Crotalaria spartioides DC.	LC	Shrub
Crotalaria virgultalis Burch. ex DC.	LC	Shrub
Croton gratissimus Burch. var. gratissimus	LC	Shrub
Deverra burchellii (DC.) Eckl. & Zeyh.	LC	Shrub
Dichrostachys cinerea (L.) Wight & Arn. subsp. africana Brenan & Brummitt	LC	Shrub
Dimorphotheca cuneata (Thunb.) Less.	LC	Shrub
Diospyros austro-africana De Winter var. microphylla (Burch.) De Winter	LC	Shrub
Diospyros lycioides Desf. subsp. lycioides	LC	Shrub
Erica flanaganii Bolus	LC	Shrub
Euclea crispa (Thunb.) Gürke subsp. ovata (Burch.) F.White	LC, end	Shrub
Euclea undulata Thunb.	LC	Shrub
Grewia flava DC.	LC	Shrub
Gymnosporia buxifolia (L.) Szyszyl.	LC	Shrub
Lycium cinereum Thunb.	LC	Shrub
Lycium hirsutum Dunal	LC	Shrub
Lycium pilifolium C.H.Wright	LC	Shrub
Lycium schizocalyx C.H.Wright	LC	Shrub
Montinia caryophyllacea Thunb.	LC	Shrub
Nymania capensis (Thunb.) Lindb.	LC	Shrub
Parkinsonia africana Sond.	LC	Shrub
Putterlickia pyracantha (L.) Szyszyl.	LC, end	Shrub
Putterlickia saxatilis (Burch.) M.Jordaan	LC, end	Shrub
Rhigozum obovatum Burch.	LC	Shrub

Rhigozum trichotomum Burch.	LC	Shrub
Rubus rosifolius Sm.	NE	Shrub
Searsia burchellii (Sond. ex Engl.) Moffett	LC	Shrub
Searsia dregeana (Sond.) Moffett	LC	Shrub
Searsia leptodictya (Diels) T.S.Yi, A.J.Mill. & J.Wen forma leptodictya	NE	Shrub
Searsia rigida (Mill.) F.A.Barkley var. rigida	LC, end	Shrub
Searsia tenuinervis (Engl.) Moffett	LC	Shrub
Searsia tridactyla (Burch.) Moffett	LC, end	Shrub
Tarchonanthus camphoratus L.	LC	Shrub
Tarchonanthus obovatus DC.	LC, end	Shrub
Acanthosicyos naudinianus (Sond.) C.Jeffrey	LC	Scrambler
Argyrolobium argenteum Eckl. & Zeyh.	LC, end	Scrambler
Citrullus lanatus (Thunb.) Matsum. & Nakai	LC	Scrambler
Corbichonia decumbens (Forssk.) Exell	LC	Scrambler
Ipomoea bolusiana Schinz	LC	Scrambler
Orthanthera jasminiflora (Decne.) Schinz	LC	Scrambler
Otoptera burchellii DC.	LC	Scrambler
Tapinanthus oleifolius (J.C.Wendl.) Danser	LC	Parasite
Viscum rotundifolium L.f.	LC	Parasite
Berula thunbergii (DC.) H.Wolff	LC	Hydrophyte
Equisetum ramosissimum Desf. subsp. ramosissimum	LC	Hydrophyte
Hydrocotyle verticillata Thunb.	LC	Hydrophyte
Nymphaea nouchali Burm.f. var. caerulea (Savigny) Verdc.	LC	Hydrophyte
Persicaria lapathifolia (L.) Gray	NE	Hydrophyte
Samolus valerandi L.	LC	Hydrophyte
Veronica anagallis-aquatica L.	LC	Hydrophyte
Utricularia gibba L.	LC	Herb (carnivore)
Achyranthes aspera L. var. aspera	NE	Herb
Achyranthes aspera L. var. pubescens (Moq.) C.C.Towns.	NE	Herb
Acrotome inflata Benth.	LC	Herb
Aerva leucura Moq.	LC	Herb
Alectra pumila Benth.	LC	Herb
Alternanthera pungens Kunth	NE	Herb
Amaranthus hybridus L. subsp. hybridus var. hybridus	NE	Herb
Amaranthus thunbergii Moq.	LC	Herb
Amellus tridactylus DC. subsp. arenarius (S.Moore) Rommel	LC	Herb
Anchusa capensis Thunb.	LC	Herb
Arctotis arctotoides (L.f.) O.Hoffm.	LC	Herb
Arctotis venusta Norl.	LC	Herb
Argemone ochroleuca Sweet subsp. ochroleuca	NE	Herb
Aster squamatus (Spreng.) Hieron.	NE	Herb
Baccharoides adoensis (Sch.Bip. ex Walp.) H.Rob. var. kotschyana	LC	Herb
Barleria bechuanensis C.B.Clarke	LC, end	Herb

Barleria macrostegia Nees	LC	Herb
Barleria media C.B.Clarke	LC, end	Herb
Bergia anagalloides E.Mey. ex Fenzl	LC	Herb
Bergia pentheriana Keissl.	LC	Herb
Berkheya pinnatifida (Thunb.) Thell. subsp. pinnatifida	LC, end	Herb
Bidens pilosa L.	NE	Herb
Blepharis integrifolia (L.f.) E.Mey. ex Schinz var. integrifolia	LC	Herb
Bolusia acuminata (DC.) Polhill	LC	Herb
Brassica tournefortii Gouan	NE	Herb
Ceratotheca triloba (Bernh.) Hook.f.	LC	Herb
Chaenostoma patrioticum (Hiern) Kornhall	LC	Herb
Chamaecrista biensis (Steyaert) Lock	LC	Herb
Chamaecrista mimosoides (L.) Greene	LC	Herb
Chascanum adenostachyum (Schauer) Moldenke	LC	Herb
Chascanum hederaceum (Sond.) Moldenke var. hederaceum	LC	Herb
Chascanum pinnatifidum (L.f.) E.Mey. var. pinnatifidum	LC	Herb
Chascanum schlechteri (Gürke) Moldenke	LC	Herb
Chenopodium ambrosioides L.	NE	Herb
Chenopodium cristatum F.Muell.	NE	Herb
Chenopodium hederiforme (Murr) Aellen var. undulatum Aellen	LC	Herb
Chenopodium opulifolium Schrad. ex W.D.J.Koch & Ziz var. opulifolium	NE	Herb
Chironia palustris Burch. subsp. palustris	LC	Herb
Chlorophytum fasciculatum (Baker) Kativu	LC	Herb
Cirsium vulgare (Savi) Ten.	NE	Herb
Cleome angustifolia Forssk. subsp. diandra (Burch.) Kers	LC	Herb
Cleome conrathii Burtt Davy	**NT**	**Herb**
Cleome kalachariensis (Schinz) Gilg & Gilg-Ben.	LC	Herb
Cleome oxyphylla Burch. var. oxyphylla	LC	Herb
Cleome rubella Burch.	LC	Herb
Commelina africana L. var. africana	LC	Herb
Commelina africana L. var. barberae (C.B.Clarke) C.B.Clarke	LC	Herb
Commelina africana L. var. krebsiana (Kunth) C.B.Clarke	LC	Herb
Commelina africana L. var. lancispatha C.B.Clarke	LC	Herb
Commelina livingstonii C.B.Clarke	LC	Herb
Commelina modesta Oberm.	LC	Herb
Convolvulus boedeckerianus Peter	LC, end	Herb
Convolvulus multifidus Thunb.	LC, end	Herb
Convolvulus ocellatus Hook.f. var. ocellatus	LC	Herb
Convolvulus sagittatus Thunb.	LC	Herb
Conyza bonariensis (L.) Cronquist	NE	Herb
Conyza pinnata (L.f.) Kuntze	LC	Herb
Corchorus asplenifolius Burch.	LC	Herb
Corchorus pinnatipartitus Wild	LC	Herb

Coronopus integrifolius (DC.) Spreng.	NE	Herb
Crotalaria griquensis L.Bolus	LC	Herb
Crotalaria leubnitziana Schinz	LC	Herb
Crotalaria podocarpa DC.	LC	Herb
Crotalaria sphaerocarpa Perr. ex DC. subsp. sphaerocarpa	LC	Herb
Cucumis africanus L.f.	LC	Herb
Cucumis heptadactylus Naudin	LC, end	Herb
Cucumis myriocarpus Naudin subsp. myriocarpus	LC	Herb
Cyamopsis serrata Schinz	LC	Herb
Cyanotis speciosa (L.f.) Hassk.	LC	Herb
Dianthus namaensis Schinz var. dinteri (Schinz) S.S.Hooper	LC	Herb
Dicoma anomala Sond. subsp. gerrardii (Harv. ex F.C.Wilson) S.Ortíz & Rodr.Oubiña	LC	Herb
Dicoma macrocephala DC.	LC	Herb
Dicoma schinzii O.Hoffm.	LC	Herb
Dimorphotheca zeyheri Sond.	LC	Herb
Emex australis Steinh.	NE	Herb
Erlangea misera (Oliv. & Hiern) S.Moore	LC	Herb
Erucastrum griquense (N.E.Br.) O.E.Schulz	LC	Herb
Erucastrum strigosum (Thunb.) O.E.Schulz	LC	Herb
Euphorbia inaequilatera Sond. var. inaequilatera	LC	Herb
Euphorbia peplus L.	NE	Herb
Euphorbia serpens Kunth	NE	Herb
Evolvulus alsinoides (L.) L.	LC	Herb
Felicia namaquana (Harv.) Merxm.	LC	Herb
Foveolina dichotoma (DC.) Källersjö	LC	Herb
Galium capense Thunb. subsp. capense	LC	Herb
Gazania krebsiana Less. subsp. arctotoides (Less.) Roessler	LC	Herb
Gazania krebsiana Less. subsp. serrulata (DC.) Roessler	LC	Herb
Geigeria burkei Harv. subsp. valida Merxm.	LC, end	Herb
Geigeria filifolia Mattf.	LC	Herb
Geigeria ornativa O.Hoffm. subsp. ornativa	LC	Herb
Gisekia africana (Lour.) Kuntze var. africana	LC	Herb
Gisekia africana (Lour.) Kuntze var. pedunculata (Oliv.) Brenan	NE	Herb
Gisekia pharnacioides L. var. pharnacioides	LC	Herb
Glossochilus burchellii Nees	LC	Herb
Gnaphalium englerianum (O.Hoffm.) Hilliard & B.L.Burtt	LC, end	Herb
Gnaphalium filagopsis Hilliard & B.L.Burtt	LC	Herb
Gomphrena celosioides Mart.	NE	Herb
Guilleminea densa (Willd. ex Roem. & Schult.) Moq.	NE	Herb
Harpagophytum procumbens (Burch.) DC. ex Meisn. subsp. procumbens	LC	Herb
Helichrysum argyrosphaerum DC.	LC	Herb
Helichrysum caespititium (DC.) Harv.	LC	Herb
Helichrysum cerastioides DC. var. cerastioides	LC	Herb

Helichrysum lineare DC.	LC	Herb
Helichrysum nudifolium (L.) Less. var. nudifolium	LC	Herb
Heliotropium ciliatum Kaplan	LC	Herb
Heliotropium nelsonii C.H.Wright	LC	Herb
Heliotropium ovalifolium Forssk.	LC	Herb
Heliotropium strigosum Willd.	LC	Herb
Hermannia bicolor Engl. & Dinter	LC	Herb
Hermannia comosa Burch. ex DC.	LC	Herb
Hermannia eenii Baker f.	LC	Herb
Hermannia linnaeoides (Burch.) K.Schum.	LC	Herb
Hermannia modesta (Ehrenb.) Mast.	LC	Herb
Hermannia pulverata Andrews	LC, end	Herb
Hermannia stellulata (Harv.) K.Schum.	LC	Herb
Hermannia tomentosa (Turcz.) Schinz ex Engl.	LC	Herb
Hermbstaedtia fleckii (Schinz) Baker & C.B.Clarke	LC	Herb
Hermbstaedtia odorata (Burch.) T.Cooke var. albi-rosea Suess.	LC	Herb
Hermbstaedtia odorata (Burch.) T.Cooke var. aurantiaca (Suess.) C.C.Towns.	LC	Herb
Hermbstaedtia odorata (Burch.) T.Cooke var. odorata	LC	Herb
Herniaria erckertii Herm. subsp. erckertii	LC	Herb
Hibiscus engleri K.Schum.	LC	Herb
Hibiscus fleckii Gürke	LC	Herb
Hibiscus marlothianus K.Schum.	LC, end	Herb
Hibiscus pusillus Thunb.	LC	Herb
Hirpicium echinus Less.	LC	Herb
Hypoestes forskaolii (Vahl) R.Br.	LC	Herb
Ifloga molluginoides (DC.) Hilliard	LC	Herb
Indigastrum argyraeum (Eckl. & Zeyh.) Schrire	LC	Herb
Indigastrum costatum (Guill. & Perr.) Schrire subsp. macrum (E.Mey.) Schrire	LC	Herb
Indigofera alternans DC. var. alternans	LC	Herb
Indigofera auricoma E.Mey.	LC	Herb
Indigofera daleoides Benth. ex Harv. var. daleoides	LC	Herb
Indigofera filipes Benth. ex Harv.	LC	Herb
Indigofera flavicans Baker	LC	Herb
Indigofera hololeuca Benth. ex Harv.	LC	Herb
Indigofera holubii N.E.Br.	LC	Herb
Indigofera vicioides Jaub. & Spach var. vicioides	LC	Herb
Ipomoea obscura (L.) Ker Gawl. var. obscura	LC	Herb
Jamesbrittenia aurantiaca (Burch.) Hilliard	LC	Herb
Kohautia caespitosa Schnizl. subsp. brachyloba (Sond.) D.Mantell	LC	Herb
Kyphocarpa angustifolia (Moq.) Lopr.	LC	Herb
Lepidium trifurcum Sond.	LC	Herb
Lessertia pauciflora Harv. var. pauciflora	LC	Herb
Leysera tenella DC.	LC	Herb

Limeum arenicolum G.Schellenb.	LC	Herb
Limeum fenestratum (Fenzl) Heimerl var. fenestratum	LC	Herb
Limeum pterocarpum (J.Gay) Heimerl var. pterocarpum	LC	Herb
Limeum sulcatum (Klotzsch) Hutch. var. sulcatum	LC	Herb
Limeum viscosum (J.Gay) Fenzl subsp. transvaalense Friedrich	LC, end	Herb
Lippia scaberrima Sond.	LC	Herb
Lithospermum cinereum A.DC.	LC	Herb
Lobelia erinus L.	LC	Herb
Lobelia thermalis Thunb.	LC	Herb
Lotononis burchellii Benth.	LC, end	Herb
Lotononis calycina (E.Mey.) Benth.	LC	Herb
Lotononis crumanina Burch. ex Benth.	LC	Herb
Lotononis laxa Eckl. & Zeyh.	LC	Herb
Malva pusilla Sm.	NE	Herb
Medicago laciniata (L.) Mill. var. laciniata	NE	Herb
Melhania burchellii DC.	LC	Herb
Melilotus albus Medik.	NE	Herb
Menodora africana Hook.	LC	Herb
Mentha aquatica L.	LC	Herb
Mollugo cerviana (L.) Ser. ex DC. var. cerviana	LC	Herb
Monsonia angustifolia E.Mey. ex A.Rich.	LC	Herb
Monsonia burkeana Planch. ex Harv.	LC	Herb
Nidorella hottentotica DC.	LC	Herb
Nidorella resedifolia DC. subsp. resedifolia	LC	Herb
Nolletia ciliaris (DC.) Steetz	LC	Herb
Ocimum americanum L. var. americanum	LC	Herb
Ocimum filamentosum Forssk.	LC	Herb
Oenothera indecora Cambess.	NE	Herb
Osteospermum muricatum E.Mey. ex DC. subsp. muricatum	LC	Herb
Oxalis corniculata L.	NE	Herb
Oxygonum alatum Burch. var. alatum	LC	Herb
Oxygonum delagoense Kuntze	LC	Herb
Oxygonum dregeanum Meisn. subsp. canescens (Sond.) Germish. var. canescens	LC	Herb
Persicaria hystricula (J.Schust.) Soják	LC	Herb
Phyllanthus incurvus Thunb.	LC	Herb
Phyllanthus maderaspatensis L.	LC	Herb
Phyllanthus parvulus Sond. var. garipensis (E.Mey. ex Drège) Radcl.-Sm.	LC	Herb
Phyllanthus parvulus Sond. var. parvulus	LC	Herb
Phyllanthus pentandrus Schumach. & Thonn.	LC	Herb
Pollichia campestris Aiton	LC	Herb
Pomaria lactea (Schinz) B.B.Simpson & G.P.Lewis	LC	herb
Pseudognaphalium luteo-album (L.) Hilliard & B.L.Burtt	NE	Herb
Pulicaria scabra (Thunb.) Druce	LC	Herb

Pupalia lappacea (L.) A.Juss. var. lappacea	LC	Herb
Requienia sphaerosperma DC.	LC	Herb
Rorippa fluviatilis (E.Mey. ex Sond.) Thell. var. caledonica (Sond.) Marais	LC	Herb
Rorippa fluviatilis (E.Mey. ex Sond.) Thell. var. fluviatilis	LC	Herb
Rubia horrida (Thunb.) Puff	LC	Herb
Rumex crispus L.	NE	Herb
Rumex lanceolatus Thunb.	LC	Herb
Salvia stenophylla Burch. ex Benth.	LC	Herb
Salvia verbenaca L.	LC	Herb
Scabiosa columbaria L.	LC	Herb
Seidelia triandra (E.Mey.) Pax	LC	Herb
Selago albomarginata Hilliard	LC	Herb
Selago mixta Hilliard	LC, end	Herb
Selago welwitschii Rolfe var. australis Hilliard	LC	Herb
Senecio consanguineus DC.	LC	Herb
Senecio inaequidens DC.	LC	Herb
Senecio mooreanus Hutch. & Burtt Davy	LC, end	Herb
Senna italica Mill. subsp. arachoides (Burch.) Lock	LC	Herb
Sericorema remotiflora (Hook.f.) Lopr.	LC	Herb
Sericorema sericea (Schinz) Lopr.	LC	Herb
Sesamum capense Burm.f.	LC	Herb
Sida ovata Forssk.	LC	Herb
Silene undulata Aiton	LC	Herb
Solanum nigrum L.	NE	Herb
Sonchus dregeanus DC.	LC	Herb
Sonchus oleraceus L.	NE	Herb
Spergularia media (L.) C.Presl	NE	Herb
Spermacoce deserti N.E.Br.	LC, end	Herb
Stachys spathulata Burch. ex Benth.	LC	Herb
Striga bilabiata (Thunb.) Kuntze subsp. bilabiata	LC	Herb
Striga elegans Benth.	LC	Herb
Striga gesnerioides (Willd.) Vatke	LC	Herb
Suessenguthiella scleranthoides (Sond.) Friedrich	LC	Herb
Sutera griquensis Hiern	LC, end	Herb
Syncolostemon linearis (Benth.) D.F.Otieno	LC	Herb
Taraxacum bessarabicum (Hornem.) Hand.-Mazz.	NE	Herb
Tephrosia burchellii Burtt Davy	LC	Herb
Tephrosia lupinifolia DC.	LC	Herb
Tephrosia purpurea (L.) Pers. subsp. leptostachya (DC.) Brummitt var. leptostachya	LC	Herb
Thesium dumale N.E.Br.	LC, end	Herb
Tolpis capensis (L.) Sch.Bip.	LC	Herb
Tribulus terrestris L.	LC	Herb
Tribulus zeyheri Sond. subsp. zeyheri	LC	Herb

Ursinia nana DC. subsp. nana	LC	Herb
Vahlia capensis (L.f.) Thunb. subsp. vulgaris Bridson var. linearis E.Mey. ex Bridson	LC	Herb
Vahlia capensis (L.f.) Thunb. subsp. vulgaris Bridson var. vulgaris	LC	Herb
Verbena brasiliensis Vell.	NE	Herb
Verbesina encelioides (Cav.) Benth. & Hook. var. encelioides	NE	Herb
Wahlenbergia androsacea A.DC.	LC	Herb
Wahlenbergia denticulata (Burch.) A.DC. var. denticulata	LC	Herb
Wahlenbergia denticulata (Burch.) A.DC. var. transvaalensis (Adamson) W.G.Welman	LC, end	Herb
Wahlenbergia undulata (L.f.) A.DC.	LC	Herb
Waltheria indica L.	LC	Herb
Xenostegia tridentata (L.) D.F.Austin & Staples subsp. angustifolia (Jacq.) Lejoly & Lisowski	LC	Herb
Zinnia peruviana (L.) L.	NE	Herb
Agrostis lachnantha Nees var. lachnantha	LC	Graminoid
Andropogon chinensis (Nees) Merr.	LC	Graminoid
Andropogon eucomus Nees	LC	Graminoid
Andropogon schirensis Hochst. ex A.Rich.	LC	Graminoid
Anthephora argentea Gooss.	LC	Graminoid
Anthephora pubescens Nees	LC	Graminoid
Aristida adscensionis L.	LC	Graminoid
Aristida congesta Roem. & Schult. subsp. barbicollis (Trin. & Rupr.) De Winter	LC	Graminoid
Aristida congesta Roem. & Schult. subsp. congesta	LC	Graminoid
Aristida diffusa Trin. subsp. burkei (Stapf) Melderis	LC	Graminoid
Aristida engleri Mez var. ramosissima De Winter	LC	Graminoid
Aristida junciformis Trin. & Rupr. subsp. galpinii (Stapf) De Winter	LC	Graminoid
Aristida meridionalis Henrard	LC	Graminoid
Aristida mollissima Pilg. subsp. mollissima	LC	Graminoid
Aristida stipitata Hack. subsp. graciliflora (Pilg.) Melderis	LC	Graminoid
Aristida stipitata Hack. subsp. spicata (De Winter) Melderis	LC	Graminoid
Aristida stipitata Hack. subsp. stipitata	LC	Graminoid
Aristida vestita Thunb.	LC	Graminoid
Brachiaria brizantha (A.Rich.) Stapf	LC	Graminoid
Brachiaria marlothii (Hack.) Stent	LC	Graminoid
Brachiaria nigropedata (Ficalho & Hiern) Stapf	LC	Graminoid
Brachiaria serrata (Thunb.) Stapf	LC	Graminoid
Bromus pectinatus Thunb.	LC	Graminoid
Cenchrus ciliaris L.	LC	Graminoid
Chrysopogon serrulatus Trin.	LC	Graminoid
Coelachyrum yemenicum (Schweinf.) S.M.Phillips	LC	Graminoid
Cymbopogon pospischilii (K.Schum.) C.E.Hubb.	NE	Graminoid
Cynodon dactylon (L.) Pers.	LC	Graminoid
Cynodon incompletus Nees	LC, end	Graminoid
Digitaria eriantha Steud.	LC	Graminoid

Digitaria polyphylla Henrard	LC	Graminoid
Digitaria seriata Stapf	LC	Graminoid
Diheteropogon amplectens (Nees) Clayton var. amplectens	LC	Graminoid
Eleusine coracana (L.) Gaertn. subsp. africana (Kenn.-O'Byrne) Hilu & de Wet	LC	Graminoid
Elionurus muticus (Spreng.) Kunth	LC	Graminoid
Enneapogon cenchroides (Licht. ex Roem. & Schult.) C.E.Hubb.	LC	Graminoid
Enneapogon desvauxii P.Beauv.	LC	Graminoid
Enneapogon scaber Lehm.	LC	Graminoid
Enneapogon scoparius Stapf	LC	Graminoid
Eragrostis amabilis (L.) Hook. & Arn.	LC	Graminoid
Eragrostis barrelieri Daveau	NE	Graminoid
Eragrostis bicolor Nees	LC	Graminoid
Eragrostis biflora Hack. ex Schinz	LC	Graminoid
Eragrostis capensis (Thunb.) Trin.	LC	Graminoid
Eragrostis chloromelas Steud.	LC	Graminoid
Eragrostis curvula (Schrad.) Nees	LC	Graminoid
Eragrostis echinochloidea Stapf	LC	Graminoid
Eragrostis gummiflua Nees	LC	Graminoid
Eragrostis homomalla Nees	LC	Graminoid
Eragrostis lehmanniana Nees var. lehmanniana	LC	Graminoid
Eragrostis mexicana (Hornem.) Link subsp. virescens (J.Presl.) S.D.Koch & Sánchez Vega	NE	Graminoid
Eragrostis micrantha Hack.	LC	Graminoid
Eragrostis nindensis Ficalho & Hiern	LC	Graminoid
Eragrostis obtusa Munro ex Ficalho & Hiern	LC	Graminoid
Eragrostis pallens Hack.	LC	Graminoid
Eragrostis procumbens Nees	LC	Graminoid
Eragrostis rigidior Pilg.	LC	Graminoid
Eragrostis rotifer Rendle	LC	Graminoid
Eragrostis trichophora Coss. & Durieu	LC	Graminoid
Eragrostis truncata Hack.	LC	Graminoid
Eragrostis viscosa (Retz.) Trin.	LC	Graminoid
Eragrostis x pseud-obtusa De Winter	NE	Graminoid
Eustachys paspaloides (Vahl) Lanza & Mattei	LC	Graminoid
Fingerhuthia africana Lehm.	LC	Graminoid
Helictotrichon turgidulum (Stapf) Schweick.	LC	Graminoid
Hemarthria altissima (Poir.) Stapf & C.E.Hubb.	LC	Graminoid
Heteropogon contortus (L.) Roem. & Schult.	LC	Graminoid
Hyparrhenia anamesa Clayton	LC	Graminoid
Hyparrhenia hirta (L.) Stapf	LC	Graminoid
Imperata cylindrica (L.) Raeusch.	LC	Graminoid
Lamarckia aurea (L.) Moench	NE	Graminoid
Leptochloa fusca (L.) Kunth	LC	Graminoid
Megaloprotachne albescens C.E.Hubb.	LC	Graminoid

Melinis nerviglumis (Franch.) Zizka	LC	Graminoid
Melinis repens (Willd.) Zizka subsp. grandiflora (Hochst.) Zizka	LC	Graminoid
Melinis repens (Willd.) Zizka subsp. repens	LC	Graminoid
Microchloa caffra Nees	LC	Graminoid
Oropetium capense Stapf	LC	Graminoid
Panicum coloratum L. var. coloratum	LC	Graminoid
Panicum kalaharense Mez	LC	Graminoid
Panicum maximum Jacq.	LC	Graminoid
Panicum schinzii Hack.	LC	Graminoid
Panicum stapfianum Fourc.	LC	Graminoid
Paspalum dilatatum Poir.	NE	Graminoid
Pogonarthria squarrosa (Roem. & Schult.) Pilg.	LC	Graminoid
Polypogon monspeliensis (L.) Desf.	NE	Graminoid
Schizachyrium sanguineum (Retz.) Alston	LC	Graminoid
Schmidtia pappophoroides Steud.	LC	Graminoid
Setaria sphacelata (Schumach.) Stapf & C.E.Hubb. ex M.B.Moss var. sphacelata	LC	Graminoid
Setaria sphacelata (Schumach.) Stapf & C.E.Hubb. ex M.B.Moss var. torta (Stapf) Clayton	LC	Graminoid
Setaria verticillata (L.) P.Beauv.	LC	Graminoid
Sporobolus acinifolius Stapf	LC	Graminoid
Sporobolus discosporus Nees	LC	Graminoid
Sporobolus fimbriatus (Trin.) Nees	LC	Graminoid
Sporobolus ioclados (Trin.) Nees	LC	Graminoid
Stipagrostis amabilis (Schweick.) De Winter	LC	Graminoid
Stipagrostis hirtigluma (Steud. ex Trin. & Rupr.) De Winter subsp. patula (Hack.) De Winter	LC	Graminoid
Stipagrostis obtusa (Delile) Nees	LC	Graminoid
Stipagrostis uniplumis (Licht.) De Winter var. neesii (Trin. & Rupr.) De Winter	LC	Graminoid
Stipagrostis uniplumis (Licht.) De Winter var. uniplumis	LC	Graminoid
Themeda triandra Forssk.	LC	Graminoid
Tragus berteronianus Schult.	LC	Graminoid
Tragus koelerioides Asch.	LC	Graminoid
Tragus racemosus (L.) All.	LC	Graminoid
Tricholaena monachne (Trin.) Stapf & C.E.Hubb.	LC	Graminoid
Trichoneura grandiglumis (Nees) Ekman	LC	Graminoid
Triraphis andropogonoides (Steud.) E.Phillips	LC	Graminoid
Triraphis pumilio R.Br.	LC	Graminoid
Triraphis schinzii Hack.	LC	Graminoid
Urelytrum agropyroides (Hack.) Hack.	LC	Graminoid
Urochloa panicoides P.Beauv.	NE	Graminoid
Urochloa stolonifera (Gooss.) Chippind.	LC	Graminoid
Actiniopteris radiata (J.König ex Sw.) Link	LC	Geophyte
Albuca tortuosa Baker	LC, end	Geophyte
Asplenium adiantum-nigrum L. var. adiantum-nigrum	LC	Geophyte

Asplenium cordatum (Thunb.) Sw.	LC	Geophyte
Babiana bainesii Baker	LC, end	Geophyte
Babiana hypogaea Burch.	LC	Geophyte
Blechnum australe L. subsp. australe	LC	Geophyte
Boophone disticha (L.f.) Herb.	**Declining**	**Geophyte**
Brachystelma circinatum E.Mey.	LC	Geophyte
Brachystelma cupulatum R.A.Dyer	LC	Geophyte
Brunsvigia radulosa Herb.	LC	Geophyte
Bulbine abyssinica A.Rich.	LC	Geophyte
Cheilanthes eckloniana (Kunze) Mett.	LC	Geophyte
Cheilanthes hirta Sw. var. hirta	LC	Geophyte
Cheilanthes multifida (Sw.) Sw. var. multifida	LC	Geophyte
Chortolirion angolense (Baker) A.Berger	LC	Geophyte
Dipcadi marlothii Engl.	LC	Geophyte
Dipcadi viride (L.) Moench	LC	Geophyte
Drimia sanguinea (Schinz) Jessop	**NT**	**Geophyte**
Eriospermum corymbosum Baker	LC	Geophyte
Ferraria glutinosa (Baker) Rendle	LC	Geophyte
Gladiolus permeabilis D.Delaroche subsp. edulis (Burch. ex Ker Gawl.) Oberm.	LC	Geophyte
Hypoxis iridifolia Baker	LC	Geophyte
Lapeirousia erythrantha (Klotzsch ex Klatt) Baker	LC	Geophyte
Lapeirousia littoralis Baker subsp. caudata (Schinz) Goldblatt	LC	Geophyte
Lapeirousia sandersonii Baker	LC	Geophyte
Ledebouria apertiflora (Baker) Jessop	LC	Geophyte
Ledebouria luteola Jessop	LC	Geophyte
Moraea pallida (Baker) Goldblatt	LC	Geophyte
Moraea polystachya (Thunb.) Ker Gawl.	LC	Geophyte
Nerine laticoma (Ker Gawl.) T.Durand & Schinz	LC	Geophyte
Ornithoglossum dinteri K.Krause	LC	Geophyte
Ornithoglossum vulgare B.Nord.	LC	Geophyte
Oxalis depressa Eckl. & Zeyh.	LC	Geophyte
Oxalis lawsonii F.Bolus	LC	Geophyte
Pellaea calomelanos (Sw.) Link var. calomelanos	LC	Geophyte
Raphionacme velutina Schltr.	LC	Geophyte
Schizocarphus nervosus (Burch.) Van der Merwe	LC	Geophyte
Trachyandra laxa (N.E.Br.) Oberm. var. laxa	LC	Geophyte
Trachyandra saltii (Baker) Oberm. var. saltii	LC	Geophyte
Abutilon austro-africanum Hochr.	LC	Dwarf shrub
Abutilon betschuanicum Ulbr.	LC	Dwarf shrub
Abutilon dinteri Ulbr.	LC	Dwarf shrub
Abutilon rehmannii Baker f.	LC	Dwarf shrub
Amphiglossa triflora DC.	LC	Dwarf shrub
Anthospermum rigidum Eckl. & Zeyh. subsp. pumilum (Sond.) Puff	LC	Dwarf shrub

Anthospermum rigidum Eckl. & Zeyh. subsp. rigidum	LC	Dwarf shrub
Aptosimum albomarginatum Marloth & Engl.	LC	Dwarf shrub
Aptosimum elongatum Engl.	LC	Dwarf shrub
Aptosimum indivisum Burch. ex Benth.	LC, end	Dwarf shrub
Aptosimum junceum (Hiern) Philcox	LC	Dwarf shrub
Aptosimum lineare Marloth & Engl. var. lineare	LC	Dwarf shrub
Aptosimum marlothii (Engl.) Hiern	LC	Dwarf shrub
Asparagus cooperi Baker	LC	Dwarf shrub
Atriplex semibaccata R.Br. var. appendiculata Aellen	LC	Dwarf shrub
Barleria irritans Nees	LC, end	Dwarf shrub
Blepharis marginata (Nees) C.B.Clarke	LC, end	Dwarf shrub
Chaenostoma halimifolium Benth.	LC	Dwarf shrub
Cineraria vallis-pacis Dinter ex Merxm.	LC	Dwarf shrub
Crotalaria orientalis Burtt Davy ex I.Verd. subsp. orientalis	LC	Dwarf shrub
Datura stramonium L.	NE	Dwarf shrub
Dichilus lebeckioides DC.	LC	Dwarf shrub
Dicoma kurumanii S.Ortiz & Netnou	LC, end	Dwarf shrub
Dyschoriste transvaalensis C.B.Clarke	LC	Dwarf shrub
Elephantorrhiza elephantina (Burch.) Skeels	LC	Dwarf shrub
Eriocephalus glandulosus M.A.N.Müll.	LC, end	Dwarf Shrub
Felicia clavipilosa Grau subsp. clavipilosa	LC	Dwarf Shrub
Felicia fascicularis DC.	LC, end	Dwarf Shrub
Felicia filifolia (Vent.) Burtt Davy subsp. filifolia	LC	Dwarf Shrub
Felicia muricata (Thunb.) Nees subsp. cinerascens Grau	LC	Dwarf Shrub
Felicia muricata (Thunb.) Nees subsp. muricata	LC	Dwarf Shrub
Galenia meziana K.Müll.	LC	Dwarf shrub
Geigeria brevifolia (DC.) Harv.	LC	Dwarf Shrub
Gnidia burchellii (Meisn.) Gilg	LC	Dwarf shrub
Gnidia polycephala (C.A.Mey.) Gilg	LC	Dwarf shrub
Gomphocarpus fruticosus (L.) Aiton f. subsp. fruticosus	NE	Dwarf shrub
Gomphocarpus tomentosus Burch. subsp. tomentosus	LC	Dwarf shrub
Helichrysum lucilioides Less.	LC	Dwarf shrub
Helichrysum spiciforme DC.	LC	Dwarf shrub
Helichrysum zeyheri Less.	LC	Dwarf shrub
Helinus spartioides (Engl.) Schinz ex Engl.	LC	Dwarf shrub
Heliophila suavissima Burch. ex DC.	LC	Dwarf shrub
Hermannia burchellii (Sweet) I.Verd.	LC	Dwarf shrub
Hermannia jacobeifolia (Turcz.) R.A.Dyer	LC	Dwarf shrub
Hermannia linearifolia Harv.	LC, end	Dwarf shrub
Hibiscus ludwigii Eckl. & Zeyh.	LC	Dwarf shrub
Hibiscus micranthus L.f. var. micranthus	LC	Dwarf shrub
Hirpicium bechuanense (S.Moore) Roessler	LC	Dwarf shrub
Hypertelis salsoloides (Burch.) Adamson var. salsoloides	LC	Dwarf shrub

Indigofera comosa N.E.Br.	LC	Dwarf Shrub
Indigofera cryptantha Benth. ex Harv. var. cryptantha	LC	Dwarf shrub
Indigofera heterotricha DC.	LC	Dwarf shrub
Indigofera melanadenia Benth. ex Harv.	LC	Dwarf shrub
Indigofera sessilifolia DC.	LC	Dwarf shrub
Ipomoea suffruticosa Burch.	LC	Dwarf shrub
Jamesbrittenia atropurpurea (Benth.) Hilliard subsp. atropurpurea	LC	Dwarf shrub
Jamesbrittenia atropurpurea (Benth.) Hilliard subsp. pubescens Hilliard	LC	Dwarf shrub
Jamesbrittenia integerrima (Benth.) Hilliard	LC	Dwarf shrub
Justicia puberula Immelman	LC, end	Dwarf shrub
Lantana rugosa Thunb.	LC	Dwarf Shrub
Leucas capensis (Benth.) Engl.	LC	Dwarf shrub
Limeum aethiopicum Burm.f. var. aethiopicum	LC	Dwarf shrub
Limeum aethiopicum Burm.f. var. intermedium Friedrich	LC, end	Dwarf shrub
Litogyne gariepina (DC.) Anderb.	LC	Dwarf shrub
Lophiocarpus polystachyus Turcz.	LC	Dwarf shrub
Lotononis divaricata (Eckl. & Zeyh.) Benth.	LC	Dwarf Shrub
Melhania acuminata Mast. var. acuminata	LC	Dwarf shrub
Melhania prostrata DC.	LC	Dwarf shrub
Melhania rehmannii Szyszyl.	LC	Dwarf shrub
Melhania virescens (K.Schum.) K.Schum.	LC	Dwarf shrub
Melolobium candicans (E.Mey.) Eckl. & Zeyh.	LC	Dwarf shrub
Melolobium canescens Benth.	LC	Dwarf shrub
Melolobium exudans Harv.	LC, end	Dwarf shrub
Melolobium macrocalyx Dummer var. longifolium Dummer	LC	Dwarf shrub
Melolobium macrocalyx Dummer var. macrocalyx	LC	Dwarf shrub
Melolobium microphyllum (L.f.) Eckl. & Zeyh.	LC	Dwarf shrub
Microloma armatum (Thunb.) Schltr. var. burchellii (N.E.Br.) Bruyns	LC	Dwarf shrub
Monechma divaricatum (Nees) C.B.Clarke	LC	Dwarf shrub
Monechma genistifolium (Engl.) C.B.Clarke subsp. australe (P.G.Mey.) Munday	LC	Dwarf shrub
Monechma incanum (Nees) C.B.Clarke	LC	Dwarf shrub
Nenax microphylla (Sond.) T.M.Salter	LC	Dwarf shrub
Oligomeris dipetala (Aiton) Turcz. var. dipetala	LC	Dwarf shrub
Osteospermum leptolobum (Harv.) Norl.	LC, end	Dwarf Shrub
Osteospermum microphyllum DC.	LC	Dwarf Shrub
Pavonia burchellii (DC.) R.A.Dyer	LC	Dwarf shrub
Pegolettia retrofracta (Thunb.) Kies	LC	Dwarf shrub
Pelargonium myrrhifolium (L.) L'Hér. var. myrrhifolium	LC, end	Dwarf shrub
Peliostomum leucorrhizum E.Mey. ex Benth.	LC	Dwarf shrub
Pentzia argentea Hutch.	LC	Dwarf Shrub
Pentzia calcarea Kies	LC	Dwarf shrub
Pentzia quinquefida (Thunb.) Less.	LC, end	Dwarf Shrub
Plinthus karooicus I.Verd.	LC	Dwarf shrub

Plinthus sericeus Pax	LC	Dwarf shrub
Polygala hottentotta C.Presl	LC	Dwarf shrub
Polygala krumanina Burch. ex Ficalho & Hiern	LC, end	Dwarf Shrub
Polygala leptophylla Burch. var. armata (Chodat) Paiva	LC	Dwarf shrub
Polygala leptophylla Burch. var. leptophylla	LC	Dwarf shrub
Pteronia glauca Thunb.	LC	Dwarf Shrub
Pteronia mucronata DC.	LC	Dwarf Shrub
Ptycholobium biflorum (E.Mey.) Brummitt subsp. angolensis (Baker) Brummitt	LC	Dwarf shrub
Ptycholobium biflorum (E.Mey.) Brummitt subsp. biflorum	LC	Dwarf shrub
Requienia pseudosphaerosperma (Schinz) Brummitt	LC	Dwarf shrub
Rosenia humilis (Less.) K.Bremer	LC	Dwarf Shrub
Salsola rabieana I.Verd.	LC	Dwarf shrub
Salsola tuberculata (Moq.) Fenzl	LC	Dwarf shrub
Salvia disermas L.	LC	Dwarf shrub
Seddera capensis (E.Mey. ex Choisy) Hallier f.	LC	Dwarf shrub
Seddera suffruticosa (Schinz) Hallier f.	LC	Dwarf shrub
Senecio burchellii DC.	LC, end	Dwarf shrub
Sida chrysantha Ulbr.	LC	Dwarf shrub
Sida cordifolia L. subsp. cordifolia	LC	Dwarf shrub
Solanum burchellii Dunal	LC	Dwarf shrub
Solanum catombelense Peyr.	LC	Dwarf shrub
Solanum lichtensteinii Willd.	LC	Dwarf shrub
Solanum panduriforme E.Mey.	LC	Dwarf shrub
Solanum supinum Dunal var. supinum	LC	Dwarf shrub
Solanum tomentosum L. var. tomentosum	LC	Dwarf shrub
Stachys burchelliana Launert	LC	Dwarf Shrub
Sutherlandia frutescens (L.) R.Br.	LC	Dwarf shrub
Tephrosia longipes Meisn. subsp. longipes var. longipes	LC	Dwarf shrub
Thesium hystricoides A.W.Hill	LC, end	Dwarf shrub
Thesium hystrix A.W.Hill	LC	Dwarf shrub
Thesium zeyheri A.DC.	LC	Dwarf shrub
Tragia dioica Sond.	LC	Dwarf shrub
Tribulus excrucians Wawra	LC	Dwarf shrub
Tripteris aghillana DC. var. aghillana	LC	Dwarf shrub
Wahlenbergia nodosa (H.Buek) Lammers	LC, end	Dwarf shrub
Withania somnifera (L.) Dunal	LC	Dwarf shrub
Bolboschoenus maritimus (L.) Palla	LC	Cyperoid
Bulbostylis burchellii (Ficalho & Hiern) C.B.Clarke	LC	Cyperoid
Bulbostylis hispidula (Vahl) R.W.Haines subsp. pyriformis (Lye) R.W.Haines	LC	Cyperoid
Bulbostylis humilis (Kunth) C.B.Clarke	LC	Cyperoid
Carex burchelliana Boeck.	LC, end	Cyperoid
Cladium mariscus (L.) Pohl subsp. jamaicense (Crantz) Kük.	LC	Cyperoid
Cyperus bellus Kunth	LC	Cyperoid

Cyperus capensis (Steud.) Endl.	LC, end	Cyperoid
Cyperus fulgens C.B.Clarke var. fulgens	LC	Cyperoid
Cyperus indecorus Kunth var. decurvatus (C.B.Clarke) Kük.	LC	Cyperoid
Cyperus indecorus Kunth var. namaquensis Kük.	LC	Cyperoid
Cyperus longus L. var. tenuiflorus (Rottb.) Boeck.	LC	Cyperoid
Cyperus margaritaceus Vahl var. margaritaceus	LC	Cyperoid
Cyperus marginatus Thunb.	LC	Cyperoid
Cyperus marlothii Boeck.	LC	Cyperoid
Cyperus sphaerospermus Schrad.	LC	Cyperoid
Cyperus usitatus Burch.	LC	Cyperoid
Juncus exsertus Buchenau	LC	Cyperoid
Juncus punctorius L.f.	LC	Cyperoid
Juncus rigidus Desf.	LC	Cyperoid
Kyllinga alba Nees	LC	Cyperoid
Schoenus nigricans L.	LC	Cyperoid
Scirpoides burkei (C.B.Clarke) Goetgh., Muasya & D.A.Simpson	LC	Cyperoid
Scirpoides dioecus (Kunth) Browning	LC	Cyperoid
Scleria dregeana Kunth	LC	Cyperoid
Antizoma angustifolia (Burch.) Miers ex Harv.	LC	Climber
Clematis brachiata Thunb.	LC	Climber
Coccinia rehmannii Cogn.	LC	Climber
Coccinia sessilifolia (Sond.) Cogn.	LC	Climber
Corallocarpus triangularis Cogn.	LC	Climber
Kedrostis africana (L.) Cogn.	LC	Climber
Pentarrhinum insipidum E.Mey.	LC	Climber
Rhynchosia confusa Burtt Davy	LC	Climber
Rhynchosia holosericea Schinz	LC	Climber
Rhynchosia totta (Thunb.) DC. var. totta	LC	Climber
Rhynchosia venulosa (Hiern) K.Schum.	LC	Climber
Sphedamnocarpus pruriens (A.Juss.) Szyszyl. subsp. pruriens	LC	Climber
Triaspis hypericoides (DC.) Burch. subsp. hypericoides	LC	Climber
Trochomeria debilis (Sond.) Hook.f.	LC	Climber
Vigna unguiculata (L.) Walp. subsp. unguiculata var. unguiculata	LC	Climber
Total: 669		

10.2. Explanation of Conservation Status as used in the Red Data classification by the RSA Threatened Species Programme (SANBI)

Status	Criterion	Guidelines for Recommendation
[a] Please notify the Threatened Species Programme immediately and provide details of the location, size and threats to the subpopulation. The fact that a subpopulation of the species was found at a site zoned for development means that its Red List status has to be reviewed and is likely to be upgraded.		
[a]Critically Endangered	PE	No further loss of natural habitat should be permitted as the species is on the brink of extinction, and all other known subpopulations have been lost. The subpopulation in question is likely to be newly discovered and the only remaining subpopulation of this species.
Critically Endangered	A,B,C,D	No further loss of natural habitat should be permitted as the species is on the verge of extinction.
Endangered	B,C,D	No further loss of habitat should be permitted as the species is likely to go extinct in the near future if current pressures continue. All remaining subpopulations have to be conserved if this species is to survive in the long term.
Endangered	Listed under A only	If the species has a restricted range (EOO < 2 000 km^2), recommend no further loss of habitat. If range size is larger, the species is possibly long-lived but widespread, and limited habitat loss may be considered under certain circumstances, such as the implementation of an offset whereby another viable, known subpopulation is formally conserved in terms of the National Environmental Management: Protected Areas Act (Act 57 of 2003), and provided that the subpopulation to be destroyed does not occur (i) within a threatened ecosystem or (ii) within an area required for biodiversity conservation in terms of a relevant spatial biodiversity plan or (iii) on a site associated with additional ecological sensitivities.
[a]Vulnerable	D	This species either constitutes less than 1 000 individuals or is known from a very restricted range. No further loss of habitat should be permitted as the species' status will immediately become either Critically Endangered or Endangered, should habitat be lost.
Vulnerable	B,C	The species is approaching extinction but there are still a number of subpopulations in existence. Recommend no further loss of habitat as this will increase the extinction risk of the species.
Vulnerable	Listed under A only	If the species has a restricted range, EOO < 2 000 km^2, recommend no further loss of habitat. If range size is larger, the species is possibly long-lived but widespread, and limited habitat loss may be considered under certain circumstances, such as the implementation of an offset whereby another viable, known subpopulation is formally conserved in terms of the Protected Areas Act, and provided that the subpopulation to be destroyed does not occur (i) within a threatened ecosystem or (ii) within an area required for biodiversity conservation in terms of a relevant spatial biodiversity plan or (iii) on a site associated with additional ecological sensitivities.
[a]Data Deficient	D	This species is very poorly known, with insufficient information on its habitat, population status or distribution to assess it. However, it is highly likely to be threatened. If a Data Deficient species will be affected by a proposed activity,

Status	Criterion	Guidelines for Recommendation
		the subpopulation should be well surveyed and the data sent to the Threatened Species Programme. The species will be reassessed and the new status of the species, with a recommendation, will be provided within a short timeframe.
Data Deficient	T	There is uncertainty regarding the taxonomic status of this species, but it is likely to be threatened. Contact the taxonomist working on this group to resolve its taxonomic status; the species will then be reassessed by the Threatened Species Programme.
[a]Near Threatened	D	Currently known from fewer than 10 locations, therefore preferably recommend no loss of habitat. Should loss of this species' habitat be considered, then an offset that includes conserving another viable subpopulation (in terms of the Protected Areas Act) should be implemented, provided that the subpopulation to be destroyed does not occur (i) within a threatened ecosystem or (ii) within an area required for biodiversity conservation in terms of a relevant spatial biodiversity plan or (iii) on a site associated with additional ecological sensitivities.
Near Threatened	B,C	The species is approaching thresholds for listing as threatened but there are still a number of subpopulations in existence and therefore there is need to minimise loss of habitat. Conservation of subpopulations is essential if they occur (i) within a threatened ecosystem or (ii) within an area required for biodiversity conservation in terms of a relevant spatial biodiversity plan or (iii) on a site associated with additional ecological sensitivities.
Near Threatened	Listed under A only	If the species has a restricted range, EOO < 2 000 km^2, then recommend no further loss of habitat. If range size is larger, the species is possibly long-lived but widespread, and limited habitat loss may be considered. Conservation of subpopulations is essential if they occur (i) within a threatened ecosystem or (ii) within an area required for biodiversity conservation in terms of a relevant biodiversity conservation plan or (iii) on a site associated with additional ecological sensitivities.
[a]Critically Rare		This is a highly range-restricted species, known from a single site, and therefore no loss of habitat should be permitted as it may lead to extinction of the species. The Threatened Species Programme is not aware of any current threats to this species and should be notified without delay.
[a]Rare		The species is likely to have a restricted range, or be highly habitat specific, or have small numbers of individuals, all of which makes it vulnerable to extinction should it lose habitat. Recommend no loss of habitat. The Threatened Species Programme is not aware of any current threats to this species and should be notified without delay.
Declining		The species is declining but the population has not yet reached a threshold of concern; limited loss of habitat may be permitted. Should the species is known to be used for traditional medicine and if individuals will not be conserved in situ, plants should be rescued and used as mother stock for medicinal plant cultivation programmes.