BASIC ASSESSMENT REPORT:

Ecological study on the potential impacts of the proposed BioTherm Tlisitseng Solar 2 power lines and substation near Lichtenburg in the North West Province

Prepared by

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REPORT VERSION: FINAL Draft

David Hoare Consulting cc

Biodiversity Assessments, Vegetation Description / Mapping, Species Surveys

DECLARATION OF INDEPENDENCE & SUMMARY OF EXPERTISE

Appointment of specialist

Dr David Hoare of David Hoare Consulting cc was commissioned by SiVEST SA (Pty) Ltd to provide specialist consulting services for the Environmental Impact Assessment for the proposed construction of the Tlisitseng Solar 2 power line and substation near Lichtenburg in the North West Province. The consulting services comprise an assessment of potential impacts on the general ecology in the study area by the proposed project.

Details of specialist

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Summary of expertise

Dr David Hoare:

- Has majors in Botany and Zoology with distinction from Rhodes University, Grahamstown, an Honours Degree (with distinction) in Botany from Rhodes University, an MSc (cum laude) from the Department of Plant Science, University of Pretoria, and a PhD in Botany from the Nelson Mandela Metropolitan University, Port Elizabeth with a focus on species diversity.
- Registered professional member of The South African Council for Natural Scientific Professions (Ecological Science, Botanical Science), registration number 400221/05.
- Founded David Hoare Consulting cc, an independent consultancy, in 2001.
- Ecological consultant since 1995, with working experience in Gauteng, Mpumalanga, Limpopo, North West, Eastern Cape, Western Cape, Northern Cape and Free State Provinces, Tanzania, Kenya, Mozambique and Swaziland.
- Conducted, or co-conducted, over 350 specialist ecological surveys as an ecological consultant. Areas of specialization include general ecology, biodiversity assessments, vegetation description and mapping, plant species surveys and remote sensing of vegetation. Has undertaken work in grassland, thicket, forest, savannah, fynbos, coastal vegetation, wetlands and nama-karoo vegetation, but has a specific specialization in grasslands and wetland vegetation.
- Published six technical scientific reports, 15 scientific conference presentations, seven book chapters and eight refereed scientific papers.
- Attended 15 national and international congresses & 5 expert workshops, lectured ecology at 2 universities and referee for 2 international journals.

A more detailed CV is attached as an appendix to this report (Appendix 6).

Independence

David Hoare Consulting cc and its Directors have no connection with the proponent. David Hoare Consulting cc is not a subsidiary, legally or financially, of the proponent. Remuneration for services by the proponent in relation to this project is not linked to approval by decision-making authorities responsible for authorising this proposed project and the consultancy has no interest in secondary or downstream developments as a result of the authorisation of this project. David Hoare is an independent consultant to SiVEST SA (Pty) Ltd and has no business, financial, personal or other interest in the activity, application or appeal in respect of which he was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of this specialist performing such work.

Conditions relating to this report

The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. David Hoare Consulting cc and its staff reserve the right to modify aspects of the report including the recommendations if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.

This report must not be altered or added to without the prior written consent of the author. This also refers to electronic copies of this report which are supplied for the purposes of inclusion as part of other reports, including main reports. Similarly, any recommendations, statements or conclusions drawn from or based on this report must make reference to this report. If these form part of a main report relating to this investigation or report, this report must be included in its entirety as an appendix or separate section to the main report.

Declaration of Independence

I, Dr David Barry Hoare, declare that:

- I act as the independent specialist 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 48 and is punishable in terms of section 24F of the Act.

Signature of the specialist: 

Name of company: David Hoare Consulting cc

Date: 9 May 2017

EXECUTIVE SUMMARY

David Hoare Consulting cc was appointed by SiVEST SA (Pty) Ltd to undertake a general ecology assessment of the study area. This report provides details of the results of the Basic Assessment study, based on a desktop assessment of the study area, mapping from aerial imagery and a field survey of the site. The study area is located in the North West Province approximately 8 km to the north-west of Lichtenburg.

The vegetation type that occurs on site (Carletonville Dolomite Grassland) is classified as Vulnerable, but has a wide distribution and extent. The natural vegetation on the sites is therefore considered from this perspective to have moderately high conservation value. The area is not within a Centre of Plant Endemism, nor does it occur in close proximity to an area identified as part of the National Parks Area Expansion Strategy. However, the site is within areas identified in the Provincial Conservation Assessment to be of importance for various reasons, including as buffer areas for pans, and as part of a dolomite aquifer recharge zone.

Local factors that may lead to parts of the sites having elevated ecological sensitivity are the potential presence of the following:

- Presence of natural vegetation on site, some of which is of elevated conservation priority.
- Potential presence of four plant species of concern, the bulb, *Boophone disticha* (occurs on site), listed as Declining, the bulb, *Crinum macowanii* (possibly occurs on site - individuals seen were not flowering), listed as Declining, the succulent herb, *Brachystelma incanum*, listed as Vulnerable, and the herb, *Cleome conrathii*, listed as Near Threatened.
- Potential presence of one protected plant species, *Harpagophytum procumbens.*
- Potential presence of three protected tree species, *Acacia erioloba*, *Combretum imberbe* and *Boscia albitrunca*. The tree *Acacia erioloba* occurs in large numbers on site.
- Potential presence of the following animals of potential conservation concern:
    - Brown Hyaena (NT)
    - Honey badger (NT)
    - Southern African Hedgehog (NT)
    - White-tailed Rat (EN)
    - Giant Bullfrog (NT/LC)
    - Kori Bustard (VU),
    - Blue Crane (VU),
    - Secretarybird (NT).
- Potential invasion of natural habitats by alien invasive plants, thus causing additional impacts on biodiversity features.

Potential risks (impacts) to the ecological receiving environment are as follows:

1. Impacts on indigenous natural vegetation;
2. Impacts on two listed plant species;
3. Impacts on protected plant species;
4. Impacts on two protected tree species;
5. Mortality of sedentary animals;
6. Displacement of mobile fauna;
7. Mortality of birds by collision with vertical infrastructure;
8. Establishment and spread of declared weeds and alien invader plants.

Table 11: Comparison of summarized impacts on environmental parameters.

Environmental parameter	Issues	Rating prior to mitigation	Average	Rating post mitigation	Average
Indigenous natural vegetation	Loss (substation)	-38		-38	
Indigenous natural vegetation	Loss (power lines)	-13		-12	
Protected plant species	Loss of individuals	-11		-9	
Protected trees	Loss of individuals	-14		-13	
Pan depressions	Damage, loss of vegetation	-28		-6	
Sedentary fauna	Loss of individuals	-10		-7	
Bird species of conservation concern	Collision with power lines	-26		-11	
Natural habitat	Invasion by alien invasive plant species leading to habitat loss and/or degradation	-28		-11	
			- 21.0		**-13.4**
			Low Negative Impact		Low Negative Impact

Cumulative impacts of this project in combination with similar projects is likely to be of low significance, with the exception of impacts on pan depressions, which may possibly be moderate due to impacts from other sources.

There is no preference between substation alternatives, primarily because they have a similar effect on the ecological receiving environment and affect similar habitats. Power line corridor Option 2 is slightly preferred over option 1 only because it is shorter, but either option is favourable.

Proposed mitigation measures include shifting power line tower structures, if necessary, to avoid sensitive features, compiling a surface runoff and stormwater management plan, formalising a rehabilitation programme, undertaking a botanical walk-through survey, undertaking search-and-rescue for any appropriate species, obtaining permits for any protected species that will be affected, undertaking a search and rescue of plants that can be rescued, compiling an alien plant management plan and undertaking regular monitoring.

The report concludes that there are some issues related to the ecology of the site that could result in potentially significant ecological impacts. The seriousness of these impacts is not considered to be high. Some impacts require permits to be issued, either by National or Provincial authorities and additional field data is required for the permit applications.

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INTRODUCTION

Terms of reference and approach

SiVEST SA (Pty) Ltd was appointed to undertake an application for environmental authorisation through an Environmental Impact Assessment (EIA) for the proposed BioTherm Tlisitseng 2 power line and substation near Lichtenburg in the North West Province. At this stage, it is proposed that the project will consist of the following components:

- A power line with a voltage of 132kV to the proposed Tlisitseng substation;
- Tlisitseng sub-station.

The purpose of the Basic Assessment is to identify environmental impacts associated with the proposed infrastructure.

On 2 October 2015 David Hoare Consulting cc was appointed by SiVEST SA (Pty) Ltd to undertake a Biodiversity (flora and fauna) assessment of the study area. It was agreed that the study would include the following:

- Conduct a desktop scoping study to broadly describe and characterise the study area in terms of:
    - Vegetation types and/or habitats;
    - National conservation status of major vegetation types;
    - Red Data (threatened and endangered) flora, fauna and avifauna species;
    - The potential presence of trees protected according to the National Forests Act and fauna and flora protected under the National Environmental Management: Biodiversity Act;
    - Important Bird Areas (IBAs) and Critical Biodiversity Areas (CBAs);
    - The general status of vegetation on site; and
    - Potential impact on biodiversity, sensitive habitats and ecosystem functioning.
- Undertake field investigations to assess and confirm the patterns identified during the desktop assessment.
- Compile impact level biodiversity report for the proposed infrastructure including (but not limited to) the following aspects:
    - Introduction;
    - Legislative background as applicable to the proposed activity;
    - Updated environmental baseline;
    - Methodology;
    - Identification and mapping of biodiversity (fauna and flora) sensitive areas within the application site based on field investigation and findings (all sensitive areas within the development site must be provided to SiVEST as shapefiles);
    - Assessment of the significance of the proposed development on flora, fauna and ecology during the Pre-construction, Construction, Operation, Decommissioning Phases (using SiVEST's Impact Assessment Methodology);
    - Findings (maps to be created and shapefiles submitted);
    - Alternatives Assessment (alternatives will be provided);
    - Implications of specialist findings for the proposed development (e.g. permits, licenses, etc.);

    - Cumulative impact identification and assessment;
    - Recommend mitigations measures and provide recommendations in order to minimize the impact of the proposed development on flora, fauna, ecology, etc.; and
    - Conclusion.
- Update and amend the draft report according to SiVEST's comments and resubmit final report for inclusion in the Basic Assessment Report.

This report provides details of the results of the Basic Assessment. The findings of the study are based on a desktop assessment of the study area, mapping from aerial imagery and a field survey of the site.

METHODOLOGY

The assessment is to be undertaken in a single phase. This report provides a description of the site and assessment of the activity.

Assessment philosophy

Many parts of South Africa contain high levels of biodiversity at species and ecosystem level. At any single site there may be large numbers of species or high ecological complexity. Sites also vary in their natural character and uniqueness and the level to which they have been previously disturbed. Assessing the potential impacts of a proposed development often requires evaluating the conservation value of a site relative to other natural areas and relative to the national importance of the site in terms of biodiversity conservation. A simple approach to evaluating the relative importance of a site includes assessing the following:

- Is the site unique in terms of natural or biodiversity features?
- Is the protection of biodiversity features on the site of national/provincial importance?
- Would development of the site lead to contravention of any international, national or provincial legislation, policy, convention or regulation?

Thus, the general approach adopted for this type of study is to identify any critical biodiversity issues that may lead to the decision that the proposed project cannot take place, i.e. to specifically focus on red flags and/or potential fatal flaws. Biodiversity issues are assessed by documenting whether any important biodiversity features occur on site, including species, ecosystems or processes that maintain ecosystems and/or species. These can be organised in a hierarchical fashion, as follows:

Species

1. threatened plant species
2. protected trees
3. threatened animal species

Ecosystems

1. threatened ecosystems
2. protected ecosystems
3. critical biodiversity areas
4. areas of high biodiversity
5. centres of endemism

Processes

1. corridors
2. mega-conservancy networks
3. rivers and wetlands
4. important topographical features

It is not the intention to provide comprehensive lists of all species that occur on site, since most of the species on these lists are usually common or widespread species. Rare, threatened, protected and conservation-worthy species and habitats are considered to be the highest priority, the presence of which are most likely to result in significant negative

impacts on the ecological environment. The focus on national and provincial priorities and critical biodiversity issues is in line with National legislation protecting environmental and biodiversity resources, including, but not limited to the following which ensure protection of ecological processes, natural systems and natural beauty as well as the preservation of biotic diversity in the natural environment:

1. Environment Conservation Act (Act 73 of 1989)
2. National Environmental Management Act, 1998 (NEMA) (Act 107 of 1998)
3. National Environmental Management Biodiversity Act, 2004. (Act 10 0f 2004)

Species of conservation concern

There are two types of species of concern for the site under investigation, (i) those listed by conservation authorities as being on a Red List and are therefore considered to be at risk of extinction, and (ii) those listed as protected according to National and/or Provincial legislation.

Red List plant species

Determining the conservation status of a species is required in oder to identify those species that are at greatest risk of extinction and, therefore, in most need of conservation action. South Africa has adopted the IUCN Red List Categories and Criteria to provide an objective, rigorous, scientifically founded system to identify Red List species. A published list of the Red List species of South African plants (Raimondo et al. 2009) contains a list of all species that are considered to be at risk of extinction. This list is updated regularly to take new information into account, but these are not published in book/paper format. Updated assessments are provided on the SANBI website (http://redlist.sanbi.org/). According to the website of the Red List of Southern African Plants (http://redlist.sanbi.org/), *the conservation status of plants indicated on the Red List of South African Plants Online represents the status of the species within South Africa's borders. This means that when a species is not endemic to South Africa, only the portion of the species population occurring within South Africa has been assessed. The global conservation status, which is a result of the assessment of the entire global range of a species, can be found on the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species: http://www.iucnredlist.org*. The South African assessment is used in this study.

The purpose of listing Red List species is to provide information on the potential occurrence of species at risk of extinction in the study area that may be affected by the proposed infrastructure. Species appearing on these lists can then be assessed in terms of their habitat requirements in order to determine whether any of them have a likelihood of occurring in habitats that may be affected by the proposed infrastructure.

Lists were compiled specifically for any species at risk of extinction (Red List species) previously recorded in the area. Historical occurrences of threatened plant species were obtained from the South African National Biodiversity Institute (http://posa.sanbi.org) for the quarter degree square/s within which the study area is situated. Habitat information for each species was obtained from various published sources. The probability of finding any of these species was then assessed by comparing the habitat requirements with those habitats that were found, during the field survey of the site, to occur there.

Protected trees

Regulations published for the National Forests Act (Act 84 of 1998) as amended, provide a list of protected tree species for South Africa. The species on this list were assessed in

order to determine which protected tree species have a geographical distribution that coincides with the study area and habitat requirements that may be met by available habitat in the study area. The distribution of species on this list was obtained from published sources (e.g. van Wyk & van Wyk 1997) and from the SANBI Biodiversity Information System website (http://sibis.sanbi.org/) for quarter degree grids in which species have been previously recorded. Species that have been recorded anywhere in proximity to the site (within 100 km), or where it is considered possible that they could occur there, were listed and were considered as being at risk of occurring there. The site was searched for these species during the field survey and any individuals or concentrations noted.

Other protected species

National legislation was evaluated in order to provide lists of any plant or animal species that have protected status. The most important legislation is the following:

- *National Environmental Management: Biodiversity Act (Act No 10 of 2004)*

This legislation contains lists of species that are protected. These lists were scanned in order to identify any species thathave a geographical range that includes the study area and habitat requirements that are met by those found on site. These species were searched for within suitable habitats on site or, where relevant, it was stated that it was considered possible that they could occur on site.

There is additional legislation that provides lists of protected species, but the legislation to which these are attached deal primarily with harvesting or trade in listed species and do not specifically address transformational threats to habitat or individuals. This includes the following legislation:

- *CITES: Convention on the Trade in Endangered Species of Wild Fauna and Flora*.

Red List animal species

Lists of threatened animal species that have a geographical range that includes the study area were obtained from literature sources (for example, Alexander & Marais 2007, Branch 1988, 2001, du Preez & Carruthers 2009, Friedmann & Daly 2004, Mills & Hes 1997, Monadjem et al. 2010). The likelihood of any of them occurring was evaluated on the basis of habitat preference and habitats available at each of the proposed sites. The three parameters used to assess the probability of occurrence for each species were as follows:

- *Habitat requirements*: most Red Data animals have very specific habitat requirements and the presence of these habitat characteristics within the study area were assessed;
- *Habitat status*: in the event that available habitat is considered suitable for these species, the status or ecological condition was assessed. Often, a high level of degradation of a specific habitat type will negate the potential presence of Red Data species (especially wetland-related habitats where water-quality plays a major role); and
- *Habitat linkage*: movement between areas used for breeding and feeding purposes forms an essential part of ecological existence of many species. The connectivity of the study area to these surrounding habitats and adequacy of these linkages are assessed for the ecological functioning Red Data species within the study area.

Species probability of occurrence

Some species of plants may be cryptic, difficult to find, rare, ephemeral or generally not easy to spot while undertaking a survey of a large area. An assessment of the possibility of these species occurring there was therefore provided. For all threatened or protected flora that occur in the general geographical area of the site, a rating of the likelihood of it

occurring on site is given as follows:

- LOW: no suitable habitats occur on site / habitats on site do not match habitat description for species;
- MEDIUM: habitats on site match general habitat description for species (e.g. karoo shrubland), but detailed microhabitat requirements (e.g. mountain shrubland on shallow soils overlying sandstone) are absent on the site or are unknown from the descriptions given in the literature or from the authorities;
- HIGH: habitats found on site match very strongly the general and microhabitat description for the species (e.g. mountain shrubland on shallow soils overlying sandstone);
- DEFINITE: species found in habitats on site.

Habitat sensitivity

The purpose of producing a habitat sensitivity map is to provide information on the location of potentially sensitive features in the study area. This was compiled by taking the following into consideration:

1. The general status of the vegetation of the study area was derived by compiling a landcover data layer for the study area (*sensu* Fairbanks et al. 2000) using available satellite imagery and aerial photography. From this it can be seen which areas are transformed versus those that are still in a natural status.
2. Various provincial, regional or national level conservation planning studies have been undertaken in the area, e.g. the National Spatial Biodiversity Assessment (NSBA). The mapped results from these were taken into consideration in compiling the habitat sensitivity map.
3. Habitats in which various species of plants or animals occur that may be protected or are considered to have high conservation status are considered to be sensitive.

An explanation of the different sensitivity classes is given in Table 1. Areas containing untransformed natural vegetation of conservation concern, high diversity or habitat complexity, Red List organisms or systems vital to sustaining ecological functions are considered potentially sensitive. In contrast, any transformed area that has no importance for the functioning of ecosystems is considered to potentially have low sensitivity.

Table 1: Explanation of sensitivity ratings.

Sensitivity	Factors contributing to sensitivity	Example of qualifying features
VERY HIGH	Indigenous natural areas that are highly positive for any of the following: • presence of threatened species (Critically Endangered, Endangered, Vulnerable) and/or habitat critical for the survival of populations of threatened species. • High conservation status (low proportion remaining intact, highly fragmented, habitat for species that are at risk). • Protected habitats (areas protected according to national / provincial legislation, e.g. National Forests Act,	• CBA 1 areas. • Remaining areas of vegetation type listed in Draft Ecosystem List of NEM:BA as Critically Endangered, Endangered or Vulnerable. • Protected forest patches. • Confirmed presence of

Sensitivity	Factors contributing to sensitivity	Example of qualifying features
	Draft Ecosystem List of NEM:BA, Integrated Coastal Zone Management Act, Mountain Catchment Areas Act, Lake Areas Development Act) And may also be positive for the following: • High intrinsic biodiversity value (high species richness and/or turnover, unique ecosystems) • High value ecological goods & services (e.g. water supply, erosion control, soil formation, carbon storage, pollination, refugia, food production, raw materials, genetic resources, cultural value) • Low ability to respond to disturbance (low resilience, dominant species very old).	populations of threatened species.
HIGH	Indigenous natural areas that are positive for any of the following: • High intrinsic biodiversity value (moderate/high species richness and/or turnover). • presence of habitat highly suitable for threatened species (Critically Endangered, Endangered, Vulnerable species). • Moderate ability to respond to disturbance (moderate resilience, dominant species of intermediate age). • Moderate conservation status (moderate proportion remaining intact, moderately fragmented, habitat for species that are at risk). • Moderate to high value ecological goods & services (e.g. water supply, erosion control, soil formation, carbon storage, pollination, refugia, food production, raw materials, genetic resources, cultural value). And may also be positive for the following: • Protected habitats (areas protected according to national / provincial legislation, e.g. National Forests Act, Draft Ecosystem List of NEM:BA, Integrated Coastal Zone Management Act, Mountain Catchment Areas Act, Lake Areas Development Act)	• CBA 2 "critical biodiversity areas". • Habitat where a threatened species could potentially occur (habitat is suitable, but no confirmed records). • Confirmed habitat for species of lower threat status (near threatened, rare). • Habitat containing individuals of extreme age. • Habitat with low ability to recover from disturbance. • Habitat with exceptionally high diversity (richness or turnover). • Habitat with unique species composition and narrow distribution. • Ecosystem providing high value ecosystem goods and

Sensitivity	Factors contributing to sensitivity	Example of qualifying features
		services.
MEDIUM-HIGH	Indigenous natural areas that are positive for one or two of the factors listed above, but not a combination of factors.	• CBA 2 "corridor areas". • Habitat with high diversity (richness or turnover). • Habitat where a species of lower threat status (e.g. (near threatened, rare) could potentially occur (habitat is suitable, but no confirmed records).
MEDIUM	Other indigenous natural areas in which factors listed above are of no particular concern. May also include natural buffers around ecologically sensitive areas and natural links or corridors in which natural habitat is still ecologically functional.	
MEDIUM-LOW	Degraded or disturbed indigenous natural vegetation.	
LOW	No natural habitat remaining.	

Any natural vegetation within which there are features of conservation concern will be classified into one of the high sensitivity classes (MEDIUM-HIGH, HIGH or VERY HIGH. The difference between these three high classes is based on a combination of factors and can be summarised as follows:

1. Areas classified into the VERY HIGH class are vital for the survival of species or ecosystems. They are either known sites for threatened species or are ecosystems that have been identified as being remaining areas of vegetation of critical conservation importance. CBA1 areas would qualify for inclusion into this class.
2. Areas classified into the HIGH class are of high biodiversity value, but do not necessarily contain features that would put them into the VERY HIGH class. For example, a site that is known to contain a population of a threatened species would be in the VERY HIGH class, but a site where a threatened species could potentially occur (habitat is suitable), but it is not known whether it does occur there or not, is classified into the HIGH sensitivity class. The class also includes any areas that are not specifically identified as having high conservation status, but have high local species richness, unique species composition, low resilience or provide very important ecosystem goods and services. CBA2 "irreplaceable biodiversity areas" would qualify for inclusion into this class, if there were no other factors that would put them into the highest class.
3. Areas classified into the MEDIUM-HIGH sensitivity class are natural vegetation in which there are one or two features that make them of biodiversity value, but not to the extent that they would be classified into one of the other two higher categories. CBA2 "corridor areas" would qualify for inclusion into this class.

Limitations and exclusions

- Red List species are, by their nature, usually very rare and difficult to locate. Compiling the list of species that could potentially occur in an area is limited by the paucity of collection records that make it difficult to predict whether a species may occur in an area or not. The methodology used in this assessment is designed to reduce the risks of omitting any species, but it is always possible that a species that does not occur on a list may be unexpectedly located in an area.
- This study excludes invertebrates and avifauna.

Impact assessment methodology

The Impact Assessment Methodology assists in evaluating the overall effect of a proposed activity on the environment. The determination of the effect of an environmental impact on an environmental parameter is determined through a systematic analysis of the various components of the impact. This is undertaken using information that is available to the environmental practitioner through the process of the environmental impact assessment. The impact evaluation of predicted impacts was undertaken through an assessment of the significance of the impacts.

Determination of Significance of Impacts

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale i.e. site, local, national or global whereas Intensity is defined by the severity of the impact e.g. the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence. Significance is calculated as shown in Table 2.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

Impact Rating System

Impact assessment must take account of the nature, scale and duration of effects on the environment whether such effects are positive (beneficial) or negative (detrimental). Each issue / impact is also assessed according to the project stages:

- planning
- construction
- operation
- decommissioning

Where necessary, the proposal for mitigation or optimisation of an impact should be detailed.

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the mitigation of the impact. Impacts have been consolidated into one rating. In assessing the significance of each issue the following criteria (including an allocated point system) is used:

Table 1: Description of terms

NATURE

A brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity.		
GEOGRAPHICAL EXTENT		
This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.		
1	Site	The impact will only affect the site
2	Local/district	Will affect the local area or district
3	Province/region	Will affect the entire province or region
4	International and National	Will affect the entire country
PROBABILITY		
This describes the chance of occurrence of an impact		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
REVERSIBILITY		
This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource.	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
DURATION		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity.		
1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time

		after construction, thereafter it will be entirely negated (0 − 2 years).
2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 − 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 − 50 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).
CUMULATIVE EFFECT		
This describes the cumulative effect of the impacts on the environmental parameter. A cumulative effect/impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.		
1	Negligible Cumulative Impact	The impact would result in negligible to no cumulative effects
2	Low Cumulative Impact	The impact would result in insignificant cumulative effects
3	Medium Cumulative Impact	The impact would result in minor cumulative effects
4	High Cumulative Impact	The impact would result in significant cumulative effects
INTENSITY / MAGNITUDE		
Describes the severity of an impact.		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.
SIGNIFICANCE		
Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time		

scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on the environmental parameter. The calculation of the significance of an impact uses the following formula:

(Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity.

The summation of the different criteria will produce a non weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.

6 to 28	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive Low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative Medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive Medium impact	The anticipated impact will have moderate positive effects.
51 to 73	Negative High impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 to 73	Positive High impact	The anticipated impact will have significant positive effects.
74 to 96	Negative Very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
74 to 96	Positive Very high impact	The anticipated impact will have highly significant positive effects.

Table 2: Impact table format

IMPACT TABLE FORMAT	
Environmental parameter	*A brief description of the environmental aspect likely to be affected by the proposed activity e.g. Surface water*
Issue/Impact/Environmental Effect/Nature	*A brief description of the nature of the impact that is likely to affect the environmental aspect as a result of the proposed activity e.g. alteration of aquatic biota The environmental impact that is likely to positively or negatively affect the environment as a result of the proposed activity e.g. oil spill in surface water*
Extent	
Probability	*A brief description indicating the chances of the impact occurring*
Reversibility	*A brief description of the ability of the environmental components recovery after a disturbance as a result of the proposed activity*
Irreplaceable loss of resources	*A brief description of the degree in which irreplaceable resources are likely to be lost*
Duration	*A brief description of the amount of time the*

	proposed activity is likely to take to its completion
Cumulative effect	*A brief description of whether the impact will be exacerbated as a result of the proposed activity*
Intensity/magnitude	*A brief description of whether the impact has the ability to alter the functionality or quality of a system permanently or temporarily*
Significance rating	*A brief description of the importance of an impact which in turn dictates the level of mitigation required*

	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	4	1
Probability	4	1
Reversibility	4	1
Irreplaceable loss	4	1
Duration	4	1
Cumulative effect	4	1
Intensity/magnitude	4	1
Significance rating	-96 (high negative)	-6 (low negative)
Mitigation measures	*Outline/explain the mitigation measures to be undertaken to ameliorate the impacts that are likely to arise from the proposed activity. Describe how the mitigation measures have reduced/enhanced the impact with relevance to the impact criteria used in analyzing the significance. These measures will be detailed in the EMPR.*	

DESCRIPTION OF STUDY AREA

Location

The study site is situated approximately 8 km north-west of Lichtenburg in the Ngaka Modiri Molema District of the North West Province (Figure 1). The site falls within the quarter degree grid 2626AA.

The project site near Lichtenburg has been identified through pre-feasibility studies conducted by BioTherm based on an estimation of the solar energy resource as well as weather, dust, dirt, and surface albedo. Grid connection and land availability were also important initial considerations. The project currently consists of two possible substation positions and a single power line corridor (these options are shown in Figure 2).

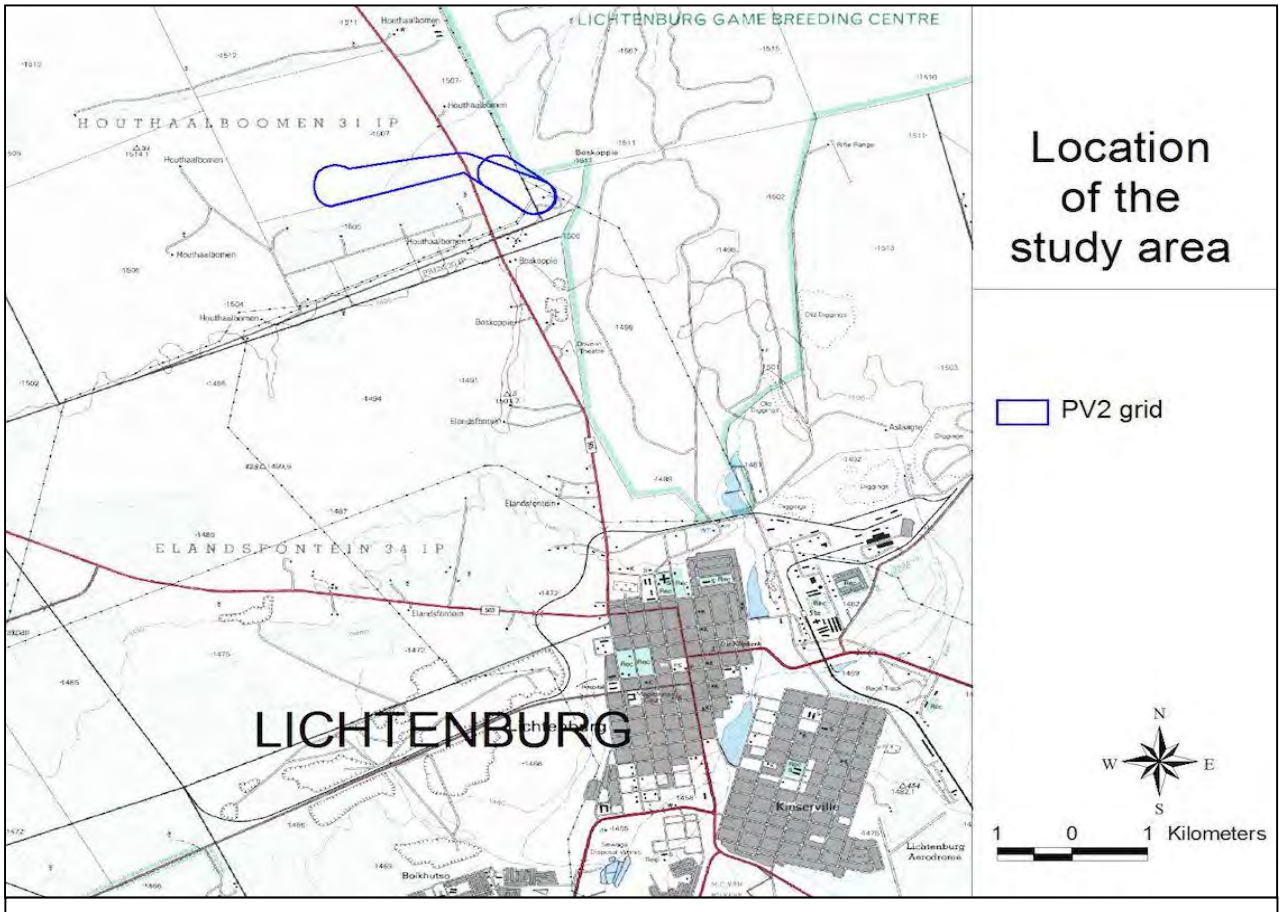

Figure 1: Location of the study area.

Topography

The study site is situated in an almost flat landscape. The elevation varies from approximately 1511 m above sea level to 1515 m above sea level, a height gain of only 4 m over a distance of 2.6 km, a gradient of shallower than 1:650.

Land types and soils

Detailed soil information is not available for broad areas of the country. As a surrogate, landtype data was used to provide a general description of soils in the study area (landtypes are areas with largely uniform soils, topography and climate). There is a single land type in the study area, the Fa landtype (Land Type Survey Staff, 1987).

The F-group of land types refer to pedologically young landscapes that are not predominantly rock and nor predominantly alluvial or aeolian and in which the dominant soil-forming processes have been rock weathering, the formation of orthic topsoil horizons and, commonly, clay illuviation, giving rise typically to lithocutanic horizons. The soil forms that epitomise these processes are Glenrosa and Mispah. However, exposed rock and soils belonging in almost any of the other 39 soil forms may be found in these land types. The Fa landtype refers to land in which lime in the soil is not encountered regularly in any part

Figure 2: Aerial image of the study area.

of the landscape (MacVicar et al. 1974). The soils on site are therefore expected to be shallow and probably rocky.

Climate

The climate is semi-arid. Rainfall occurs in summer and autumn with very dry winters. Mean annual rainfall is about 500 mm per year. All areas with less than 400 mm rainfall are considered to be arid. The study area can therefore be considered to be dry / semi-arid. Frost is frequent to very frequent in winter and summer temperatures can get hot with a mean monthly maximum temperature of over 36°C in January.

Landuse and landcover of the study area

A landcover map of the study area (Fairbanks *et al*. 2000) indicates that the study consists of natural vegetation, classified as "grassland". The 1:50 000 topocadastral map of the site and a Google image of the site (Figure 2) show essentially the same pattern, with the addition of the edges of two large centre-pivot fields in the northern part of the corridor and the Mookodi Substation at the southern end.

Broad vegetation types of the region

The sites fall within the Grassland Biome (Rutherford & Westfall 1986, Mucina & Rutherford 2006). The most recent and detailed description of the vegetation of this region is part of a national map (Mucina, Rutherford & Powrie, 2005; Mucina *et al*. 2006). This map shows one vegetation type occurring within the area of interest, Carletonville Dolomite Grassland. This vegetation type is described in more detail below.

Carletonville Dolomite Grassland

Carletonville Dolomite Grassland is found mainly in the North-West Province but also in Gauteng and marginally in the Free State Province. It is found in the region of Potchefstroom, Ventersdorp and Carletonville, extending westwards to the vicinity of Ottoshoop, but also occurring as far east as Centurion and Bapsfontein in Gauteng Province. Carletonville Dolomite Grassland is characterised by slightly undulating plains dissected by prominent rocky chert ridges. Species-rich grasslands form a complex mosaic pattern dominated by many species.

Conservation status of broad vegetation types

On the basis of a recently established approach used at national level by SANBI (Driver *et al*. 2005), vegetation types can be categorised according to their conservation status which is, in turn, assessed according to the degree of transformation relative to the expected extent of each vegetation type. The status of a habitat or vegetation type is based on how much of its original area still remains intact relative to various thresholds. The original extent of a vegetation type is as presented in the most recent national vegetation map (Mucina, Rutherford & Powrie 2005) and is the extent of the vegetation type in the absence of any historical human impact. On a national scale the thresholds are as depicted in Table 1, as determined by best available scientific approaches (Driver *et al*. 2005).

The level at which an ecosystem becomes Critically Endangered differs from one

ecosystem to another and varies from 16% to 36% (Driver et al. 2005).

The vegetation type occurring in the study area (Table 2) is classified as Vulnerable (Driver *et al*. 2005; Mucina *et al*., 2006) and is therefore flagged as being of potential conservation concern.

Table 1: Determining ecosystem status (from Driver et al. 2005). *BT = biodiversity target (the minimum conservation requirement).

Habitat remaining (%)			
	80–100	least threatened	LT
	60–80	vulnerable	VU
	*BT–60	endangered	EN
	0–*BT	critically endangered	CR

Table 2: Conservation status of different vegetation types occurring in the study area, according to Driver *et al*. 2005 and Mucina *et al*. 2005.

Vegetation Type	Target (%)	Conserved (%)	Transformed (%)	Conservation status	
				Driver *et al*. 2005; Mucina *et al*., 2006	Draft Ecosystem List (NEMBA)
Carletonville Dolomite Grassland	24	3	24	Vulnerable	Not listed

The National List of Ecosystems that are Threatened and need of protection (GN1002 of 2011), published under the National Environmental Management: Biodiversity Act (Act No. 10, 2004), lists national vegetation types that are afforded protection on the basis of rates of transformation. The thresholds for listing in this legislation are higher than in the scientific literature, which means there are fewer ecosystems listed in the National Ecosystem List versus in the scientific literature. Carletonville Dolomite Grassland is not listed in the "National List of Ecosystems that are Threatened and need of protection" (GN1002 of 2011).

Biodiversity Conservation Plans

The North-West Province Biodiversity Sector Plan 2015 (obtained from bgis.sanbi.org) provides maps that show Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) for the Province. This classified the natural vegetation of the Province according to conservation value in decreasing value, as follows:

1. Protected
2. CBA1
3. CBA2
4. ESA1

5. ESA2
6. Other natural
7. Degraded

This map shows that the a large proportion of the site (the western half) is within an area classified as ESA1 and a small piece at the eastern extent is within an area classified as CBA2 (see Figure 3).

Proposed protected areas

According to the National Parks Area Expansion Strategy (NPAES), there is an area 20 km to the north-west of the project study area that has been identified as priority areas for inclusion in future protected areas. This particular component of the landscape is considered to be of high biodiversity value by National Parks, but the proposed project does not affect this area at all.

Red List plant species of the study area

Lists of plant species of conservation concern previously recorded in the quarter degree grids in which the study area is situated were obtained from the South African National Biodiversity Institute. These are listed in Appendix 1. Additional species that could occur in similar habitats, as determined from database searches and literature sources, but have

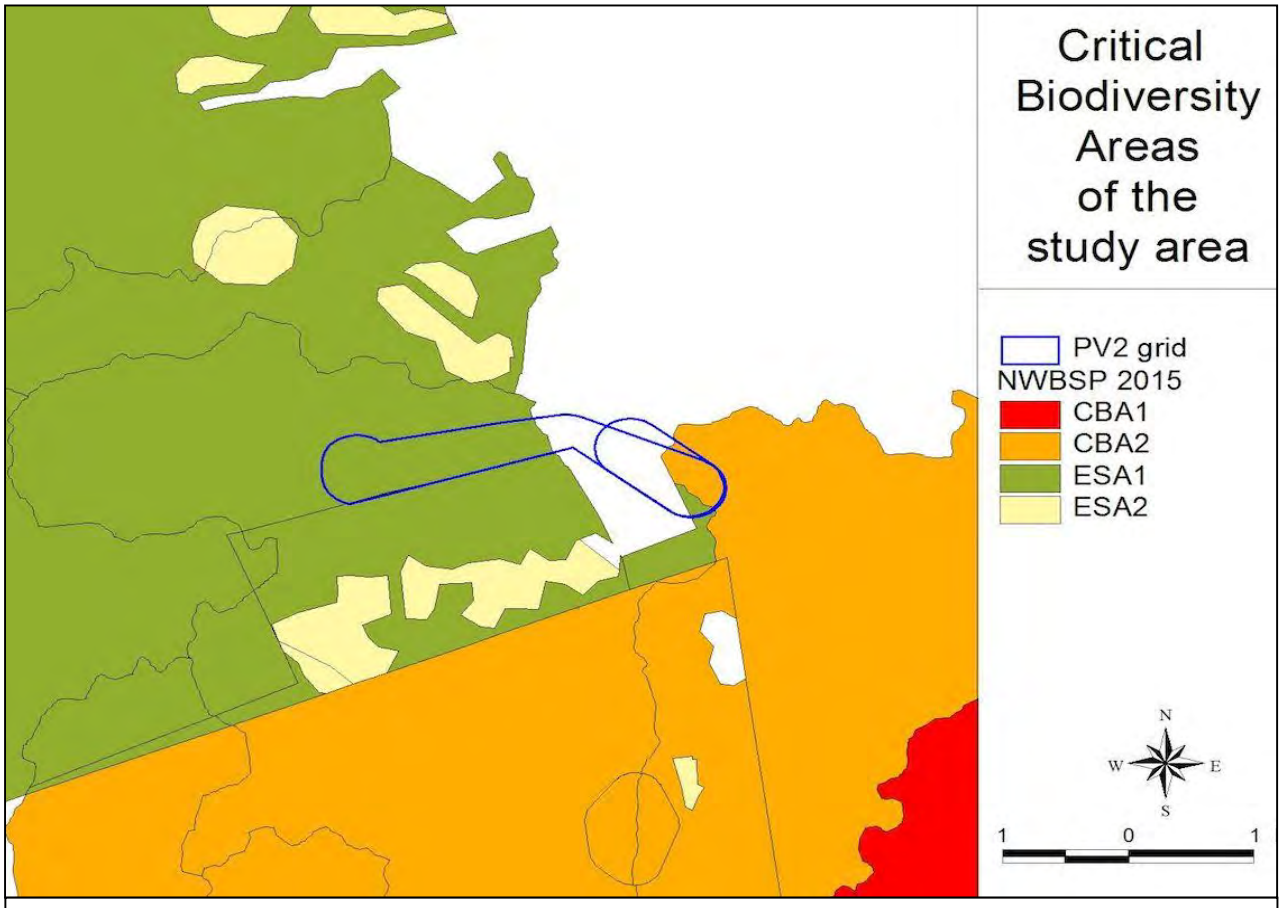

Figure 3: Biodiversity Conservation Assessment for the study area.

not been recorded in these grids are also listed.

There are four species that may occur in the study area, the bulb, *Boophone disticha*, listed as Declining, the bulb, *Crinum macowanii*, listed as Declining, the succulent herb, *Brachystelma incanum*, listed as Vulnerable, and the herb, *Cleome conrathii*, listed as Near Threatened (see Table 3 for explanation of categories). *Boophone disticha* is found in dry grassland and rocky areas. The species has been recorded in grid in which the site is located in the type of habitat that is found on site. One individual was near to the corridor and based on the habitat present on site there is a probability that more individuals occur there. *Crinum macowanii* is found in mountain grassland and stony slopes in hard dry shale, gravely soil or sandy flats. The species has been recorded in grid in which the site is located in the type of habitat that is probably found on site and the possibility of it occurring in the study area is therefore considered to be high. A species of *Crinum* was recorded in nearby areas, but it is unknown which species this is until flowering material is found. *Brachystelma incanum* is found in sandy loam soils in bushveld. Such habitat does not strictly occur on site, although there are occasional bush-clumps that may be suitable. The species has been previously recorded in the grid to the north of the site and there is therefore the possibility that it occurs on site. *Cleome conrathii* is found in stony quartzite slopes, usually in red sandy soil, in grassland or deciduous woodland, at all aspects. It is possible that it could also occur on site, but was not seen there.

Table 3: Explanation of IUCN Ver. 3.1 categories (IUCN, 2001), and Orange List categories (Victor & Keith, 2004).

IUCN / Orange List category	Definition	Class
EX	Extinct	Extinct
CR	Critically Endangered	Red List
EN	Endangered	Red List
VU	Vulnerable	Red List
NT	Near Threatened	Orange List
Declining	Declining taxa	Orange List
Rare	Rare	Orange List
Critically Rare	Rare: only one subpopulation	Orange List
Rare-Sparse	Rare: widely distributed but rare	Orange List
DDD	Data Deficient: well known but not enough information for assessment	Orange List
DDT	Data Deficient: taxonomic problems	Data Deficient
DDX	Data Deficient: unknown species	Data Deficient

Red List animal species of the study area

All Red List vertebrates (mammals, birds, reptiles, amphibians) that could occur in the study area are listed in Appendix 3.

There are 93 mammal species that have a geographical distribution that includes the study area, of which nine are listed in a conservation category of some level (see Appendix 3). Of the listed species, there are three of low conservation concern and one of high conservation concern that could occur in available habitats in the study area (see Appendix 4 for habitat requirements of listed species). These are the Brown Hyaena, the Honey Badger and Southern African Hedgehog. All of these species are classified nationally as

near threatened (NT), but globally as Least Concern. They are, therefore, of relatively low conservation concern in comparison to more threatened species found in other parts of the country. The Honey Badger and the Hedgehog are protected under the National Environmental Management: Biodiversity Act and any impacts on a specimen of this species or that may negatively affect the survival of the species would require a permit. The species of high conservation concern that could occur on site is the White-tailed Rat (*Mystromys albicaudatus*), listed as Endangered. The White-tailed Rat is restricted to savannas and grasslands of South Africa and Swaziland. They tend to inhabit burrows of meerkats and cracks in the soil during the day and venture out at night. They apparently require black loam soils with good cover (Coetzee & Monadjem 2008). It has been previously recorded in the grid in which the study area is located (Friedmann & Daly 2004, http://vmus.adu.org.za). The survey capture rate for this species is very low, suggesting that there are low numbers of the species (Coetzee & Monadjem 2008). Information sources suggest that there is a likelihood of this species occurring on site, although, if it does occur there, it is likely to be at a low density.

There are a total of 17 frog species with a geographical distribution that includes the study area (see Appendix 3). The Giant Bullfrog is the only amphibian species with a distribution that includes the study area and which could occur on site. This species is listed as Least Concern globally and Near threatened in South Africa. It is, however, protected under the National Environmental Management: Biodiversity Act and any impacts on a specimen of this species or that may negatively affect the survival of the species would require a permit.

There are a total of 58 reptile species with a geographical distribution that includes the study area. There is one reptile species of conservation concern that has a distribution that includes the study area, the Southern African Python. This species is not listed in a threat category, but is protected under the National Environmental Management: Biodiversity Act.

Protected plants (National Environmental Management: Biodiversity Act)

Plant species protected under the National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004) are listed in Appendix 5. One plant species that appears on this list that could potentially occur in the general region, although thay have not previously been recorded in the grids of the study area, is *Harpagophytum procumbens*.

Harpagophytum procumbens occurs in Angola, Botswana, Mozambique, Namibia, South Africa, Zambia, and Zimbabwe. Within South Africa this species occurs in the Northern Cape, North West, Free State, and Limpopo Provinces and the largest populations are found in the communally owned areas of the North West Province and the north eastern parts of the Northern Cape. The species is found in well drained sandy habitats in open savanna and woodlands. It has not been previously recorded in this grid in which the site is located and may be outside the scattered geographic range of the species. However, it is considered possible, but unlikely that this species could occur on site due to habitat conditions found there relative to the species requirements.

Protected trees

Tree species protected under the National Forest Act are listed in Appendix 2. There are three that have a geographical distribution that includes the study site, *Acacia erioloba*,

Combretum imberbe and *Boscia albitrunca*. There are a number of others that have a geographical distribution that ends close to the study site, including *Sclerocarya birrea* subsp. *caffra*, *Prunus africana*, *Pittosporum viridiflorum* and *Erythrophysa transvaalensis*. There is therefore a small possibility that they could also occur on site if suitable habitat occurs there.

Acacia erioloba (Camelthorn / Kameeldoring) is found in savanna, semi-desert and desert areas with deep, sandy soils and along drainage lines in very arid areas, sometimes in rocky outcrops. This species occurs in moderate numbers in areas affected by the proposed project. Two individuals were seen on site without specifically looking for them. There is therefore probably a much greater number that occurs there.

Boscia albitrunca (Shepherd's Tree / Witgatboom / !Xhi) occurs in semi-desert areas and bushveld, often on termitaria, but is common on sandy to loamy soils and calcrete soils. This species could potentially occur on site in areas affected by the proposed project. No individuals were seen on site, but one individual was recorded nearby.

Combretum imberbe (Leadwood / Hardekool / Motswere) is found in bushveld and mixed woodland, often in alluvial soils along dry and active river beds. This species could potentially occur on site in areas affected by the proposed project, although the habitat on site does not appear from the desktop assessment to be suitable. No individuals were seen during the field survey.

Erythrophysa transvaalensis (Transvaal Red Balloon / Rooiklapperboom / Mofalatsane) grows on the rocky slopes of hills, often amongst boulders. This species has a limited distribution in South Africa occurring in Gauteng, Limpopo and the North West Province. It was first thought to be endemic to syenite hills in the Pilanesburg National Park, but is found in a wider area. It is considered unlikely that it occurs on site. No individuals were seen there.

Pittosporum viridiflorum (Cheesewood / Bosboekenhout / Mosetlela) is widely distributed in the eastern half of South Africa, occuring from the Western Cape up into tropical Africa and beyond to Arabia and India. It grows over a wide range of altitudes and varies in form from one location to another. *Pittosporum viridiflorum* grows in tall forest and in scrub on the forest margin, kloofs and on stream banks. No such habitat occurs on site and it is considered unlikely that this species occurs there. No individuals were seen there.

Prunus africana (Bitter Almond / Bitteralmandelhout / Mogohloro) is found in evergreen forests near the coast, inland mistbelt forests and afromontane forests up to 2100 m. The species is listed as Vulnerable in the Red List of South African plants. Based on habitat requirements, it is not expected that it occurs there. No individuals were seen there.

Sclerocarya birrea subsp. *caffra* (Marula / Maroela / Morula) is widespread in Africa from Ethiopia in the north to KwaZulu-Natal in the south. In South Africa it is more dominant in the Baphalaborwa area in Limpopo. It occurs naturally in various types of woodland, on sandy soil or occasionally sandy loam. No individuals were seen there and the habitat on site is considered to not be typical of the habitat in which the species usually occurs.

Protected animals

There are a number of animal species protected according to the National Environmental Management: Biodiversity Act (Act No. 10 of 2004).According to this Act, "*a person may*

not carry out a restricted activity involving a specimen of a listed threatened or protected species without a permit issued in terms of Chapter 7". Such activities include any that are "*of a nature that may negatively impact on the survival of a listed threatened or protected species*". This implies that any negative impacts on habitats in which populations of protected species occur or are dependent upon would be restricted according to this Act.

Those species protected according to the National Environmental Management: Biodiversity Act (Act No. 10 of 2004) that have a geographical distribution that includes the site are listed in Appendix 6, marked with the letter "N". This includes the following species: Roan Antelope, Black Wildebeest, Reedbuck, Cape Clawless Otter, Brown Hyaena, Spotted-necked Otter, Honey Badger, Leopard, Cape Fox, Southern African Hedgehog, Southern African Python, Giant Bullfrog, Blue Crane, Martial Eagle, Lesser Kestrel, Black Stork, Cape Vulture, Lappet-faced Vulture and White-backed Vulture.

Due to habitat and forage requirements and the fact that some species are restricted to game farms and/or conservation areas, only the Brown Hyaena, Black-footed Cat, Honey Badger, Leopard, Cape Fox and the Giant Bullfrog have a likelihood of occurring on site. All of these species are mobile animals that are likely to move away in the event of any activities on site disturbing them. They are therefore unlikely to be affected by the proposed development of the solar power facility and associated infrastructure.

Important Bird Areas

The study area is not within an Important Bird Area (IBA). The nearest IBAs are the Botsolano Nature Reserve IBA, which is 70 km away to the north-west, the Barberspan & Leeupan IBA, which is 70 km away to the south-west and the Magaliesberg IBA, which is 100 km away to the east.

Habitats on site

Aerial imagery indicates that most of the site consists of natural vegetation (grassland called Carletonville Dolomite Grassland). This was confirmed from the field survey, but with the addition of scattered trees and bushclumps. The distribution of main habitats on site, as identifiable from aerial imagery, is shown in Figure 4.

Watercourses

The study area contains no watercourses / drainage lines that are visible from aerial imagery or from the Surveyor-General's 1:50 000 topocadastral map. No drainage areas or water features were observed on site during the field survey.

Sensitivity assessment

The sensitivity assessment identifies those parts of the study area that have high conservation value or that may be sensitive to disturbance. Areas of potentially high sensitivity are shown in Figure 5. The information provided in the preceding sections was used to compile a map of remaining natural habitats and areas important for maintaining ecological processes in the study area.

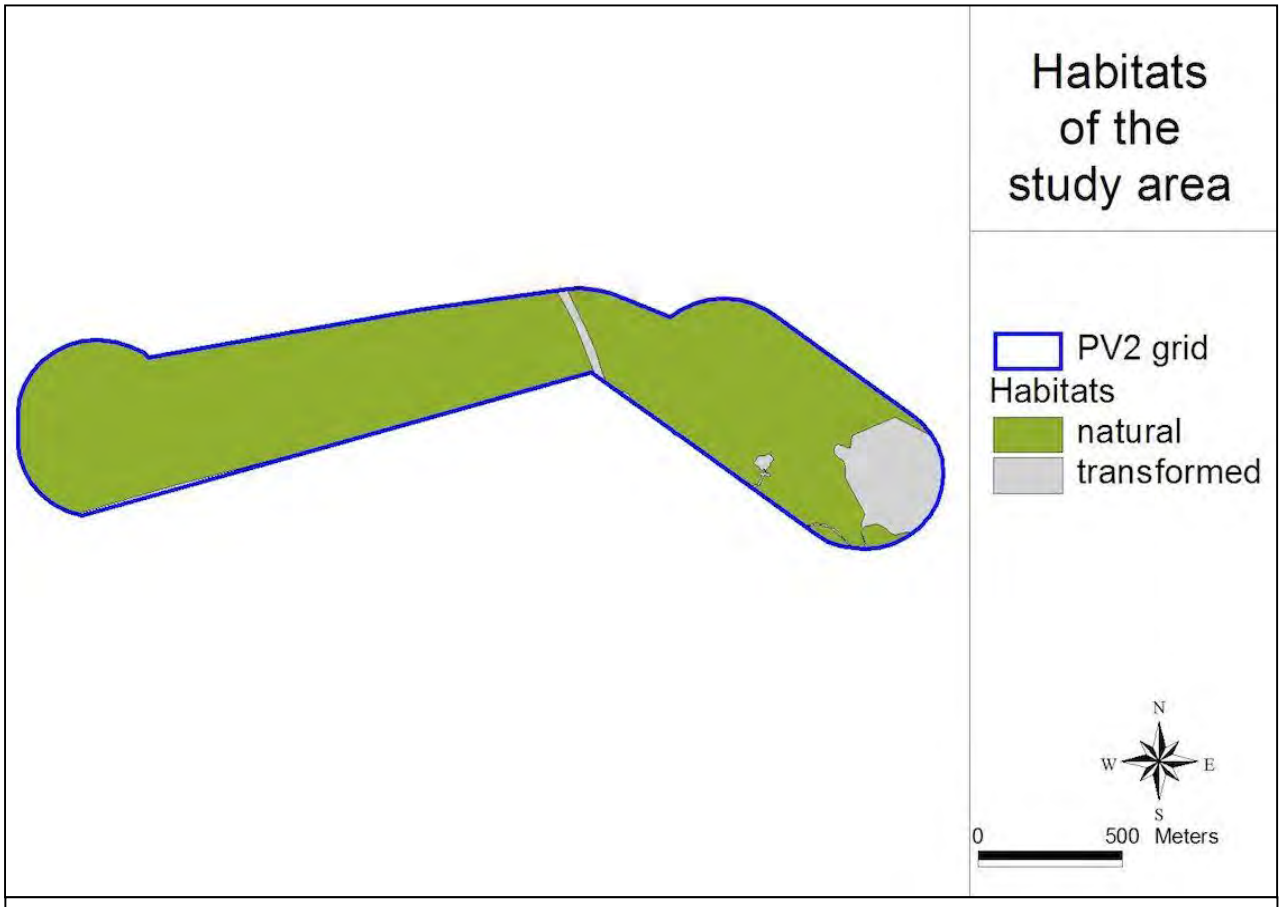

Figure 4: Main habitats of the study area.

These factors have been taken into account in evaluating sensitivity within the study area. Watercourses are considered to be the most sensitive features on site. The sensitivity classification is as follows:

1. MEDIUM-HIGH: The majority of the study area is classified as having medium sensitivity (see Figure 5). These are areas of natural vegetation which may harbour features of conservation concern (listed or protected plants and/or animals), as well as falling within C-Plan Ecological Support Areas and being part of a vegetation type classified as Vulnerable.
2. LOW: Transformed areas are classified as having low sensitivity (see Figure 5). These are areas in which no intact natural habitat still remains.

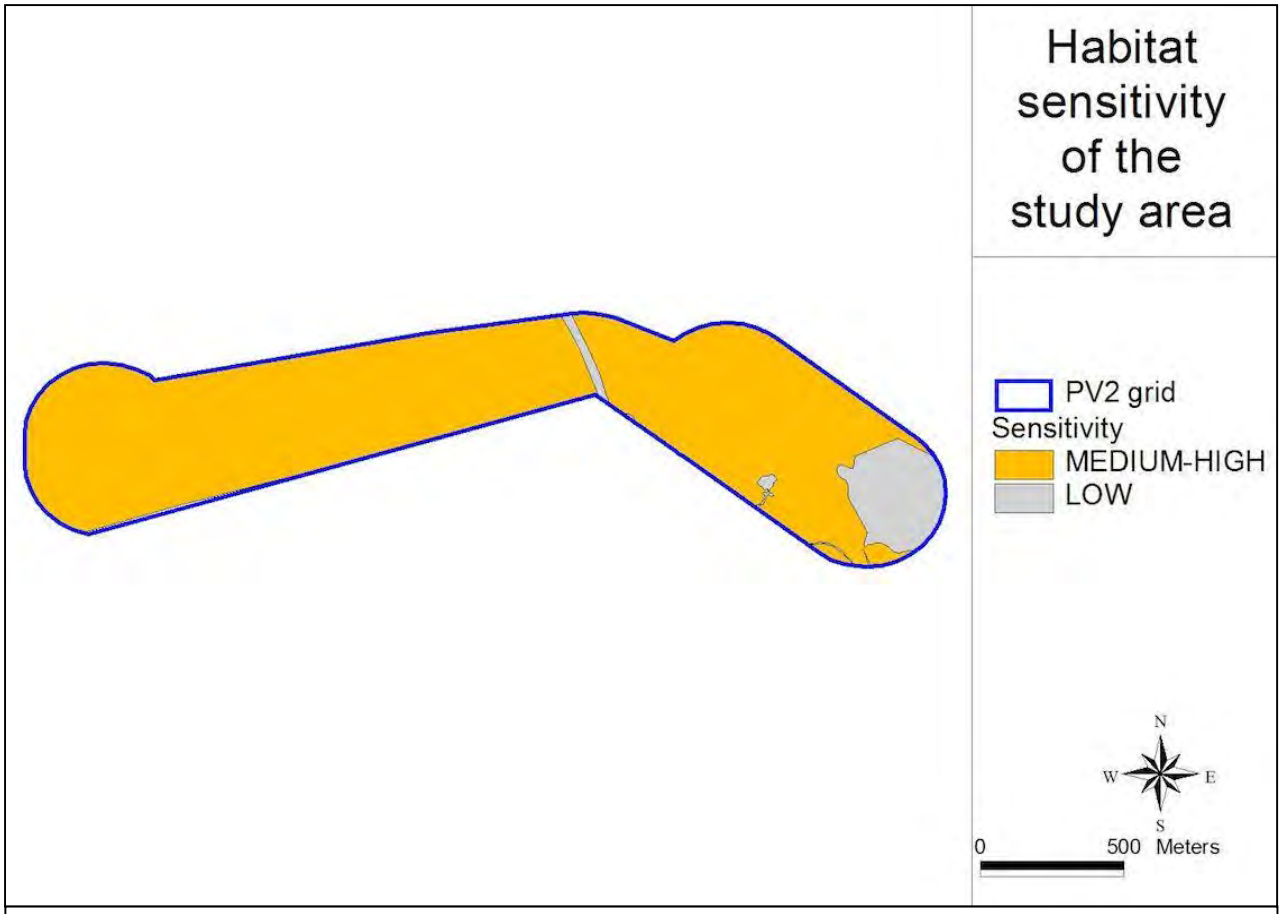

Figure 5: Potentially sensitive areas of the study area.

RELEVANT LEGISLATIVE AND PERMIT REQUIREMENTS

Relevant legislation is provided in this section to provide a description of the key legal considerations of importance to the proposed project. The applicable legislation is listed below.

Legislation

National Environmental Management Act, Act No. 107 of 1998 (NEMA)

NEMA requires, inter alia, that:

- "development must be socially, environmentally, and economically sustainable",
- "disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied." ,
- "a risk-averse and cautious approach is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions",

NEMA states that "the environment is held in public trust for the people, the beneficial use of environmental resources must serve the public interest and the environment must be protected as the people's common heritage."

Environment Conservation Act No 73 of 1989 Amendment Notice No R1183 of 1997

The ECA states that:

Development must be environmentally, socially and economically sustainable. Sustainable development requires the consideration of inter alia the following factors:

- that pollution and degradation of the environment is avoided, or, where they cannot be altogether avoided, are minimised and remedied;
- that the use and exploitation of non-renewable natural resources is responsible and equitable, and takes into account the consequences of the depletion of the resource;
- that the development, use and exploitation of renewable resources and the ecosystems of which they are part do not exceed the level beyond which their integrity is jeopardised; and
- that negative impacts on the environment and on peoples' environmental rights be anticipated and prevented, and where they cannot be altogether prevented are minimised and remedied.

The developer is required to undertake Environmental Impact Assessments (EIA) for all projects listed as a Schedule 1 activity in the EIA regulations in order to control activities which might have a detrimental effect on the environment. Such activities will only be permitted with written authorisation from a competent authority.

National Forests Act (Act no 84 of 1998)

Protected trees

According to this act, the Minister may declare a tree, group of trees, woodland or a species of trees as protected. The prohibitions provide that 'no person may cut, damage, disturb, destroy or remove any *protected tree*, or collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a licence granted by the Minister'.

Forests

Prohibits the destruction of indigenous trees in any natural forest without a licence.

National Environmental Management: Biodiversity Act (Act No 10 of 2004)

In terms of the Biodiversity Act, the developer has a responsibility for:

- The conservation of endangered ecosystems and restriction of activities according to the categorisation of the area (not just by listed activity as specified in the EIA regulations).

- Promote the application of appropriate environmental management tools in order to ensure integrated environmental management of activities thereby ensuring that all development within the area are in line with ecological sustainable development and protection of biodiversity.
- Limit further loss of biodiversity and conserve endangered ecosystems.

Chapter 4 of the Act relates to threatened or protected ecosystems or species. According to Section 57 of the Act, "Restricted activities involving listed threatened or protected species":

- (1) A person may not carry out a restricted activity involving a specimen of a listed threatened or protected species without a permit issued in terms of Chapter 7.

Such activities include any that are "of a nature that may negatively impact on the survival of a listed threatened or protected species".

Chapter 5 of the Act relates to species and organisms posing a potential threat to biodiversity. According to Section 75 of the Act, "Control and eradication of listed invasive species":

- (1) Control and eradication of a listed invasive species must be carried out by means of methods that are appropriate for the species concerned and the environment in which it occurs.
- (2) Any action taken to control and eradicate a listed invasive species must be executed with caution and in a manner that may cause the least possible harm to biodiversity and damage to the environment.
- (3) The methods employed to control and eradicate a listed invasive species must also be directed at the offspring, propagating material and re-growth of such invasive species in order to prevent such species from producing offspring, forming seed, regenerating or re-establishing itself in any manner.

Government Notice No. 1002 of 2011: National List of Ecosystems that are Threatened and in need of protection

Published under Section 52(1)(a) of the National Environmental Management: Biodiversity Act (Act No. 10 of 2004). This Act provides for the listing of threatened or protected ecosystems based on national criteria. The list of threatened terrestrial ecosystems supersedes the information regarding terrestrial ecosystem status in the National Spatial Biodiversity Assessment (2004).

The Environmental Impact Assessment (EIA) Regulations include three lists of activities that require environmental authorisation:

- Listing Notice 1: activities that require a basic assessment (R544 of 2010),
- Listing Notice 2: activities that require seeping and environmental impact report (EIR) (R545 of 201 0),
- Listing Notice 3: activities that require a basic assessment in specific identified geographical areas only (R546 of 2010).

Activity 12 in Listing Notice 3 relates to the clearance of 300m^2 of more of vegetation, which will trigger a basic assessment within any critically endangered or endangered ecosystem listed in terms of S52 of the Biodiversity Act. This means any development that involves loss of natural habitat in a listed critically endangered or endangered ecosystem is likely to require at least a basic assessment in terms of the EIA regulations.

It is important to note that while the original extent of each listed ecosystem has been mapped, a basic assessment report in terms of the EIA regulations is triggered only in remaining natural habitat within each ecosystem and not in portions of the ecosystem

where natural habitat has already been irreversibly lost.

GNR 151: Critically Endangered, Endangered, Vulnerable and Protected Species List

Published under Section 56(1) of the National Environmental Management: Biodiversity Act (Act No. 10 of 2004).

GNR 1187: Amendment of Critically Endangered, Endangered, Vulnerable and Protected Species List

Published under Section 56(1) of the National Environmental Management: Biodiversity Act (Act No. 10 of 2004).

Conservation of Agricultural Resources (Act No. 43 of 1983) as amended in 2001

Declared Weeds and Invaders in South Africa are categorised according to one of the following categories:

- Category 1 plants: are prohibited and must be controlled.
- Category 2 plants: (commercially used plants) may be grown in demarcated areas providing that there is a permit and that steps are taken to prevent their spread.
- Category 3 plants: (ornamentally used plants) may no longer be planted; existing plants may remain, as long as all reasonable steps are taken to prevent the spreading thereof, except within the floodline of watercourses and wetlands.

National Water Act (Act 36 of 1998)

Wetlands, riparian zones and watercourses are defined in the Water Act as a water resource and any activities that are contemplated that could affect the wetlands requires authorisation (Section 21 of the National Water Act of 1998). A "watercourse" in terms of the National Water Act (Act 36 of 1998) means:

- River or spring;
- A natural channel in which water flows regularly or intermittently;
- A wetland, lake or dam into which, or from which, water flows; and

Any collection of water which the Minister may, by notice in the gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

National Veld and Forest Fire Act (Act No. 101 of 1998)

Provides requirements for veldfire prevention through firebreaks and required measures for fire-fighting. Chapter 4 of the Act places a duty on landowners to prepare and maintain firebreaks. Chapter 5 of the Act places a duty on all landowners to acquire equipment and have available personnel to fight fires.

Other Acts

Other Acts that may apply to biodiversity issues, but which are considered to not apply to the current site are as follows:

- National Environmental Management Protected Areas Act (Act No. 57 of 2003)
- Marine Living Resources Act (Act No. 18 of 1998)
- Sea Birds and Seals Protection Act (Act No. 46 of 1973)
- Lake Areas Development Act (Act No. 39 of 1975)
- Mountain Catchment Areas Act (Act No. 63 of 1970)
- Integrated Coastal Zone Management Act (Act No. 24 of 2008)

ASSESSMENT OF POTENTIAL IMPACTS

Description of potential impacts

Potential issues relevant to potential impacts on the ecology of the study area include the following:

- Impacts on biodiversity: this includes any impacts on populations of individual species of concern (flora and fauna), including protected species, and on overall species richness. This includes impacts on genetic variability, population dynamics, overall species existence or health and on habitats important for species of concern.
- Impacts on sensitive habitats: this includes impacts on any sensitive or protected habitats, including indigenous forest and/or woodland and wetland vegetation that leads to direct or indirect loss of such habitat.
- Impacts on ecosystem function: this includes impacts on any processes or factors that maintain ecosystem health and character, including the following:
    - disruption to nutrient-flow dynamics;
    - impedance of movement of material or water;
    - habitat fragmentation;
    - changes to abiotic environmental conditions;
    - changes to disturbance regimes, e.g. increased or decreased incidence of fire;
    - changes to successional processes;
    - effects on pollinators;
    - increased invasion by alien plants.

Changes to factors such as these may lead to a reduction in the resilience of plant communities and ecosystems or loss or change in ecosystem function.

- Secondary and cumulative impacts on ecology: this includes an assessment of the impacts of the proposed project taken in combination with the impacts of other known projects for the area or secondary impacts that may arise from changes in the social, economic or ecological environment.
- Impacts on the economic use of vegetation: this includes any impacts that affect the productivity or function of ecosystems in such a way as to reduce the economic value to users, e.g. reduction in grazing capacity, loss of harvestable products. It is a general consideration of the impact of a project on the supply of so-called ecosystem goods and services.

A number of direct risks to ecosystems that would result from **construction** of the proposed power line are as follows:

- Clearing of land for construction.
- Construction of access roads.
- Placement of power lines.
- Establishment of borrow and spoil areas.
- Chemical contamination of the soil by construction vehicles and machinery.
- Operation of construction camps.
- Storage of materials required for construction.

There are also risks associated with **operation** of the proposed facility, as follows:

- Maintenance of surrounding vegetation as part of management of the power line.
- Animal collisions with infrastructure, especially flying animals.

- Invasion of habitats by alien plants as a consequence of disturbance.

Potential issues for the general study area

A summary of the potential ecological issues for the study area is as follows:

- Presence of natural vegetation on site, some of which is included in Provincial CBA areas and is therefore of potentially high conservation priority.
- Potential presence of four plant species of concern, the bulb, *Boophone disticha* (occurs on site), listed as Declining, the bulb, *Crinum macowanii* (probably occurs on site), listed as Declining, the succulent herb, *Brachystelma incanum*, listed as Vulnerable, and the herb, *Cleome conrathii*, listed as Near Threatened.
- Potential presence of one protected plant species, *Harpagophytum procumbens.*
- Potential presence of three protected tree species, *Acacia erioloba* (occurs in large numbers on site), *Combretum imberbe* and *Boscia albitrunca* (occurs in adjacent habitats).
- Potential presence of the some animals of potential conservation concern:
    - Brown Hyaena (NT)
    - Honey badger (NT)
    - Southern African Hedgehog (NT)
    - White-tailed Rat (EN)
    - Giant Bullfrog (NT/LC)
    - Kori Bustard (VU),
    - Blue Crane (VU),
    - Secretarybird (NT).
- Potential invasion of natural habitats by alien invasive plants, thus causing additional impacts on biodiversity features.

Potential risks to the ecological receiving environment are therefore the following:

1. Loss of indigenous natural vegetation during construction;
2. Impacts on two listed plant species;
3. Impacts on protected plant species;
4. Impacts on two protected tree species;
5. Impacts on pan depression areas;
6. Mortality of populations of sedentary species during construction (terrestrial and aquatic);
7. Displacement of populations of mobile species (terrestrial);
8. Mortality of bird species of concern due to secondary factors, such as collisions with overhead power lines;
9. Introduction and/or spread of declared weeds and alien invasive plants in terrestrial habitats.

Planning Phase impacts

There are no impacts that are likely to be created as a result of project planning.

Construction Phase impacts

Impact 1: Impacts on indigenous natural vegetation

The regional terrestrial vegetation type in the broad study area is Carletonville Dolomite Grassland, listed as Vulnerable in the scientific literature. However, natural habitat on site has been identified as being of importance in the Provincial Conservation Assessment. Loss of habitat will definitely occur, but this will be a small area in comparison to the total area of the vegetation type concerned.

Table 4a: Impact table for Impact 1 for power lines.

Loss of indigenous natural vegetation		
Environmental parameter	*Indigenous natural vegetation*	
Issue/Impact/Environmental Effect/Nature	*Loss, degradation or fragmentation of vegetation.*	
Extent	*The impact will affect natural vegetation on site and possibly in immediately surrounding areas.*	
Probability	*The impact will probably happen.*	
Reversibility	*Reversible to some degree for power lines because of the limited local footprint. Secondary vegetation will probably never resemble the original vegetation found on site.*	
Irreplaceable loss of resources	*Some loss of resources will occur.*	
Duration	*The impact will be medium-term due to the fact that local impacts will soon recover through natural successional processes.*	
Cumulative effect	*Medium cumulative impact. Added to existing impacts on natural habitat, the current project will cause additional loss of vegetation.*	
Intensity/magnitude	*Low. Vegetation will continue to function.*	
Significance rating	*Low negative impact expected.*	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1	1
Probability	3	2
Reversibility	3	3
Irreplaceable loss	2	2
Duration	2	2
Cumulative effect	2	2
Intensity/magnitude	1	1
Significance rating	-13 (low negative)	-12 (low negative)
Mitigation measures	*The following mitigation measures would help to limit impacts, but will not affect the extent, probability, reversibility, irreplaceable loss of resources, duration, cumulative effect or intensity:* *1. Compile a rehabilitation programme.* *2. Compile an Alien Plant Management Plan, including monitoring, to ensure minimal impacts on surrounding areas.*	

Table 4b: Impact table for Impact 1 for both substation options.

Loss of indigenous natural vegetation	
Environmental parameter	*Indigenous natural vegetation*
Issue/Impact/Environmental Effect/Nature	*Loss, degradation or fragmentation of vegetation.*
Extent	*The impact will affect natural vegetation on site and*

	possibly in immediately surrounding areas.
Probability	*The impact will definitely happen.*
Reversibility	*Irreversible in human timeframes, since natural successional processes cannot compensate for complete local loss of habitat and diversity. Secondary vegetation will probably never resemble the original vegetation found on site.*
Irreplaceable loss of resources	*Significant loss of resources will occur.*
Duration	*The impact will be permanent (mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient.)*
Cumulative effect	*Medium cumulative impact. Added to existing impacts on natural habitat, the current project will cause additional loss of vegetation.*
Intensity/magnitude	*Medium. Regional vegetation will continue to function.*
Significance rating	*Medium negative impact expected.*

	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1	1
Probability	4	4
Reversibility	4	4
Irreplaceable loss	3	3
Duration	4	4
Cumulative effect	3	3
Intensity/magnitude	2	2
Significance rating	-38 (medium negative)	-38 (medium negative)
Mitigation measures	*The following mitigation measures would help to limit impacts, but will not affect the extent, probability, reversibility, irreplaceable loss of resources, duration, cumulative effect or intensity:* *1. Compile a rehabilitation programme.* *3. Compile an Alien Plant Management Plan, including monitoring, to ensure minimal impacts on surrounding areas.*	

Impact 2: Impacts on listed plant species

There are four species that may occur in the study area, the bulb, *Boophone disticha*, listed as Declining, the bulb, *Crinum macowanii*, listed as Declining, the succulent herb, *Brachystelma incanum*, listed as Vulnerable, and the herb, *Cleome conrathii*, listed as Near Threatened

Table 5: Impact summary table for Impact 2 for all infrastructure components.

Loss of individuals of listed plants	
Environmental parameter	*Listed plants, as per Red & Orange List.*
Issue/Impact/Environmental Effect/Nature	*Loss of individuals.*
Extent	*The impact will affect local populations or individuals of the affected species.*
Probability	*The impact will probably happen.*
Reversibility	*Partly reversible. Individuals can be rescued or else*

	cultivated to replace lost specimens.
Irreplaceable loss of resources	*Marginal loss of resources could occur. The species that are likely to occur on site are likely to be relatively common throughout their range.*
Duration	*The impact will be medium-term.*
Cumulative effect	*Low cumulative impact. Cumulative effects will not be significant.*
Intensity/magnitude	*Low. Loss of some individuals will be insignificant compared to the number that probably occur in surrounding areas.*
Significance rating	*Low negative impact expected.*

	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1	1
Probability	3	2
Reversibility	2	2
Irreplaceable loss	2	2
Duration	2	2
Cumulative effect	2	1
Intensity/magnitude	1	1
Significance rating	-12 (low negative)	-10 (low negative)
Mitigation measures	*The following mitigation measures would help to limit impacts:* 1. *It is a legal requirement to obtain permits for specimens that will be lost.* 2. *A pre-construction walk-through survey will be required to locate any listed plants.* 3. *Near threatened and Declining plants lost to the development can be rescued and planted in appropriate places in surrounding areas. This will reduce the probability as well as the cumulative effect.* 4. *If any listed plants are located during the pre-construction survey, a Plant Rescue Plan would be required to manage the process of attempting to rescue such individuals.* 5. *If any threatened species are found (only Brachystelma incanum listed for this area), the infrastructure layout would need to be adjusted to allow in situ conservation of affected plants as well as a suitable buffer zone. An Ecological Management Plan would need to be compiled to manage the locality where it occurs.*	

Impact 3: Impacts on protected plant species

There is one species protected according to the National Environmental Management: Biodiversity Act, *Harpagophytum procumbens*, that may potentially occur on site.

There is one species protected according to the National Environmental Management: Biodiversity Act, *Harpagophytum procumbens*, that may potentially occur on site. No individuals were found on site during the field survey and, based on an assessment of available habitat on site, it is considered unlikely that any occur there. This potential

impact will therefore not occur and is not assessed further.

There are a number of species that may be protected according to provincial legislation. The possible presence of these on site is unknown due to the dry conditions at the time of the survey. There is therefore a possibility that additional protected species may occur there and that they may be detected at a later stage of the project. The assessment below is therefore based on this possibility.

Table 6: Impact summary table for Impact 3 for all infrastructure components.

Loss of individuals of protected plants		
Environmental parameter	*Protected plants, as per NEM:BA and provincial legislation.*	
Issue/Impact/Environmental Effect/Nature	*Loss of individuals.*	
Extent	*The impact will affect local populations or individuals of the affected species.*	
Probability	*The impact may possibly happen.*	
Reversibility	*Partly reversible. Individuals can be rescued or else cultivated to replace lost specimens.*	
Irreplaceable loss of resources	*Marginal loss of resources could occur. The species that are likely to occur on site are likely to be relatively common throughout their range.*	
Duration	*The impact will be medium-term.*	
Cumulative effect	*Low cumulative impact. Cumulative effects will not be significant.*	
Intensity/magnitude	*Low. Loss of some individuals will be insignificant compared to the number that probably occur in surrounding areas.*	
Significance rating	*Low negative impact expected.*	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1	1
Probability	2	2
Reversibility	2	2
Irreplaceable loss	2	1
Duration	2	2
Cumulative effect	2	1
Intensity/magnitude	1	1
Significance rating	-11 (low negative)	-9 (low negative)
Mitigation measures	*The following mitigation measures would help to limit impacts:* 1. *It is a legal requirement to obtain permits for specimens that will be lost.* 6. *A pre-construction walk-through survey will be required to locate any protected plants.* 7. *Plants lost to the development can be rescued and planted in appropriate places in surrounding areas. This will reduce the irreplaceable loss of resources as well as the cumulative effect.* 8. *If any protected plants are located during the pre-construction survey, a Plant Rescue*	

	Plan would be required to manage the process of attempting to rescue such individuals.

Impact 4: Loss of individuals of protected trees

There are three protected tree species that could occur on site, *Acacia erioloba*, *Combretum imberbe* and *Boscia albitrunca*. Whether these species occur on site or not is unknown until a site evaluation has been undertaken.

Table 7: Impact summary table for Impact 4 for all infrastructure components.

Loss of individuals of protected trees		
Environmental parameter	*Protected trees, as per National Forests Act.*	
Issue/Impact/Environmental Effect/Nature	*Loss of individuals.*	
Extent	*The impact will affect local populations or individuals of the affected species.*	
Probability	*The impact will definitely happen.*	
Reversibility	*Irreversible. Individuals are not possible to be rescued.*	
Irreplaceable loss of resources	*Marginal loss of resources could occur. The species that occurs on site is relatively common throughout its range although a large number of individuals were seen to occur on site.*	
Duration	*The impact will be permanent.*	
Cumulative effect	*Low cumulative impact. Cumulative effects will not be significant.*	
Intensity/magnitude	*Low. Loss of some individuals will be insignificant compared to the number that probably occur in surrounding areas.*	
Significance rating	*Low negative impact expected.*	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1	1
Probability	4	4
Reversibility	4	4
Irreplaceable loss	2	2
Duration	4	5
Cumulative effect	2	2
Intensity/magnitude	1	1
Significance rating	-17 (low negative)	-9 (low negative)
Mitigation measures	*The following mitigation measures would help to limit impacts:* 1. *It is a legal requirement to obtain permits for specimens that will be lost.* 2. *A pre-construction walk-through survey will be required to locate any protected trees and record information about each specimen.*	

Impact 6: Mortality of populations of sedentary species

There are five animal species of conservation concern that could potentially be affected by the proposed project:

1. Brown Hyaena (NT),
2. Honey badger (NT),
3. Southern African Hedgehog (NT),
4. White-tailed Rat (EN),
5. Giant Bullfrog (NT/LC).

Three of these species, the Southern African Hedgehog, the White-tailed Rat and the Giant Bullfrog, are relatively sedentary and therefore considered to be potentially vulnerable to habitat loss, as related to this project.

Table 8: Impact summary table for Impact 6 for all infrastructure components.

Loss of populations of sedentary animals		
Environmental parameter	*Species of conservation concern*	
Issue/Impact/Environmental Effect/Nature	*Loss of individuals/populations.*	
Extent	*The impact will affect local populations or individuals of the affected species.*	
Probability	*The impact may possibly happen.*	
Reversibility	*Partly reversible. Individuals may be rescued and translocated.*	
Irreplaceable loss of resources	*Marginal loss of resources could occur. The species that potentially occur on site have very wide geographical ranges.*	
Duration	*The impact will be short-term.*	
Cumulative effect	*Low cumulative impact. Cumulative effects will not be significant.*	
Intensity/magnitude	*Low. Loss of some individuals will be insignificant compared to the number that probably occur throughout their range.*	
Significance rating	*Low negative impact expected.*	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1	1
Probability	2	1
Reversibility	2	2
Irreplaceable loss	2	1
Duration	1	1
Cumulative effect	2	1
Intensity/magnitude	1	1
Significance rating	-10 (low negative)	-7 (low negative)
Mitigation measures	*The following mitigation measures would help to limit impacts:* 1. *It is a legal requirement to obtain permits for specimens that will be lost.* 2. *A pre-construction walk-through survey will be required to locate any individuals and move them to surrounding habitats.*	

Impact 7: Displacement of mobile fauna

Construction activities, loss of habitat, noise, dust and general activity associated with the construction phase of the project are likely to cause all mobile species to move away from the site. Mobile species of conservation concern (two sedentary species are discussed for the previous impact) that could potentially be affected by the proposed project are as

follows:

1. Brown Hyaena (NT)
2. Honey badger (NT).

These are all highly mobile terrestrial species with a large home range and the ability to travel long distances in short periods of time. For these species, they may be locally displaced, but this will have little effect on the overall range of any of these species nor is it expected that any overall impacts will result from local displacement. This potential impact is therefore not assessed further.

Operational Phase impacts

Impact 8: Mortality of birds by collision with vertical infrastructure

During operation, flying species could potentially suffer mortality by collisions with vertical infrastructure, especially infrastructure with low visibility, such as power lines.

The species most affected by loss of individuals are species that are already threatened in their general range by other factors. These species appear on various Red Lists. Species that are not threatened are unlikely to be significantly negatively affected by loss of habitat, since they are generally widespread and/or catholic in their requirements. Also, there are certain groups of birds, the large, low-flying species (bustards, cranes, etc.) that are most at risk from power lines.

Table 9: Impact summary table for Impact 8 for power lines (both options).

Mortality of individuals due to collisions with power lines		
Environmental parameter	*Threatened bird species*	
Issue/Impact/Environmental Effect/Nature	*Loss of individuals.*	
Extent	*The impact will affect individuals on site and possibly in immediately surrounding areas.*	
Probability	*The impact may possibly happen.*	
Reversibility	*Partly reversible. Preventative measures could reduce mortality to below replacement levels.*	
Irreplaceable loss of resources	*Marginal loss of resources will occur.*	
Duration	*The impact will be long-term.*	
Cumulative effect	*Medium cumulative impact. Cumulative effects will be minor.*	
Intensity/magnitude	*Medium. May impact on population processes.*	
Significance rating	*Low negative impact expected.*	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1	1
Probability	2	1
Reversibility	2	2
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	3	2
Intensity/magnitude	2	1
Significance rating	-26 (low negative)	-11 (low negative)
Mitigation measures	*Visibility devices could be placed on overhead powerlines, if necessary. This will reduce the probability slightly, but not to an extent that it will*	

	change the impact rating scores. The mitigation measure is therefore not required unless monitoring identifies this as an issue during operation.

Impact 9: Establishment and spread of declared weeds and alien invader plants

Major factors contributing to invasion by alien invader plants includes *inter alia* high disturbance (such as clearing for construction activites) and negative grazing practices (Zachariades *et al*. 2005). Exotic species are often more prominent near infrastructural disturbances than further away (Gelbard & Belnap 2003, Watkins *et al*. 2003). Consequences of this may include:

1. loss of indigenous vegetation;
2. change in vegetation structure leading to change in various habitat characteristics;
3. change in plant species composition;
4. change in soil chemical properties;
5. loss of sensitive habitats;
6. loss or disturbance to individuals of rare, endangered, endemic and/or protected species;
7. fragmentation of sensitive habitats;
8. change in flammability of vegetation, depending on alien species;
9. hydrological impacts due to increased transpiration and runoff; and
10. impairment of wetland function.

There is a moderate possibility that alien plants could be introduced to areas within the footprint of the proposed infrastructure from surrounding areas in the absence of control measures. The potential consequences may be of moderate seriousness for surrounding natural habitats due to the fact that a lot of natural vegetation still remains on site. Control measures could prevent the impact from occurring.

Table 10: Impact summary table for Impact 8 for all infrastructure.

Establishment and spread of declared weeds		
Environmental parameter	*Vegetation and habitat*	
Issue/Impact/Environmental Effect/Nature	*Loss of habitat due to invasion by alien plants*	
Extent	*The impact will affect habitat on site and possibly in immediately surrounding areas.*	
Probability	*The impact will probably happen in the absence of control measures.*	
Reversibility	*Partly reversible in the absence of control measures. Completely reversible if mitigation measures applied. Preventative measures will stop the impact from occurring.*	
Irreplaceable loss of resources	*Marginal to significant loss of resources will occur. Uncontrolled invasion can affect all nearby natural habitats.*	
Duration	*The impact will be long-term.*	
Cumulative effect	*Low cumulative impact. Cumulative effects will not be significant.*	
Intensity/magnitude	*Medium. Severe invasion can alter the functioning of natural ecosystems.*	
Significance rating	*Low negative impact expected.*	
	Pre-mitigation impact	Post-mitigation impact

	rating	rating
Extent	1	1
Probability	3	2
Reversibility	2	1
Irreplaceable loss	3	2
Duration	3	3
Cumulative effect	2	2
Intensity/magnitude	2	1
Significance rating	-28 (medium negative)	-11 (low negative)
Mitigation measures	*Compile and implement an alien management plan.* *Undertake regular monitoring to detect alien invasions early so that they can be controlled.* *Implement control measures.*	

Decommissioning Phase impacts

It is expected that the project will operate for a minimum of twenty years or more (a typical planned life-span for a project of this nature. Decommissioning will probably require a series of steps resulting in the removal of equipment from the site and rehabilitation of footprint areas. It is possible that the site could be returned to a rural nature, but it is unlikely that natural vegetation would become established on site for a very long time. The reality is that it is not possible to determine at this stage whether rehabilitation measures will be implemented or not or what the future plans for the site would be nor is it possible at this stage to determine what surrounding land pressures would be. These uncertainties make it impossible to undertake any assessment to determine possible impacts of decommissioning.

Cumulative impacts

There are a number of renewable energy developments that have been proposed or authorised in the region within a 25 km radius of the Tlisitseng PV application area. These projects are likely to have a similar impact on the ecological receiving environment as the current project. The cumulative impact of the current project in addition to all these other projects is assessed here. The list of projects is shown in Table 11 and shown in Figure 6.

Table 11: Renewable energy developments proposed within a 20km radius from the Tlisitseng PV application site

Proposed Development	DEA Reference Number	Current Status of EIA	Proponent	Proposed Capacity	Farm Details
Tlisitseng 1	14/12/16/3/3/2/890	EIA ongoing	BioTherm Energy	75MW	Portion 25 of the Farm Houthaalboomen No 31
Lichtenburg Solar Park	14/12/16/3/3/3/270	Project has received environmental authorisation	Matrigenix (Pty) Ltd	70MW	A portion of portion 10 of the Farm Lichtenburg Town and Townlands No. 27
Watershed Solar Energy Facility Phase 1	14/12/16/3/3/2/556	Scoping and EIA processes underway.	FVR Energy South Africa (Pty) Ltd	75MW	Portions 1, 9, 10 and 18 of the Farm Houthaalbomen 31
Watershed Solar Energy Facility Phase 2	14/12/16/3/3/2/557	Scoping and EIA processes underway.	FVR Energy South Africa (Pty) Ltd	75MW	Portions 1, 9, 10 and 18 of the Farm Houthaalbomen 31
Hibernia PV Solar Energy Facility	14/12/16/3/3/2/1062	Project has received environmental authorisation	South Africa Mainstream Renewable Power Developments (Pty) Ltd	5MW	Portions 9 and 31 of the Farm Hibernia 52

Cumulative Assessment – Motivation for lack of information

Based on the DEA's comments on the Draft Basic Assessment Report (DBAR), the DEA requested that a cumulative environmental impact assessment be conducted including a literature review of other specialist assessments / studies on the neighbouring adjacent properties in order to ascertain any additional cumulative impacts that should be taken into consideration.

In an effort to meet this requirement SiVEST under took every effort to obtain the information (including specialist studies, BA / EIA / Scoping and EMPr Reports) for the above mentioned developments. The steps taken to acquire the relevant documents for the above mentioned projects is detailed below (Table 12):

Table 12: Proposed renewable energy projects in the area, steps taken to obtain the relevant information and documents obtains.

Proposed Development	EAP	Steps taken to obtain relevant documents	Documents Obtained
Tlisitseng 1	SiVEST SA (Pty) Ltd	SiVEST is the EAP for the proposed development. The proposed development Final Scoping Report (FSR) has been accepted by the DEA. Additionally, the specialist impact assessments have been conducted to form part of the Draft Environmental Impact Assessment Report (DEIAR). All the relevant documents were therefore available for the cumulative assessment.	▪ Biodiversity Impact Assessment Report; ▪ Avifaunal Impact Assessment Report; ▪ Surface Water Impact Assessment Report; ▪ Soils and Agricultural potential Impact Assessment Report; ▪ Visual Impact Assessment Report; ▪ Heritage Impact Assessment Report; ▪ Socio-economic Impact Assessment Report; ▪ Geotechnical Impact Assessment Report; and

			▪ Traffic Impact Assessment Report
Lichtenburg Solar Park	Africa Geo-Environmental Services (AGES)	▪ Google Search for PV facilities near Lichtenberg North West Province; ▪ Proposed Development was found on Leads 2 Business website (www.l2b.co.za/project-region/**North-West**). ▪ Google search of the proposed development project name was undertaken. ▪ Consulted the SAHRA Website for Heritage and PIA Report (http://sahra.org.za/sahris/cases/lichtenburg-solar-park). ▪ Attempted to download reports from the AGES Website (http://ages-group.com/) o Reports were not available for publically available to download ▪ Contacted AGES in an effort to obtain outstanding specialist reports that were not available for public download. o AGES responded to SiVEST request for the FBAR and specialist reports noting that the proposed development has not been awarded preferred Bidder Status in terms on the DoE's IPP programme. o AGES further stated that they are not in a position to send any of the reports through to SiVEST. However, they were able to provide SiVEST with the	▪ Archaeological Impact Assessment Report ▪ Heritage Impact Assessment Report

		locality map for the proposed Lichtenburg Solar Park as well as layout plans. ▪ Additionally, SiVEST attempted to contact the developers of the proposed development, however contact details were not publically available.	
Watershed Solar Energy Facility Phase 1	Savannah Environmental (Pty) Ltd	▪ Google Search for PV facilities near Lichtenberg North West Province; ▪ The proposed Development was found on Leads 2 Business website (www.l2b.co.za/project-region/**North-West**). ▪ Google search of the proposed development project name was undertaken. FEIR (excluding appendices) was able to be downloaded as a PDF. ▪ Consulted the SAHRA Website for Heritage Report (http://sahra.org.za/sahris/heritage-reports/heritage-report-watershed-solar-facility). ▪ From the SAHRA website other documents were available to be downloaded. (http://sahra.org.za/sahris/cases/watershed-solar-energy-facilities-556-557). ▪ Attempted to download reports from the Savannah Environmental Website o Reports were not publically available to download. ▪ Contacted Savannah Environmental in an effort to obtain outstanding specialist reports that we not available for public download. o Savannah Environmental noted that the project has already been archived and handed over to the developers. o Savannah Environmental noted that it is against their company policy to give out developers contact details. However, they were able to provide SiVEST with the EA's for the proposed development.	▪ Watershed PV (phase I and II) FEIR ▪ Visual Scoping Report ▪ Social Scoping report ▪ Draft EMPr (Phase 1) ▪ Draft EMPr (Phase 2) ▪ Archaeological Impact Assessment Report ▪ Background Information Documents ▪ EAs
Watershed Solar Energy Facility Phase 2	Savannah Environmental (Pty) Ltd		
Hibernia PV Solar Energy Facility	Savannah Environmental (Pty) Ltd	▪ Google Search for PV facilities near Lichtenberg North West Province; ▪ The proposed Development was found on Leads 2 Business website (www.l2b.co.za/project-region/**North-West**). ▪ Google search of the proposed development project name was undertaken. BID was able to be downloaded as a PDF. ▪ Consulted the SAHRA Website for Heritage Report (http://sahra.org.za/sahris/heritage-reports/aia-paleo-reports-hibernia).	▪ Heritage Assessment Report ▪ Final BAR ▪ BID

		▪ From the SAHRA website other documents were available to be downloaded. FEIR (excluding appendices)was able to be downloaded as a PDF. http://sahra.org.za/sahris/cases/hibernia-solar-facility-1062). ▪ Attempted to download reports from the Savannah Environmental Website o Reports were not publically available to download ▪ Contacted Savannah Environmental in an effort to obtain outstanding specialist reports that we not available for public download. o Savannah Environmental noted that the project has already been archived and handed over to the developers. o Savannah Environmental noted that it is against their company policy to give out developers contact details. However, they were able to provide SiVEST with the EA's for the proposed development. ▪ Additionally, SiVEST attempted to contact the developers of the proposed development, however contact details were not publically available.	

Some of the project sites are at a very advanced stage, and the initial studies were undertaken in 2012. As a result, many of the documents are not currently publically available to download. Nonetheless, SiVEST was able to source some of information that was available. The information (including specialist studies, EIA / Scoping and EMPr Reports) that could be obtained for the surrounding renewable energy sites planned that were taken into account by the various specialists is elaborated on below.

Cumulative impacts on indigenous natural vegetation

The regional terrestrial vegetation type in the broad study area is Carletonville Dolomite Grassland, listed as Vulnerable. This is the same vegetation type that will be affected by many of the other proposed projects (Table 13). Loss of habitat will definitely occur, but this will be a small area in comparison to the total area of the vegetation type concerned. The vegetation type occupies an area in excess of 8 800 km^2, of which just less than 25% has been altered. The total loss of habitat due to all the projects together will be greater than for any single project, so a cumulative effect will occur. However, the area lost in total will be small compared to the total area of the vegetation type and will not result in a change in the conservation status of the vegetation type. The cumulative effect will therefore be low.

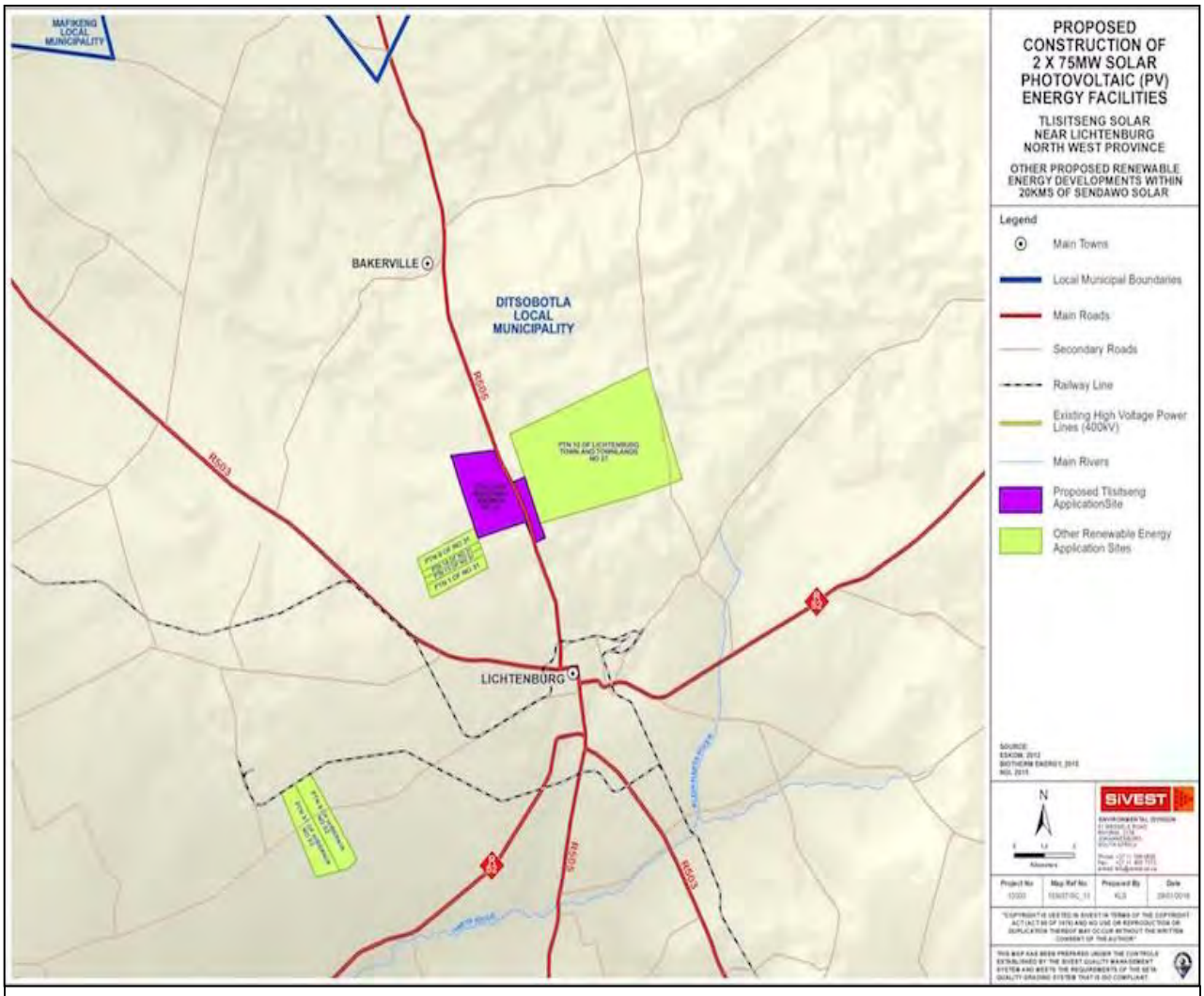

Figure 6: Location of similar projects in the study area near to the current site.

Table 13: Impact table for Impact 1 for power lines and associated infrastructure.

Loss of indigenous natural vegetation		
Environmental parameter	*Indigenous natural vegetation*	
Issue/Impact/Environmental Effect/Nature	*Loss, degradation or fragmentation of vegetation.*	
Extent	*The impact will affect natural vegetation on site and possibly in immediately surrounding areas.*	
Probability	*The impact will probably happen.*	
Reversibility	*Reversible to some degree for power lines because of the limited local footprint. Secondary vegetation will probably never resemble the original vegetation found on site.*	
Irreplaceable loss of resources	*Some loss of resources will occur.*	
Duration	*The impact will be medium-term due to the fact that local impacts will soon recover through natural successional processes.*	
Cumulative effect	*Medium cumulative impact. Added to existing impacts on natural habitat, the current project will cause additional loss of vegetation.*	
Intensity/magnitude	*Low. Vegetation will continue to function.*	
Significance rating	*Low negative impact expected.*	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1	1
Probability	3	3
Reversibility	3	3
Irreplaceable loss	2	2
Duration	2	2
Cumulative effect	2	2
Intensity/magnitude	1	1
Significance rating	-13 (low negative)	-13 (low negative)
Mitigation measures	*The following mitigation measures would help to limit impacts, but will not affect the extent, probability, reversibility, irreplaceable loss of resources, duration, cumulative effect or intensity:* *1. Compile a rehabilitation programme.* *2. Compile an Alien Plant Management Plan, including monitoring, to ensure minimal impacts on surrounding areas.*	

Cumulative impacts on listed plant species

There are four species that may occur in the study area, the bulb, *Boophone disticha*, listed as Declining, the bulb, *Crinum macowanii*, listed as Declining, the succulent herb, *Brachystelma incanum*, listed as Vulnerable, and the herb, *Cleome conrathii*, listed as Near Threatened. Three of the species are relatively widespread, whereas the species listed as Vulnerable is known from a general area that includes the study area. An increased number of projects increases the likelihood of one of the populations being affected, but unless a population is directly affected, there is no cumulative effect.

Table 14: Impact table for Impact 2 for power lines and associated infrastructure.

Loss of individuals of listed plants

Environmental parameter	*Listed plants, as per Red & Orange List.*
Issue/Impact/Environmental Effect/Nature	*Loss of individuals.*
Extent	*The impact will affect local populations or individuals of the affected species.*
Probability	*The impact will probably happen.*
Reversibility	*Partly reversible for some species, irreversible for others. Individuals of some species can be rescued or else cultivated to replace lost specimens, for other species this is not possible.*
Irreplaceable loss of resources	*Marginal loss of resources could occur. The species that are likely to occur on site are likely to be relatively common throughout their range.*
Duration	*The impact will be medium-term.*
Cumulative effect	*Low cumulative impact. Cumulative effects will not be significant.*
Intensity/magnitude	*Low. Loss of some individuals will be insignificant compared to the number that probably occur in surrounding areas.*
Significance rating	*Low negative impact expected.*

	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1	1
Probability	3	2
Reversibility	2	2
Irreplaceable loss	2	2
Duration	2	2
Cumulative effect	2	2
Intensity/magnitude	1	1
Significance rating	-12 (low negative)	-11 (low negative)
Mitigation measures	*The following mitigation measures would help to limit impacts:* 1. *It is a legal requirement to obtain permits for specimens that will be lost.* 2. *A pre-construction walk-through survey will be required to locate any listed plants.* 3. *Near threatened and Declining plants lost to the development can be rescued and planted in appropriate places in surrounding areas. This will reduce the probability as well as the cumulative effect.* 4. *If any listed plants are located during the pre-construction survey, a Plant Rescue Plan would be required to manage the process of attempting to rescue such individuals.* 5. *If any threatened species are found (only* Brachystelma incanum *listed for this area), the infrastructure layout would need to be adjusted to allow in situ conservation of affected plants as well as a suitable buffer zone. An Ecological Management Plan would need to be compiled to manage the locality where it occurs.*	

Cumulative impacts on protected plant species

There is one species protected according to the National Environmental Management: Biodiversity Act, *Harpagophytum procumbens*, that may potentially occur on site. There are also a number of plant species protected according to Provincial legislation. An increased number of projects will increase the likelihood of protected species being affected as well as the number of individuals likely to be affected. There is therefore a cumulative effect, but this is considered to be low.

Table 15: Impact table for Impact 3 for power lines and associated infrastructure.

Loss of individuals of protected plants		
Environmental parameter	*Protected plants, as per NEM:BA and provincial legislation.*	
Issue/Impact/Environmental Effect/Nature	*Loss of individuals.*	
Extent	*The impact will affect local populations or individuals of the affected species.*	
Probability	*The impact may possibly happen.*	
Reversibility	*Partly reversible. Individuals can be rescued or else cultivated to replace lost specimens.*	
Irreplaceable loss of resources	*Marginal loss of resources could occur. The species that are likely to occur on site are likely to be relatively common throughout their range.*	
Duration	*The impact will be medium-term.*	
Cumulative effect	*Low cumulative impact. Cumulative effects will not be significant.*	
Intensity/magnitude	*Low. Loss of some individuals will be insignificant compared to the number that probably occur in surrounding areas.*	
Significance rating	*Low negative impact expected.*	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1	1
Probability	2	2
Reversibility	2	2
Irreplaceable loss	2	1
Duration	2	2
Cumulative effect	2	1
Intensity/magnitude	1	1
Significance rating	-11 (low negative)	-9 (low negative)
Mitigation measures	*The following mitigation measures would help to limit impacts:* 1. *It is a legal requirement to obtain permits for specimens that will be lost.* 2. *A pre-construction walk-through survey will be required to locate any protected plants.* 3. *Plants lost to the development can be rescued and planted in appropriate places in surrounding areas. This will reduce the irreplaceable loss of resources as well as the cumulative effect.* 4. *If any protected plants are located during the pre-construction survey, a Plant Rescue Plan would be required to manage the process of attempting to rescue such individuals.*	

Cumulative impacts on protected trees

There are three protected tree species that could occur on site, *Acacia erioloba*, which appears to occur in large numbers in the area, *Combretum imberbe*, of which no individuals were seen on site or nearby, and *Boscia albitrunca*, which occurs in low numbers in the area. The tree, *Combretum imberbe*, is also at the edge of its distribution range at this location. With each additional project that is constructed there will be an increasing likelihood of individuals being affected and the number of individuals affected will increase. There is therefore a cumulative effect. The permit authorities are in a good position to evaluate the magnitude of this effect, since they will obtain numbers of trees affected for each project. The significance of this effect is, however, likely to be low due to the high number of individuals of each of these species that occurs over their entire geographical range.

Table 16: Impact table for Impact 4 for power lines and associated infrastructure.

Loss of individuals of protected trees		
Environmental parameter	*Protected trees, as per National Forests Act.*	
Issue/Impact/Environmental Effect/Nature	*Loss of individuals.*	
Extent	*The impact will affect local populations or individuals of the affected species.*	
Probability	*The impact will definitely happen.*	
Reversibility	*Irreversible. Individuals are not possible to be rescued.*	
Irreplaceable loss of resources	*Marginal loss of resources could occur. The species that occurs on site is relatively common throughout its range although a large number of individuals were seen to occur on site.*	
Duration	*The impact will be permanent.*	
Cumulative effect	*Low cumulative impact. Cumulative effects will not be significant.*	
Intensity/magnitude	*Low. Loss of some individuals will be insignificant compared to the number that probably occur in surrounding areas.*	
Significance rating	*Low negative impact expected.*	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1	1
Probability	4	4
Reversibility	4	4
Irreplaceable loss	2	2
Duration	4	5
Cumulative effect	2	2
Intensity/magnitude	1	1
Significance rating	-17 (low negative)	-9 (low negative)
Mitigation measures	*The following mitigation measures would help to limit impacts:* 1. *It is a legal requirement to obtain permits for specimens that will be lost.* 2. *For the permit application, a pre-construction walk-through survey will be required to locate any protected trees and record information about each specimen.*	

Cumulative impacts on populations of sedentary fauna

There are five animal species of conservation concern that could potentially be affected by the proposed project:

1. Brown Hyaena (NT),
2. Honey badger (NT),
3. Southern African Hedgehog (NT),
4. White-tailed Rat (EN),
5. Giant Bullfrog (NT/LC).

Three of these species, the Southern African Hedgehog, the White-tailed Rat and the Giant Bullfrog, are relatively sedentary and therefore considered to be potentially vulnerable to habitat loss, as related to this and other similar projects. All three have a relatively wide geographical distribution and loss of some habitat in part of their range will have a minimal effect on the species. The combination of a number of projects will have a cumulative effect, but this is likely to be of low significance.

Table 17: Impact table for Impact 6 for power lines and associated infrastructure.

Loss of populations of sedentary animals		
Environmental parameter	*Species of conservation concern*	
Issue/Impact/Environmental Effect/Nature	*Loss of individuals/populations.*	
Extent	*The impact will affect local populations or individuals of the affected species, but taking the combination of all projects into account, will operate at a district level.*	
Probability	*The impact may possibly happen.*	
Reversibility	*Partly reversible. Individuals may be rescued and translocated.*	
Irreplaceable loss of resources	*Marginal loss of resources could occur. The species that potentially occur on site have very wide geographical ranges.*	
Duration	*The impact will be short-term.*	
Cumulative effect	*Low cumulative impact. Cumulative effects will not be significant.*	
Intensity/magnitude	*Low. Loss of some individuals will be insignificant compared to the number that probably occur throughout their range.*	
Significance rating	*Low negative impact expected.*	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	2	2
Probability	2	1
Reversibility	2	2
Irreplaceable loss	2	1
Duration	1	1
Cumulative effect	2	1
Intensity/magnitude	1	1
Significance rating	-11 (low negative)	-8 (low negative)
Mitigation measures	*The following mitigation measures would help to limit impacts:* 1. *It is a legal requirement to obtain permits for specimens that will be lost.*	

	3. *A pre-construction walk-through survey will be required to locate any individuals and move them to surrounding habitats.*

Cumulative impacts on mobile fauna

Construction activities, loss of habitat, noise, dust and general activity associated with the construction phase of the project are likely to cause all mobile species to move away from the site. This effect will be increased if there are a number of projects being constructed at the same time or in quick succession, so the effect is likely to be cumulative. However, the geographical ranges of the species of concern is wide and it is considered that the significance of the effect will be low.

Table 18: Impact table for Impact 6 for power lines and associated infrastructure.

Loss of populations of sedentary animals		
Environmental parameter	*Species of conservation concern*	
Issue/Impact/Environmental Effect/Nature	*Loss of individuals/populations.*	
Extent	*The impact will affect local populations or individuals of the affected species, but taking the combination of all projects into account, will operate at a district level.*	
Probability	*The impact may possibly happen.*	
Reversibility	*Fully reversible. Individuals will move to other areas.*	
Irreplaceable loss of resources	*No loss of resources is likely to occur. The species that potentially occur on site are highly mobile and have very wide geographical ranges.*	
Duration	*The impact will be short-term.*	
Cumulative effect	*Low cumulative impact. Cumulative effects will not be significant.*	
Intensity/magnitude	*Low. Loss of some individuals will be insignificant compared to the number that probably occur throughout their range.*	
Significance rating	*Low negative impact expected.*	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	2	2
Probability	2	2
Reversibility	1	1
Irreplaceable loss	1	1
Duration	1	1
Cumulative effect	2	2
Intensity/magnitude	1	1
Significance rating	-9 (low negative)	-9 (low negative)
Mitigation measures	*No mitigation is required*	

Cumulative impacts due to mortality of birds by collision with vertical infrastructure

During operation, flying species could potentially suffer mortality by collisions with vertical infrastructure, especially infrastructure with low visibility, such as power lines. The species most affected by loss of individuals are species that are already threatened in their general range by other factors. These species appear on various Red Lists. Species that are not threatened are

unlikely to be significantly negatively affected by loss of habitat, since they are generally widespread and/or catholic in their requirements. Also, there are certain groups of birds, the large, low-flying species (bustards, cranes, etc.) that are most at risk from power lines.

Table 19: Impact table for Impact 7 for power lines and associated infrastructure.

Mortality of individuals due to collisions with power lines		
Environmental parameter	*Threatened bird species*	
Issue/Impact/Environmental Effect/Nature	*Loss of individuals.*	
Extent	*The impact will affect local populations or individuals of the affected species, but taking the combination of all projects into account, will operate at a district level.*	
Probability	*The impact will probably happen.*	
Reversibility	*Partly reversible. Preventative measures could reduce mortality to below replacement levels.*	
Irreplaceable loss of resources	*Marginal loss of resources will occur.*	
Duration	*The impact will be long-term.*	
Cumulative effect	*Medium cumulative impact. Cumulative effects will be minor.*	
Intensity/magnitude	*Medium. May impact on population processes.*	
Significance rating	*Low negative impact expected.*	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	2	2
Probability	3	2
Reversibility	2	2
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	3	2
Intensity/magnitude	2	1
Significance rating	-30 (medium negative)	-13 (low negative)
Mitigation measures	*Visibility devices could be placed on overhead powerlines, if necessary. This will reduce the probability slightly, but not to an extent that it will change the impact rating scores. The mitigation measure is therefore not required unless monitoring identifies this as an issue during operation.*	

Cumulative impacts due to spread of declared weeds and alien invader plants

There is a moderate possibility that alien plants could be introduced to areas within the footprint of the proposed infrastructure from surrounding areas in the absence of control measures. The greater the number of projects, the more likely this effect will happen, therefore the effect is cumulative. For the current site, the impact is predicted to be low due to existing impacts on site and the high ability to control any additional impact. The significance will therefore be low, especailly if control measures are implemented.

Table 20: Impact table for Impact 8 for power lines and associated infrastructure.

Establishment and spread of declared weeds	
Environmental parameter	*Vegetation and habitat*
Issue/Impact/Environmental Effect/Nature	*Loss of habitat due to invasion by alien plants*

Extent	*The impact will affect habitat on site and possibly in immediately surrounding areas.*
Probability	*The impact will probably happen in the absence of control measures.*
Reversibility	*Partly reversible in the absence of control measures. Completely reversible if mitigation measures applied. Preventative measures will stop the impact from occurring.*
Irreplaceable loss of resources	*Marginal to significant loss of resources will occur. Uncontrolled invasion can affect all nearby natural habitats.*
Duration	*The impact will be long-term.*
Cumulative effect	*Minor cumulative impact. Cumulative effects will not be significant.*
Intensity/magnitude	*Medium. Severe invasion can alter the functioning of natural ecosystems.*
Significance rating	*Low negative impact expected.*

	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1	1
Probability	3	2
Reversibility	2	1
Irreplaceable loss	3	2
Duration	3	3
Cumulative effect	3	3
Intensity/magnitude	2	1
Significance rating	-30 (medium negative)	-12 (low negative)
Mitigation measures	*Compile and implement an alien management plan. Undertake regular monitoring to detect alien invasions early so that they can be controlled. Implement control measures.*	

POSSIBLE MITIGATION MEASURES

This section of the report provides a description of mitigation measures that could be applied to minimize identified impacts for this project. In terms of the location of features of concern, all mitigation measures apply to all components of the project.

The mitigation hierarchy approach

The mitigation hierarchy consists of a number of sequential steps (avoid, mitigate, restore or rehabilitate and offset). This approach enables an infrastructure development project to work towards "no net loss" of biodiversity, and ideally, a net gain. The mitigation hierarchy is defined as:

- **Avoidance**: measures taken to avoid creating impacts from the outset, such as careful spatial or temporal placement of elements of infrastructure, in order to completely avoid impacts on certain components of biodiversity.
- **Minimisation**: measures taken to reduce the duration, intensity and / or extent of impacts (including direct, indirect and cumulative impacts, as appropriate) that cannot be completely avoided, as far as is practically feasible.
- **Rehabilitation/restoration**: measures taken to rehabilitate degraded ecosystems or restore cleared ecosystems following exposure to impacts that cannot be completely avoided and/ or minimised.
- **Offset:** measures taken to compensate for any residual significant, adverse impacts that cannot be avoided, minimised and / or rehabilitated or restored, in order to achieve no net loss or a net gain of biodiversity. Offsets can take the form of positive management interventions such as restoration of degraded habitat, arrested degradation or averted risk, protecting areas where there is imminent or projected loss of biodiversity.

Mitigation measures

Local shifting of components of the infrastructure

Components of the infrastructure can be re-sited to avoid sensitive habitats or features, either partially or completely. This is especially important for avoiding CBA habitats, protected areas and buffer areas. The re-siting can also be used to create buffer areas around sensitive sites in order to protect their ecological integrity. In the case of the current project, there are various pan depressions where it has been recommended that these are not developed and that an appropriate buffer zone is maintained around them. Power line tower structures are relatively easy to microsite in this way.

Surface Runoff and Stormwater Management Plan

The purpose of a Surface Runoff and Stormwater Management Plan is to prevent damage to areas downslope / downstream of the project area. This is an impact avoidance measure. This plan must indicate how all surface runoff generated as a result of the project and associated activities (during both the construction and operational phases) will be managed (e.g. artificial wetlands/stormwater and flood retention ponds) prior to entering any natural drainage system or wetland and how surface water runoff will be retained outside of any demarcated buffer/flood

zones and subsequently released to simulate natural hydrological conditions.

Rehabilitation Programme

The purpose of a Rehabilitation Plan is to provide a framework for rehabilitating areas outside of the infrastructure footprint that will be disturbed during the construction of the proposed project. Rehabilitation Programme should be established before operation. The programme must address the rehabilitation of the existing habitats as well as rehabilitation after closure. This Rehabilitation Programme must be approved by the relevant government departments. Rehabilitation can also be undertaken in habitats adjacent to sensitive areas that will not be developed, but that are currently disturbed by existing impacts on site. This will constitute a form of offset. Rehabilitation must include aspects such as undertaking rehabilitation as quickly as possible after disturbance, soil management measures and using native plants during rehabilitation.

Botanical walk-through survey

A preconstruction walk-through survey should be undertaken to list the identity and location of all listed and protected species. The results of the walk-through survey should provide an indication of the number of individuals of each listed species that are likely to be impacted by the proposed development. The botanical walk-through survey is a requirement for various permit applications.

Search and rescue

Search and rescue operation of all listed species within the activity footprint. For each individual plant that is rescued, the plant must be photographed before removal, tagged with a unique number or code and a latitude longitude position recorded using a hand-held GPS device. The plants must be planted into a container to be housed within a temporary nursery on site or immediately planted into the target habitat. If planted into natural habitat, the position must be marked to aid in future monitoring of that plant. Rescued plants housed in temporary nursery may be used in one of two ways: (1) transplanted into suitable natural habitats near to where they were rescued, or (2) used for replanting in rehabilitation areas. Receiver sites must be matched as closely as possible with the origin of the plants and, where possible, be placed as near as possible to where they originated.

Obtain permits for protected plants

It is a legal requirement that permits will be required for any species protected according to National or Provincial legislation. The identity of species affected by such permit requirements can only be identified during the walk-through survey (previous mitigation measure). It is common practice for the authorities that issue the permits to require search and rescue of affected plants. There are a number of individuals of the protected tree, *Acacia erioloba*, that occur on site. The location and condition of each individual tree must be recorded and a permit obtained for the removal of each of these.

Alien plant management plan

It is recommended that a monitoring programme be implemented to enforce continual eradication of alien and invasive species, especially within the riparian habitat. An Alien Invasive Programme is an essential component to the successful conservation of habitats and species. Alien species, especially invasive species are a major threat to the ecological functioning of natural systems and to the productive use of land. In terms of the amendments of the

regulations under the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983), landowners are legally responsible for the control of alien species on their properties. The protection of our natural systems from invasive species is further strengthened within Sections 70-77 of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004). This programme should include monitoring procedures.

Undertake regular monitoring

Monitoring should be undertaken to evaluate the success of mitigation measures. Monitoring methods must be in accordance with features that need to be monitored and can form part of a monitoring programme to be compiled.

Worker education

Educate workers (permanent staff and contractors) regarding the occurrence of important ecological features and resources in the area and the importance of their protection.

Dust control

Use abatement measures to minimise fugitive dust that could have a negative effect on vegetation and habitats, especially adjacent to sensitive areas and in areas adjacent to the project site.

COMPARISON OF ALTERNATIVES

Tlisitseng 2 Substation and power line corridor

There are two possible locations for the proposed sub-station, Option 1 and Option 2. Both are within natural grasslands, but also within areas that will be affected by the proposed solar project. If the solar project is authorised then it is irrelevant which substation option is selected. From the point of view of power line length, Option 2 is a slightly better option due to being shorter.

Key

PREFERRED	The alternative will result in a low impact / reduce the impact
FAVOURABLE	The impact will be relatively insignificant
NOT PREFERRED	The alternative will result in a high impact / increase the impact
NO PREFERENCE	The alternative will result in equal impacts

Alternative	Preference	Reasons
SUBSTATIONS		
Tlisitseng 2 Substation Option 1	**NO PREFERENCE**	Similar habitats and impacts. Shorter power line length
Tlisitseng 2 Substation Option 2	**NO PREFERENCE**	Similar habitats and impacts.
CORRIDOR		
Tlisitseng 2 Corridor Option 1	**FAVOURABLE**	Similar habitats and impacts.
Tlisitseng 2 Corridor Option 2	**PREFERRED**	Similar habitats and impacts. Shorter power line length

DISCUSSION AND CONCLUSIONS

Biodiversity features in the study area

The vegetation type that occurs on site, Carletonville Dolomite Grassland, is classified as Vulnerable, but has a wide distribution and extent. From this perspective, the natural vegetation on the sites is therefore considered to have moderately high conservation value. The area is not within a Centre of Plant Endemism, nor does it occur in close proximity to an area identified as part of the National Parks Area Expansion Strategy, but is within areas identified in Provincial Conservation Plans to be of conservation priority.

Local factors that may lead to parts of the sites having elevated ecological sensitivity are the potential presence of four listed plant species, one protected plant species and the potential presence of various animal species of conservation concern. There are also three protected tree (*Acacia erioloba*, *Combretum imberbe* and *Boscia albitrunca*) that occur in the general region of which one (*Acacia erioloba*) occurs in high numbers in the area, including some individuals that occur on site.

The site is mapped as an Ecological Support Area in terms of most of it being on a dolomite area. These dolomite areas and the associated aquifers are considered to be ecologically important in terms of being groundwater recharge areas.

There are a number of animal species of conservation concern that may occur in habitats within the study area. This includes one frog species, the Giant Bullfrog, and four mammal species (Honey Badger (NT), Brown Hyaena (NT), White-tailed Rat (EN) and Southern African Hedgehog (NT)) and five bird species of conservation concern (Barrow's Korhaan (VU), Blue Crane (VU), Melodious Lark (NT), Short-clawed Lark (NT) and Secretarybird (NT)). Lists and habitat requirements for these species are provided in the appendices to this report.

Bats do not appear, from this initial assessment, to be of major concern. There is a maximum of three species of low conservation concern that could be affected. All species are listed as Near Threatened in South Africa and globally as Least Concern. The key factor is the presence of roosting habitats nearby, which is of higher concern in areas close to mountainous or rocky hillside topography. There are no such topographical features in close proximity to the project study area.

One protected amphibian species, the Giant Bullfrog, and one protected reptile, the Southern African Python, have a geographical distribution that includes the site. These species are protected according to the National Environmental Management: Biodiversity Act (Act No 10 of 2004). Under this Act, a permit would be required for any activity which is of a nature that may negatively impact on the survival of a listed protected species. The Giant Bullfrog is most likely to be found near seasonal pans or water sources and the Southern African Python in rocky kloofs, usually near water.

The study area consists mostly of natural vegetation, with the exception of the existing substation, which is mapped as transformed. These transformed and degraded areas in the project study area have low sensitivity and conservation value. Most areas have medium-high sensitivity.

Summary of potential impacts

A summary of the potential risks to the ecological receiving environment are therefore the following:

1. Impacts on indigenous natural vegetation;
2. Impacts on two listed plant species;
3. Impacts on protected plant species;
4. Impacts on two protected tree species;
5. Mortality of sedentary animals;
6. Displacement of mobile fauna;
7. Mortality of birds by collision with vertical infrastructure;
8. Establishment and spread of declared weeds and alien invader plants.

A summary and comparison between pre- and post-mitigation phases is provided in Table 21 below.

Table 21: Comparison of summarized impacts on environmental parameters.

Environmental parameter	Issues	Rating prior to mitigation	Average	Rating post mitigation	Average
Indigenous natural vegetation	Loss (substation)	-38		-38	
Indigenous natural vegetation	Loss (power lines)	-13		-12	
Protected plant species	Loss of individuals	-11		-9	
Protected trees	Loss of individuals	-14		-13	
Pan depressions	Damage, loss of vegetation	-28		-6	
Sedentary fauna	Loss of individuals	-10		-7	
Bird species of conservation concern	Collision with power lines	-26		-11	
Natural habitat	Invasion by alien invasive plant species leading to habitat loss and/or degradation	-28		-11	
			- 21.0		**-13.4**
			Low Negative Impact		Low Negative Impact

There is no preference between substation alternatives, primarily because they have a similar effect on the ecological receiving environment and affect similar habitats. Power line corridor Option 2 is preferred over option 1 only because it is shorter.

For all potential impacts, the cumulative impacts of this project in combination with similar projects is likely to be of low significance, with the exception of impacts on pan depressions,

which may possibly be moderate due to impacts from other sources.

Conclusions

There are some issues related to the ecology of the site that could result in potentially significant ecological impacts. The seriousness of these impacts is not considered to be high. Some impacts require permits to be issued, either by National or Provincial authorities and additional field data is required for the permit applications.

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APPENDICES:

Appendix 1: Plant species of conservation importance (Threatened, Near Threatened and Declining) that have historically been recorded in the general geographical area that includes Copperton.

Sources: South African National Biodiversity Institute in Pretoria.

Family	Taxon	Status	Distribution and habitat	Likelihood of occurrence on site
AMARYLLIDACEAE	Boophone disticha	Declining	Dry grassland and rocky areas	**HIGH,** suitable habitat probably occurs
APOCYNACEAE	Brachystelma incanum	VU	Coligny, Lichtenburg and Wolmaransstad. Sandy loam soils in bushveld. Previously recorded in grid to north of site.	**MEDIUM,** suitable habitat may occur
CAPPARACEAE	Cleome conrathii	NT	Stony quartzite slopes, usually in red sandy soil, grassland or deciduous woodland, all aspects.	**MEDIUM,** presence of suitable habitat unknown
AMARYLLIDACEAE	Crinum macowanii	Declining	Mountain grassland and stony slopes in hard dry shale, gravely soil or sandy flats.	**HIGH,** suitable habitat probably occurs

* Conservation Status Category assessment according to IUCN Ver. 3.1 (IUCN, 2001), as evaluated by the Threatened Species Programme of the South African National Biodiversity Institute in Pretoria. *IUCN (3.1) Categories: VU = Vulnerable, EN = Endangered, CR = Critically Endangered, NT = Near Threatened.

Appendix 2: List of protected tree species (National Forests Act).

Acacia erioloba	*Acacia haematoxylon*
Adansonia digitata	*Afzelia quanzensis*
Balanites subsp. *maughamii*	*Barringtonia racemosa*
Boscia albitrunca	*Brachystegia spiciformis*
Breonadia salicina	*Bruguiera gymnhorrhiza*
Cassipourea swaziensis	*Catha edulis*
Ceriops tagal	*Cleistanthus schlectheri* var. *schlechteri*
Colubrina nicholsonii	*Combretum imberbe*
Curtisia dentata	*Elaedendron (Cassine) transvaalensis*
Erythrophysa transvaalensis	*Euclea pseudebenus*
Ficus trichopoda	*Leucadendron argenteum*
Lumnitzera racemosa var. *racemosa*	*Lydenburgia abottii*
Lydenburgia cassinoides	*Mimusops caffra*
Newtonia hildebrandtii var. *hildebrandtii*	*Ocotea bullata*
Ozoroa namaensis	*Phileno*ptera *violacea* (*Lonchocarpus capassa*)
Pittosporum viridiflorum	*Podocarpus elongatus*
Podocarpus falcatus	*Podocarpus henkelii*
Podocarpus latifolius	*Protea comptonii*
Protea curvata	*Prunus africana*
Pterocarpus angolensis	*Rhizophora mucronata*
Sclerocarya birrea subsp. *caffra*	*Securidaca longependunculata*
Sideroxylon inerme subsp. *inerme*	*Tephrosia pondoensis*
Warburgia salutaris	*Widdringtonia cedarbergensis*
Widdringtonia schwarzii	

Boscia albitrunca, Combretum imberbe and *Acacia erioloba* have a geographical distribution that coincides with the study areas.

Appendix 3: Animal species with a geographical distribution that includes the study area.

Notes:

1. Species of conservation concern are in red lettering.
2. Species protected according to the National Environmental Management: Biodiversity Act of 2004 (Act 10 of 2000) marked with "N"

Mammals:

Red hartebeest
Springbok
White rhinoceros
[N]Black wildebeest
Blue wildebeest
Blesbok
Black rhinoceros VU
Plains zebra
Giraffe
[N]Roan antelope VU
Klipspringer
Gemsbok
Warthog
Steenbok
[N]Reedbuck
Mountain reedbuck
Common duiker
Eland
Bushbuck
Kudu
Rock hyrax
[N]Cape clawless otter
Water mongoose
Black-backed jackal
Caracal
Yellow mongoose
[N]Black-footed cat
African wild cat
Slender mongoose
Small-spotted genet
Large-spotted genet
[N]Brown hyaena NT
White-tailed mongoose
Striped polecat
[N]Spotted-necked otter NT
[N]Honey badger NT
Banded mongoose
Bat-eared fox
[N]Leopard
African weasel
Aardwolf
Suricate
[N]Cape fox
Natal long-fingered bat NT
Cape serotine bat
Egyptian slit-faced bat
Rusty bat NT
Geoffroy's horseshoe bat NT
Darling's horseshoe bat NT
Flat-headed free-tailed bat
Yellow house bat
Egyptian free-tailed bat
[N]South African hedgehog NT
Reddish-grey musk shrew
Tiny musk shrew
Lesser red musk shrew
Swamp musk shrew
Lesser grey-brown musk shrew
Cape/desert hare
Scrub/savannah hare
Jameson's red rock rabbit
Vervet monkey
Southern lesser galago
Chacma baboon
Red veld rat
Tete veld rat
Namaqua rock mouse
Common mole rat
Grey climbing mouse
Short-tailed gerbil
Woodland dormouse
Rock dormouse
Porcupine
Single-striped mouse
Large-eared mouse
Multimammate mouse
Desert pygmy mouse
White-tailed rat EN
Angoni vlei rat
Vlei rat
Tree squirrel
Springhare
Striped mouse
Pouched mouse
Kreb's fat mouse
Highveld gerbil
Bushveld gerbil
Tree rat
Greater cane rat

Cape ground squirrel
Rock elephant shrew
Aardvark

Reptiles:
Puff adder
Rhombic night adder
Cape cobra
Mozambique spitting cobra
Rinkhals
Highveld garter snake
Boomslang
Vine snake
Southern stiletto snake
Short-snouted whip snake
Kalahari sand snake
Western stripe-bellied sand snake
Striped skaapsteker
Common tiger snake
Herald snake
Black-headed centipede eater
[N]Southern African python
Brown house snake
(Aurora house snake)
Common brown water snake
Mole snake
Two-striped shovel-snout
Spotted bush snake
Western Natal green snake
Common slug-eater
Common wolf snake
Southern file snake
Common egg-eater
Delalande's beaked blind snake
Bibron's blind snake
Peter's worm snake
Incognito worm snake
Southern tree agama
Distant's ground agama
Southern rock agama
Common flap-necked chameleon
Rock monitor
Water monitor
Common rough-scaled lizard
Holub's sandveld lizard
(Spotted sandveld lizard)
Spotted sand lizard
Thin-tailed legless skink
Wahlberg's snake-eyed skink
Sundevall's writhing skink
Cape skink
Speckled rock skink
Variable skink
Yellow-throated plated lizard
Common girdled lizard
Common dwarf gecko
Cape gecko
Marsh terrapin
Lobatse hinged tortoise
Leopard tortoise

Amphibians
Bushveld rain frog
Eastern olive toad
Guttural toad
Western olive toad
Red toad
Bubbling kassina
Banded rubber frog
Snoring puddle frog
Common platanna
Boettger's caco
Common river frog
[N]Giant bullfrog NT
Striped stream frog
Tremolo sand frog
Knocking sand frog
Natal sand frog
Tandy's sand frog

Birds
Apalis Bar-throated
Avocet Pied
Babbler Arrow-marked
Babbler Southern Pied
Barbet Acacia Pied
Barbet Black-collared
Barbet Crested
Batis Chinspot
Batis Pririt
Bee-eater Blue-cheeked
Bee-eater European
Bee-eater Little
Bee-eater Swallow-tailed
Bee-eater White-fronted
Bishop Southern Red
Bishop Yellow-crowned
Bittern Dwarf
Bittern Little
Bokmakierie
Boubou Southern
Brubru
Bulbul African Red-eyed
Bulbul Dark-capped
Bunting Cape

Bunting Cinnamon-breasted
Bunting Golden-breasted
Bunting Lark-like
Buttonquail Small
Buzzard European Honey-
Buzzard Jackal
Buzzard Steppe
Cameroptera Grey-backed
Canary Black-throated
Canary Yellow
Canary Yellow-fronted
Chat Ant-eating
Chat Familiar
Chat Mocking Cliff-
Cisticola Cloud
Cisticola Desert
Cisticola Lazy
Cisticola Levaillant's
Cisticola Rattling
Cisticola Tinkling
Cisticola Wing-snapping
Cisticola zitting
Coot Red-knobbed
Cormorant Reed
Cormorant White-breasted
Coucal Burchell's
Courser Double-banded
Courser Temminck's
Crake African
Crake Black
Crake Spotted
[N]Crane Blue VU
Crombec Long-billed
Crow Cape
Crow Pied
Cuckoo African
Cuckoo Black
Cuckoo Common
Cuckoo Diderick
Cuckoo Great Spotted
Cuckoo Jacobin
Cuckoo Klaas's
Cuckoo Levaillant's
Cuckoo Red-chested
Cuckooshrike Black
Darter African
Dove Cape Turtle-
Dove Emerald-spotted Wood-
Dove Laughing
Dove Namaqua
Dove Red-eyed
Dove Rock
Drongo Fork-tailed
Duck African Black
Duck Comb
Duck Fulvous
Duck Maccoa
Duck White-backed
Duck White-faced
Duck Yellow-billed
Eagle African Fish-
Eagle Black-chested Snake-
Eagle Booted
Eagle Brown Snake-
[N]Eagle Martial VU
Eagle Tawny VU
Eagle Wahlberg's
Egret Cattle
Egret Great
Egret Little
Egret Yellow-billed
Eremomela Burnt-necked
Eremomela Yellow-bellied
Falcon Amur
Falcon Lanner NT
Falcon Peregrine NT
Falcon Red-footed
Finch Cuckoo
Finch Cut-throat
Finch Red-headed
Finch Scaly-feathered
Firefinch Red-billed
Fiscal Common
Flamingo Greater NT
Flamingo Lesser NT
Flufftail Red-chested
Flycatcher African Paradise
Flycatcher Chat
Flycatcher Fairy
Flycatcher Fiscal
Flycatcher Marico
Flycatcher Spotted
Francolin Coqui
Francolin Crested
Francolin Natal
Francolin Orange River
Go-away-bird Grey
Godwit Black-tailed
Goose Egyptian
Goose Spur-winged
Goshawk Gabar
Goshawk Southern Pale Chanting-
Grebe Black-necked
Grebe Great Crested
Grebe Little
Greenshank Common

Guineafowl Helmeted
Gull Grey-headed
Hamerkop
Harrier African Marsh- VU
Harrier Black VU
Harrier Montagu's
Harrier Pallid NT
Harrier Western Marsh-
Hawk African Harrier-
Helmet-shrike
Heron Black
Heron Black-crowned Night-
Heron Black-headed
Heron Goliath
Heron Green-backed
Heron Grey
Heron Purple
Heron Squacco
Hobby Eurasian
Honeyguide Greater
Honeyguide Lesser
Hoopoe African
Hornbill African Grey
Hornbill Red-billed
Hornbill Southern Yellow-billed
Ibis African Sacred
Ibis Glossy
Ibis Hadeda
Indigobird Purple
Indigobird Village
Jacana African
Kestrel Greater
[N]Kestrel Lesser VU
Kestrel Rock
Kingfisher Brown-hooded
Kingfisher Giant
Kingfisher Half-collared
Kingfisher Malachite
Kingfisher Pied
Kingfisher Striped
Kingfisher Woodland
Kite Black
Kite Black-shouldered
Kite Yellow-billed
Korhaan Barrow's VU
Korhaan Northern Black
Korhaan Red-crested
Lapwing African Wattled
Lapwing Blacksmith
Lapwing Crowned
Lark Eastern Clapper
Lark Fawn-coloured
Lark Melodious NT
Lark Monotonous
Lark Pink-billed
Lark Red-capped
Lark Rufous-naped
Lark Sabota
Lark Short-clawed NT
Lark Spike-heeled
Longclaw Cape
Mannikin Bronze
Martin Banded
Martin Brown-throated
Martin Common House-
Martin Rock
Martin Sand
Moorhen Common
Mousebird Red-faced
Mousebird Speckled
Mousebird White-backed
Myna Common
Neddicky
Nightjar European
Nightjar Fiery-necked
Nightjar Freckled
Nightjar Rufous-cheeked
Oriole Black-headed
Oriole Eurasian Golden
Osprey
Ostrich Common
Owl African Grass- VU
Owl African Scops-
Owl Barn
Owl Marsh
Owl Southern White-faced Scops-
Owl Spotted Eagle-
Owl Verraeux's Eagle-
Owlet Pearl-spotted
Pelican Great White NT
Pelican Pink-backed VU
Petronia Yellow-throated
Pigeon African Green
Pigeon African Olive-
Pigeon Speckled
Pipit African
Pipit Buffy
Pipit Bushveld
Pipit Long-billed
Pipit Plain-backed
Pipit Striped
Plover Caspian
Plover Chestnut-banded NT
Plover Common Ringed
Plover Grey
Plover Kittlitz's

Plover Three-banded
Pochard Southern
Pratincole Black-winged NT
Prinia Black-chested
Prinia Tawny-flanked
Puffback Black-headed
Phytilia Green-winged
Quail Common
Quail Harlequin
Quailfinch African
Quelea Red-billed
Rail African
Robin Kalahari Scrub-
Robin White-browed Scrub-
Robin-Chat Cape
Robin-chat White-throated
Roller European
Roller Lilac-breasted
Roller Purple
Ruff
Sanderling
Sandgrouse Namaqua
Sandpiper Common
Sandpiper Curlew
Sandpiper Marsh
Sandpiper Wood
Scimitarbill Common
Secretarybird NT
Seedeater Streaky-headed
Shelduck South African
Shikra
Shoveler Cape
Shrike Crimson-breasted
Shrike Grey-headed Bush-
Shrike Lesser Grey
Shrike Magpie
Shrike Red-backed
Shrike Southern White-breasted
Snipe African
Snipe Greater Painted- NT
Sparrow Cape
Sparrow Great
Sparrow House
Sparrow Southern Grey-headed
Sparrow-Weaver White-browed
Sparrowhawk Black
Sparrowhawk Little
Sparrowhawk Ovambo
Sparrowlark Chestnut-backed
Sparrowlark Grey-backed
Spoonbill African
Spurfowl Swainson's
Starling Burchell's
Starling Cape Glossy
Starling Pied
Starling Red-winged
Starling Violet-backed
Starling Wattled
Stilt Black-winged
Stint Little
Stonechat African
Stork Abdim's
[N]Stork Black NT
Stork Marabou NT
Stork White
Stork Yellow-billed NT
Sunbird Amethyst
Sunbird Marico
Sunbird White-bellied
Swallow Barn
Swallow Greater Striped
Swallow Lesser Striped
Swallow Pearl-breasted
Swallow Red-breasted
Swallow South African Cliff-
Swallow White-throated
Swamphen African Purple
Swift African Black
Swift African Palm
Swift Alpine
Swift Common
Swift Horus
Swift Little
Swift White-rumped
Tchagra Black-crowned
Tchagra Brown-crowned
Teal Cape
Teal Hottentot
Teal Red-billed
Tern Caspian NT
Tern Whiskered
Tern White-winged
Thick-knee Spotted
Thrush Groundscraper
Thrush Karoo
Thrush Kurrichane
Thrush Short-toed Rock-
Tinkerbird Yellow-fronted
Tit Ashy
Tit Cape Penduline-
Tit Southern Black
Tit-Babbler Chestnut-vented
Turnstone Ruddy
[N]Vulture Cape VU
[N]Vulture Egyptian RE
[N]Vulture Lappet-faced VU

Vulture Palm-nut
[N]Vulture White-backed VU
Wagtail African Pied
Wagtail Cape
Wagtail Yellow
Warbler African Reed-
Warbler Barred Wren-
Warbler Garden
Warbler Great Reed
Warbler Icterine
Warbler Little Rush-
Warbler Marsh
Warbler Rufous-eared
Warbler Sedge
Warbler Willow
Waxbill Black-faced
Waxbill Blue
Waxbill Common
Waxbill Orange-breasted
Waxbill Swee
Waxbill Violet-eared
Weaver Cape
Weaver Red-billed Buffalo-
Weaver Sociable
Weaver Southern Masked-
Weaver Village
Wheatear Capped
Wheatear Mountain
Whimbrel Common
White-eye Cape
Whitethroat Common
Whydah Long-tailed Paradise
Whydah Pin-tailed
Whydah Shaft-tailed
Widowbird Long-tailed
Widowbird Red-collared
Widowbird White-winged
Wood-hoopoe Green
Woodpecker Bearded
Woodpecker Cardinal
Woodpecker Golden-tailed

Appendix 4: Threatened vertebrate species with a geographical distribution that includes the study area.

MAMMALS

Common name	Taxon	Habitat[1]	National status	Global status[2]	Likelihood of occurrence
Black rhinoceros	*Diceros bicornis minor*	Wide variety of habitats, but currently only occurs in game reserves.	VU	CR	**NONE**, only occurs in game reserves
Roan antelope	*Hippotragus equinus*	Medium to tall grassland in open savannah. Only occurs in reserves and on private game farms.	VU	LC	**LOW**, overall geographical distribution includes this area, general habitat is suitable, but only occurs in reserves.
Brown hyaena	*Hyaena brunnea*	All vegetation types, including urban areas. Scavenger.	NT	NT	**HIGH,** within known distribution range, habitat is suitable
Spotted-necked otter	*Lutra maculicollis*	Permanent, unsilted and unpolluted rivers, streams and freshwater lakes, where sufficient numbers of its prey are present.Adequate riparian vegetation is essential to provide cover during periods of inactivity.	NT	LC	**NONE,** within known distribution range, but no suitable habitat
Honey badger	*Mellivora capensis*	Wide variety of habitats. Probably only in natural habitats.	NT	LC	**HIGH**, within known distribution range, habitat is suitable
Natal long-fingered bat	*Miniopterus natalensis*	Occurs widely in the region, but more often in the southern and eastern parts than the arid west. It is predominantly a temperate to sub-tropical species with the core of its distribution in the savannas and grasslands of southern Africa. It is cave-dependent and congregates in huge numbers in suitable sites. Uses separate hibernacula and summer maternity roosts. Females migrate between these caves, which may be up to 150 km apart.	NT	LC	**LOW**, overall geographical distribution includes this area, general habitat is suitable – no caves on site.
Rusty Bat	*Pipistrellus rusticus*	Aerial insectivore that roosts in crevices in trees. It is found in savannah woodland, associated with open water bodies. It is absent from moist miombo woodland and arid savannah. In the Limpopo valley, it is common in mopane woodland where rocky habitat is also present.	NT	LC	**LOW**, overall geographical distribution includes this area, but general habitat is not suitable.
Geoffroy's horseshoe bat	*Rhinolophus clivosus*	Caves and subterranean habitats; fynbos, shrubland, grassland, succulent and Nama-karoo; insectivore	NT	LC	**LOW**, overall geographical distribution

					includes this area, general habitat is suitable – no caves on site.
Darling's horseshoe bat	*Rhinolophus darlingi*	Caves and subterranean habitats. Woodland savannah.	NT	LC	**LOW**, overall geographical distribution includes this area, general habitat not suitable – no caves on site.
South African hedgehog	*Atelerix frontalis*	Variety of terrestrial habitats with good ground cover.	NT	LC	**MEDIUM,** within geographical range and suitable habitat probably occurs on site.
White-tailed Rat	*Mystromys albicaudatus*	The white-tailed rat is restricted to savannas and grasslands of South Africa and Swaziland. They tend to inhabit burrows of meerkats and cracks in the soil during the day and venture out at night. They eat vegetable matter such as seeds and have been known to take insects.	EN	EN	**MEDIUM,** within geographical range and suitable habitat probably occurs on site.

[1]Distribution and national status according to Friedmann & Daly 2004.

[2]Global status according to IUCN 2010. IUCN Red List of Threatened Species. Version 2010.3. (www.iucnredlist.org). Downloaded on 11 September 2010.

AMPHIBIANS

Common name	Species	Habitat	Status	Likelihood of occurrence
Giant Bullfrog	*Pyxicephalus adspersus*	Widely distributed in southern Africa, mainly at higher elevations. Inhabits a variety of vegetation types where it breeds in seasonal, shallow, grassy pans in flat, open areas; also utilises non-permanent vleis and shallow water on margins of waterholes and dams. Prefer sandy substrates although they sometimes inhabit clay soils.	NT[1] LC[2] Protected (NEMBA)	**MEDIUM**, within known distribution range and partially suitable habitat occurs on site.

[1]Status according to Minter et al. 2004.

[2]Status according to IUCN 2010. IUCN Red List of Threatened Species. Version 2010.3. (www.iucnredlist.org). Downloaded on 11 September 2010.

REPTILES

Common name	Species	Habitat	Status[3]	Likelihood of occurrence
None				

[3]Distribution according to Alexander & Marais 2007.

[4]Status according to Alexander & Marais 2007.

BIRDS

Common name	Species	Habitat	Status	Importance of site for species
Blue Crane	*Anthropoides*	Midland and highland grassveld, edge of	VU[1]	LOW, breeding,

Common name	Species	Habitat	Status	Importance of site for species
	paradisea	karoo, cultivated land, edges of vleis. Roosts on ground or in shallow water. Uncommon resident in study area.*Nest*: Scrape on bare ground or rock (klipplaat) in open grassveld, often in moist places; sometimes thinly lined or ringed with pebbles, sheep droppings or bits of plant material.	VU[2] Protected (NEMBA)	MEDIUM, foraging
Martial Eagle	*Polemaetus bellicosus*	The Martial Eagle is widespread but uncommon throughout South Africa and neighbouring countries. It tolerates a wide range of vegetation types, being found in open grassland, scrub, Karoo and woodland. It relies on large trees (and electricity pylons) to provide nest sites. It is found typically in flat country and is rarer in mountains and forests. One of the main reason it is declining is because of persecution on private land. This species has been recorded from the study area and many surrounding areas. Common resident in study area.	VU[1] VU[2] Protected (NEMBA)	LOW, breeding, LOW, foraging
Tawny Eagle	*Aquila rapax*	Woodland and savanna to semi-arid savanna or grassland with scattered *Acacia* trees. Uncommon resident in study area.	VU[1] VU[2] Protected (NEMBA)	LOW, breeding, LOW, foraging
Lanner Falcon	*Falco biarmicus*	Most frequent in open grassland, open or cleared woodland, and agricultural areas. Breeding pairs generally favour habitats where cliffs available as nest and roost sites, but will use alternative sites (eg trees, electricity pylons, buildings) if cliffs absent. Widespread species, occurring in Afrotropics, Middle East and western Palearctic. Occurs in mountains or open country from semidesert to woodland and agricultural land; also cities (Durban, Harare). Uncommon resident in study area.	NT[1] LC[2]	LOW, breeding, LOW, foraging
Peregrine Falcon	*Falco peregrinus*	Cliffs, mountains, steep gorges; may hunt over open grassland, farmland and forests; rarely enters cities to hunt pigeons. Uncommon non-breeding migrant in study area.	NT[1] LC[2]	ZERO, breeding, LOW, foraging
Greater Flamingo	*Phoenicopterus ruber*	Large bodies of shallow water, both inland and coastal; saline and brackish waters preferred.Uncommon resident in study area.	NT[1] LC[2]	ZERO, breeding, ZERO, foraging
Lesser Flamingo	*Phoenicopterus minor*	Larger brackish or saline inland and coastal waters. Common resident in study area.	NT[1] NT[2]	ZERO, breeding, ZERO, foraging
Harrier Black	*Circus maurus*	Grassveld, karoo scrub, mountain fynbos, cultivated lands, subalpine vegetation,	VU[1] VU[2]	ZERO, breeding, LOW, foraging

Common name	Species	Habitat	Status	Importance of site for species
		semidesert. Endemic to southern Africa. Uncommon non-breeding migrant in study area.Dry grassland, Karoo scrub and agricultural fields.		
Harrier African Marsh-	*Circus ranivorus*	Almost exclusively inland and coastal wetlands. Uncommon resident in study area. Roosts in dense grass or reeds, sometimes communally when not breeding.	VU[1] LC[2]	LOW, breeding, LOW, foraging
Harrier Pallid	*Circus macrourus*	Grasslands associated with open pans or flood plains; also croplands. Uncommon non-breeding migrant in study area.	NT[1] NT[2]	ZERO, breeding, LOW, foraging
Barrow's Korhaan	*Eupodotis barrowii*	Open grassland; sometimes in sparse *Acacia* thornveld. Eggs laid on bare ground. Uncommon to common resident in study area.	VU[1] na[2]	MEDIUM, breeding, MEDIUM, foraging
Melodious Lark	*Mirafra cheniana*	Open climax grassland, sometimes with rocky outcrops, termite mounds or sparse bushes; also cultivated fields of Teff. Nest set into scrape on ground among tall grass. Common resident in study area.	NT[1] NT[2]	MEDIUM, breeding, MEDIUM, foraging
Short-clawed Lark	*Certhilauda chuana*	Open ground in semi-arid scrub of Karee (*Lycium* and *Rhus* species) and Vaalbos *Tarchonanthus camphoratus*; grassland 30-40 cm tall with scattered *Acacia* thorntrees, or taller open grassland in n Transvaal, usually with open patches of shorter grass; fallow lands. Nest is a cup of grass stems, leaves and roots in hollow in ground at base of herb or shrub in overgrazed grassveld. Uncommon resident in study area.	NT[1] LC[2]	MEDIUM, breeding, MEDIUM, foraging
African Grass-Owl	*Tyto capensis*	Long grass, usually near water, vleis, marshes. Uncommon resident in study area.	VU[1] na[2]	ZERO, breeding, LOW, foraging
Great White Pelican	*Pelecanus onocrotalus*	Coastal bays, estuaries, lakes, larger pans and dams. Uncommon resident in study area.	NT[1] LC[2]	ZERO, breeding, ZERO, foraging
Pink-backed Pelican	*Pelecanus rufescens*	Coastal bays and estuaries, seldom inland on larger rivers, marshes and floodplains. Uncommon resident in study area.	VU[1] LC[2]	ZERO, breeding, ZERO, foraging
Lesser Kestrel	*Falco naumannii*	Open grassveld, mainly on highveld, usually near towns or farms. Common non-breeding migrant in study area.	VU[1] na[2]	ZERO, breeding, LOW, foraging
Chestnutbanded Plover	*Charadrius pallidus*	Saline lagoons, saline and brackish pans, saltworks, occasionally estuaries and sandy lagoons. Uncommon resident in study area.	NT[1] NT[2]	LOW, breeding, LOW, foraging
Black-winged pratincole	*Glareola nordmanni*	Breeds mainly on alkaline flats and saltpans in river valleys and lake depressions, also on fields and fallow lands devoid of vegetation. Large colonies always near water and damp meadows or marshes overgrown with dense grass; access to drinking water important. In winter	NT[1] NT[2]	ZERO, breeding, LOW, foraging

Common name	Species	Habitat	Status	Importance of site for species
		quarters, prefers open grassland, edges of pans and cultivated fields, but most common in seasonally wet grasslands and pan systems. Attracted to damp ground after rains, also to agricultural activities, incl mowing and ploughing, and to newly flooded grasslands. Common non-breeding migrant in study area.		
Secretarybird	*Sagittarius serpentarius*	Widespread across South Africa, occurring in savanna and open grassland from coastal regions to high altitudes, but avoids thick bush and forest. Sensitive to disturbance and high human population numbers - higher numbers usually found in conservation areas. Common resident in study area.	NT[1] VU[2]	LOW, breeding, MEDIUM, foraging
Greater painted snipe	*Rostratula benghalensis*	Dams, pans and marshy river flood plains. Favours waterside habitats with substantial cover and receding water levels with exposed mud among vegetation, departing when water recedes beyond fringes of vegetation. Rare in seasonally flooded grassland and palm savanna in Ovamboland, Namibia. Uncommon resident in study area.	NT[1] LC[2]	ZERO, breeding, ZERO, foraging
Black Stork	*Ciconia nigra*	Feeds in or around marshes, dams, rivers and estuaries; breeds in mountainous regions. Common resident in study area.	NT[1] LC[2] Protected (NEMBA)	ZERO, breeding, LOW, foraging
Marabou Stork	*Leptoptelos crumeniferus*	Open to semi-arid woodland, bushveld, fishing villages, rubbish tips, lake shores. Uncommon resident in study area.	NT[1] LC[2]	ZERO, breeding, LOW, foraging
Yellow-billed Stork	*Mycteria ibis*	Mainly inland waters; rivers, dams, pans, floodplains, marshes; less often estuaries. Uncommon non-breeding migrant in study area.	NT[1] LC[2]	ZERO, breeding, LOW, foraging
Caspian Tern	*Sterna caspia*	Estuaries, marine shores, larger inland dams and pans. Uncommon resident in study area.	NT[1] LC[2]	ZERO, breeding, ZERO, foraging
Cape vulture	*Gyps coprotheres*	Wide range of habitats up to ca 3 000 m; closely linked to subsistence communal-grazing areas, where stock losses high. Uncommon resident in study area. Nests on cliff ledges.	VU[1] VU[2] Protected (NEMBA)	ZERO, breeding, LOW, foraging
Egyptian Vulture		Semidesert and open plains; abattoirs, refuse dumps, seashore; absent from woodland. Rare and vagrant in study area.	RE[1] EN[2] Protected (NEMBA)	ZERO, breeding, LOW, foraging
Lappet-faced Vulture	*Torgos tracheliotus*	Savanna to desert. Common resident in study area.	VU[1] VU[2]	ZERO, breeding, LOW, foraging

Common name	Species	Habitat	Status	Importance of site for species
			Protected (NEMBA)	
Whitebacked Vulture	*Gyps africanus*	Savanna and bushveld. Uncommon resident in study area. Nests in tall trees.	VU[1] VU[2] Protected (NEMBA)	LOW, breeding, LOW, foraging

[1]Status according to Barnes 2000.

[2]Status according to IUCN 2010. IUCN Red List of Threatened Species. Version 2010.3. (www.iucnredlist.org). Downloaded on 8 September 2014.

Appendix 4: Checklist of plant species recorded during previous botanical surveys in the study area and surrounds.
(Species from quarter degree grid in which the site is located as well as surrounding grids in which similar vegetation is found)

Abildgaardia ovata (Burm.f.) Kral
Acacia erioloba E.Mey.
Acacia hebeclada DC. subsp. hebeclada
Acacia hereroensis Engl.
Acacia karroo Hayne
Acanthosicyos naudinianus (Sond.) C.Jeffrey
Acrotome inflata Benth.
Aerva leucura Moq.
Alectra sessiliflora (Vahl) Kuntze var. sessiliflora
Andropogon schirensis Hochst. ex A.Rich.
Anthemis cotula L.
Anthephora pubescens Nees
Anthospermum rigidum Eckl. & Zeyh. subsp. rigidum
Antizoma angustifolia (Burch.) Miers ex Harv.
Arctotis venusta Norl.
Aristida canescens Henrard subsp. canescens
Aristida congesta Roem. & Schult. subsp. barbicollis (Trin. & Rupr.) De Winter
Aristida congesta Roem. & Schult. subsp. congesta
Aristida diffusa Trin. subsp. burkei (Stapf) Melderis
Aristida scabrivalvis Hack. subsp. scabrivalvis
Aristida stipitata Hack. subsp. graciliflora (Pilg.) Melderis
Aristida vestita Thunb.
Asparagus laricinus Burch.
Barleria macrostegia Nees
Bergia decumbens Planch. ex Harv.
Berkheya onopordifolia (DC.) O.Hoffm. ex Burtt Davy var. onopordifolia
Berkheya pinnatifida (Thunb.) Thell. subsp. stobaeoides (Harv.) Roessler
Blepharis angusta (Nees) T.Anderson
Blepharis squarrosa (Nees) T.Anderson
Brachiaria marlothii (Hack.) Stent
Brachiaria nigropedata (Ficalho & Hiern) Stapf
Brachiaria serrata (Thunb.) Stapf
Brachystelma foetidum Schltr.
Bulbine abyssinica A.Rich.
Bulbine frutescens (L.) Willd.
Bulbine narcissifolia Salm-Dyck
Bulbostylis burchellii (Ficalho & Hiern) C.B.Clarke
Calamagrostis epigejos (L.) Roth var. capensis Stapf
Cannabis sativa L. var. sativa
Celtis africana Burm.f.
Chaenostoma patrioticum (Hiern) Kornhall
Chamaecrista biensis (Steyaert) Lock
Chascanum adenostachyum (Schauer) Moldenke
Chascanum pinnatifidum (L.f.) E.Mey. var. pinnatifidum
Chironia palustris Burch. subsp. palustris
Chloris virgata Sw.
Chlorophytum cooperi (Baker) Nordal
Chrysocoma ciliata L.

Chrysocoma obtusata (Thunb.) Ehr.Bayer
Chrysopogon serrulatus Trin.
Cirsium vulgare (Savi) Ten.
Clematis brachiata Thunb.
Cleome maculata (Sond.) Szyszyl.
Coccinia sessilifolia (Sond.) Cogn.
Commelina africana L. var. krebsiana (Kunth) C.B.Clarke
Commelina livingstonii C.B.Clarke
Commicarpus pentandrus (Burch.) Heimerl
Convolvulus ocellatus Hook.f. var. ocellatus
Convolvulus thunbergii Roem. & Schult.
Corchorus asplenifolius Burch.
Crabbea angustifolia Nees
Crassula lanceolata (Eckl. & Zeyh.) Endl. ex Walp. subsp. transvaalensis (Kuntze) Toelken
Crassula natans Thunb. var. natans
Crinum graminicola I.Verd.
Crinum macowanii Baker
Cucumis myriocarpus Naudin subsp. myriocarpus
Cucumis zeyheri Sond.
Cyanotis speciosa (L.f.) Hassk.
Cymbopogon pospischilii (K.Schum.) C.E.Hubb.
Cynanchum virens (E.Mey.) D.Dietr.
Cynodon dactylon (L.) Pers.
Cynoglossum austroafricanum Hilliard & B.L.Burtt
Cynoglossum lanceolatum Forssk.
Cyperus congestus Vahl
Cyperus marginatus Thunb.
Cyperus rubicundus Vahl
Cyperus sexangularis Nees
Cyphia stenopetala Diels
Deverra burchellii (DC.) Eckl. & Zeyh.
Dianthus mooiensis F.N.Williams subsp. mooiensis var. mooiensis
Dicoma anomala Sond. subsp. anomala
Dicoma anomala Sond. subsp. gerrardii (Harv. ex F.C.Wilson) S.Ortíz & Rodr.Oubiña
Digitaria eriantha Steud.
Digitaria sanguinalis (L.) Scop.
Diheteropogon amplectens (Nees) Clayton var. amplectens
Diospyros austro-africana De Winter var. microphylla (Burch.) De Winter
Diospyros lycioides Desf. subsp. lycioides
Dipcadi marlothii Engl.
Dipcadi viride (L.) Moench
Echinochloa holubii (Stapf) Stapf
Ehretia alba Retief & A.E.van Wyk
Elionurus muticus (Spreng.) Kunth
Epilobium hirsutum L.
Eragrostis barbinodis Hack.
Eragrostis biflora Hack. ex Schinz
Eragrostis chloromelas Steud.
Eragrostis curvula (Schrad.) Nees
Eragrostis gummiflua Nees
Eragrostis micrantha Hack.
Eragrostis plana Nees
Eragrostis superba Peyr.

Eragrostis trichophora Coss. & Durieu
Eragrostis x pseud-obtusa De Winter
Eriosema salignum E.Mey.
Euphorbia inaequilatera Sond. var. inaequilatera
Eustachys paspaloides (Vahl) Lanza & Mattei
Falkia oblonga Bernh. ex C.Krauss
Felicia muricata (Thunb.) Nees subsp. muricata
Fingerhuthia africana Lehm.
Flaveria bidentis (L.) Kuntze
Fuirena pubescens (Poir.) Kunth var. pubescens
Galium capense Thunb. subsp. capense
Geigeria aspera Harv. var. aspera
Geigeria brevifolia (DC.) Harv.
Geigeria burkei Harv. subsp. burkei var. burkei
Geigeria burkei Harv. subsp. burkei var. zeyheri (Harv.) Merxm.
Gladiolus permeabilis D.Delaroche subsp. edulis (Burch. ex Ker Gawl.) Oberm.
Gnaphalium filagopsis Hilliard & B.L.Burtt
Gomphocarpus fruticosus (L.) Aiton f. subsp. fruticosus
Grewia flava DC.
Gymnosporia buxifolia (L.) Szyszyl.
Habenaria epipactidea Rchb.f.
Helichrysum callicomum Harv.
Helichrysum harveyanum Wild
Helichrysum nudifolium (L.) Less. var. nudifolium
Hermannia stellulata (Harv.) K.Schum.
Hermannia tomentosa (Turcz.) Schinz ex Engl.
Hermbstaedtia odorata (Burch.) T.Cooke var. odorata
Heteropogon contortus (L.) Roem. & Schult.
Hibiscus trionum L.
Hyparrhenia filipendula (Hochst.) Stapf var. pilosa (Hochst.) Stapf
Hyparrhenia hirta (L.) Stapf
Indigastrum costatum (Guill. & Perr.) Schrire subsp. macrum (E.Mey.) Schrire
Indigastrum parviflorum (B.Heyne ex Wight & Arn.) Schrire subsp. parviflorum var. parviflorum
Indigofera heterotricha DC.
Indigofera oxytropis Benth. ex Harv.
Ipomoea bathycolpos Hallier f.
Ipomoea oblongata E.Mey. ex Choisy
Ipomoea obscura (L.) Ker Gawl. var. obscura
Jamesbrittenia atropurpurea (Benth.) Hilliard subsp. atropurpurea
Kohautia amatymbica Eckl. & Zeyh.
Kohautia caespitosa Schnizl. subsp. brachyloba (Sond.) D.Mantell
Kyllinga alba Nees
Kyphocarpa angustifolia (Moq.) Lopr.
Lantana rugosa Thunb.
Leersia denudata Launert
Leptochloa fusca (L.) Kunth
Lippia scaberrima Sond.
Litogyne gariepina (DC.) Anderb.
Lobelia erinus L.
Lobelia thermalis Thunb.
Loudetia simplex (Nees) C.E.Hubb.
Lycium cinereum Thunb.

Lycium hirsutum Dunal
Marsilea macrocarpa C.Presl
Medicago laciniata (L.) Mill. var. laciniata
Melilotus albus Medik.
Melinis repens (Willd.) Zizka subsp. grandiflora (Hochst.) Zizka
Melinis repens (Willd.) Zizka subsp. repens
Mentha aquatica L.
Microchloa caffra Nees
Microchloa kunthii Desv.
Monsonia burkeana Planch. ex Harv.
Moraea pallida (Baker) Goldblatt
Nananthus vittatus (N.E.Br.) Schwantes
Nemesia fruticans (Thunb.) Benth.
Nidorella hottentotica DC.
Nidorella resedifolia DC. subsp. resedifolia
Nolletia ciliaris (DC.) Steetz
Oenothera glazioviana Micheli
Oenothera rosea L'Hér. ex Aiton
Olea europaea L. subsp. africana (Mill.) P.S.Green
Ophrestia oblongifolia (E.Mey.) H.M.L.Forbes var. oblongifolia
Oropetium capense Stapf
Osteospermum muricatum E.Mey. ex DC. subsp. muricatum
Oxygonum dregeanum Meisn. subsp. canescens (Sond.) Germish. var. canescens
Ozoroa paniculosa (Sond.) R.& A.Fern. var. paniculosa
Pachystigma pygmaeum (Schltr.) Robyns
Panicum coloratum L. var. coloratum
Panicum stapfianum Fourc.
Parinari capensis Harv. subsp. capensis
Paspalum dilatatum Poir.
Pastinaca sativa L.
Pavonia burchellii (DC.) R.A.Dyer
Pearsonia cajanifolia (Harv.) Polhill subsp. cajanifolia
Pelargonium dolomiticum R.Knuth
Pellaea calomelanos (Sw.) Link var. calomelanos
Pentarrhinum insipidum E.Mey.
Phragmites australis (Cav.) Steud.
Plantago lanceolata L.
Plectranthus neochilus Schltr.
Pogonarthria squarrosa (Roem. & Schult.) Pilg.
Pollichia campestris Aiton
Polygala gracilenta Burtt Davy
Polygala hottentotta C.Presl
Polygala producta N.E.Br.
Polygala rehmannii Chodat
Potamogeton pectinatus L.
Pygmaeothamnus zeyheri (Sond.) Robyns var. zeyheri
Ranunculus multifidus Forssk.
Raphionacme hirsuta (E.Mey.) R.A.Dyer
Rhynchosia monophylla Schltr.
Riccia albolimbata S.W.Arnell
Riccia argenteolimbata O.H.Volk & Perold
Rubia petiolaris DC.
Rumex lanceolatus Thunb.

Salvia radula Benth.
Salvia runcinata L.f.
Salvia stenophylla Burch. ex Benth.
Scabiosa columbaria L.
Schizachyrium sanguineum (Retz.) Alston
Searsia pyroides (Burch.) Moffett var. pyroides
Selago densiflora Rolfe
Senecio digitalifolius DC.
Setaria incrassata (Hochst.) Hack.
Setaria nigrirostris (Nees) T.Durand & Schinz
Setaria sphacelata (Schumach.) Stapf & C.E.Hubb. ex M.B.Moss var. torta (Stapf) Clayton
Sida chrysantha Ulbr.
Sida cordifolia L. subsp. cordifolia
Silene undulata Aiton
Solanum lichtensteinii Willd.
Sporobolus festivus Hochst. ex A.Rich.
Sporobolus fimbriatus (Trin.) Nees
Stachys spathulata Burch. ex Benth.
Stipagrostis uniplumis (Licht.) De Winter var. neesii (Trin. & Rupr.) De Winter
Striga elegans Benth.
Striga gesnerioides (Willd.) Vatke
Sutherlandia microphylla Burch. ex DC.
Tarchonanthus parvicapitulatus P.P.J.Herman
Tephrosia longipes Meisn. subsp. longipes var. longipes
Tephrosia lupinifolia DC.
Teucrium trifidum Retz.
Themeda triandra Forssk.
Trachyandra burkei (Baker) Oberm.
Trachyandra laxa (N.E.Br.) Oberm. var. rigida (Suess.) Roessler
Trachypogon spicatus (L.f.) Kuntze
Tragus berteronianus Schult.
Tragus racemosus (L.) All.
Tribulus terrestris L.
Trichodesma angustifolium Harv. subsp. angustifolium
Trichoneura grandiglumis (Nees) Ekman
Trifolium africanum Ser. var. africanum
Tripteris aghillana DC. var. aghillana
Triraphis andropogonoides (Steud.) E.Phillips
Triraphis schinzii Hack.
Tritonia nelsonii Baker
Triumfetta sonderi Ficalho & Hiern
Urelytrum agropyroides (Hack.) Hack.
Urochloa brachyura (Hack.) Stapf
Urochloa panicoides P.Beauv.
Ursinia nana DC. subsp. leptophylla Prassler
Verbena bonariensis L.
Vigna unguiculata (L.) Walp. subsp. stenophylla (Harv.) Maréchal, Mascherpa & Stainier
Viscum verrucosum Harv.
Wahlenbergia denticulata (Burch.) A.DC. var. denticulata
Xanthium spinosum L.
Ziziphus mucronata Willd. subsp. mucronata
Ziziphus zeyheriana Sond.
Zornia milneana Mohlenbr.

Appendix 5: Flora and vertebrate animal species protected under the National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004)
(as updated in R. 1187, 14 December 2007)

CRITICALLY ENDANGERED SPECIES
Flora
Adenium swazicum
Aloe pillansii
Diaphananthe millarii
Dioscorea ebutsniorum
Encephalartos aemulans
Encephalartos brevifoliolatus
Encephalartos cerinus
Encephalartos dolomiticus
Encephalartos heenanii
Encephalartos hirsutus
Encephalartos inopinus
Encephalartos latifrons
Encephalartos middelburgensis
Encephalartos nubimontanus
Encephalartos woodii

Reptilia
Loggerhead sea turtle
Leatherback sea turtle
Hawksbill sea turtle

Aves
Wattled crane
Blue swallow
Egyptian vulture
Cape parrot

Mammalia
Riverine rabbit
Rough-haired golden mole

ENDANGERED SPECIES
Flora
Angraecum africae
Encephalartos arenarius
Encephalartos cupidus
Encephalartos horridus
Encephalartos laevifolius
Encephalartos lebomboensis
Encephalartos msinganus
Jubaeopsis caffra
Siphonochilus aethiopicus
Warburgia salutaris
Newtonia hilderbrandi

Reptilia
Green turtle
Giant girdled lizard
Olive ridley turtle
Geometric tortoise

Aves
Blue crane
Grey crowned crane
Saddle-billed stork
Bearded vulture
White-backed vulture
Cape vulture
Hooded vulture
Pink-backed pelican
Pel's fishing owl
Lappet-faced vulture

Mammalia
Robust golden mole
Tsessebe
Black rhinoceros
Mountain zebra
African wild dog
Gunning's golden mole
Oribi
Red squirrel
Four-toed elephant-shrew

VULNERABLE SPECIES
Flora
Aloe albida
Encephalartos cycadifolius
Encephalartos Eugene-maraisii
Encephalartos ngovanus
Merwilla plumbea
Zantedeschia jucunda

Aves
White-headed vulture
Tawny eagle
Kori bustard
Black stork
Southern banded snake eagle
Blue korhaan
Taita falcon
Lesser kestrel
Peregrine falcon
Bald ibis

Ludwig's bustard
Martial eagle
Bataleur
Grass owl

Mammalia
Cheetah
Samango monkey
Giant golden mole
Giant rat
Bontebok
Tree hyrax
Roan antelope
Pangolin
Juliana's golden mole
Suni
Large-eared free-tailed bat
Lion
Leopard
Blue duiker

PROTECTED SPECIES
Flora
Adenia wilmsii
Aloe simii
Clivia mirabilis
Disa macrostachya
Disa nubigena
Disa physodes
Disa procera
Disa sabulosa
Encephelartos altensteinii
Encephelartos caffer
Encephelartos dyerianus
Encephelartos frederici-guilielmi
Encephelartos ghellinckii
Encephelartos humilis
Encephelartos lanatus
Encephelartos lehmannii
Encephelartos longifolius
Encephelartos natalensis
Encephelartos paucidentatus
Encephelartos princeps
Encephelartos senticosus
Encephelartos transvenosus
Encephelartos trispinosus
Encephelartos umbeluziensis
Encephelartos villosus
Euphorbia clivicola
Euphorbia meloformis
Euphorbia obesa
Harpagophytum procumbens
Harpagophytum zeyherii
Hoodia gordonii
Hoodia currorii
Protea odorata
Stangeria eriopus

Amphibia
Giant bullfrog
African bullfrog

Reptilia
Gaboon adder
Namaqua dwarf adder
Smith's dwarf chameleon
Armadillo girdled lizard
Nile crocodile
African rock python

Aves
Southern ground hornbill
African marsh harrier
Denham's bustard
Jackass penguin

Mammalia
Cape clawless otter
South African hedgehog
White rhinoceros
Black wildebeest
Spotted hyaena
Black-footed cat
Brown hyaena
Serval
African elephant
Spotted-necked otter
Honey badger
Sharpe's grysbok
Reedbuck
Cape fox

Appendix 6: Curriculum Vitae for Dr David Hoare

Dr. David Barry Hoare

B.Sc. (Hons), M.Sc., Ph.D., Pr.Nat.Sci. (Ecology, Botany)

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Personal information
Date of birth: 04 November 1966, Grahamstown, South Africa
Citizenship: Republic of South Africa
ID no.: 661104 5024 088

Education
Matric - Graeme College, Grahamstown, 1984
B.Sc (majors: Botany, Zoology) - Rhodes University, 1991-1993
B.Sc (Hons) (Botany) - Rhodes University, 1994 with distinction
M.Sc (Botany) - University of Pretoria, 1995-1997 with distinction
PhD (Botany) – Nelson Mandela Metropolitan University, Port Elizabeth

Main areas of specialisation
- Vegetation ecology, primarily in grasslands, thicket, coastal systems, wetlands
- Plant biodiversity and threatened species specialist
- Remote sensing, analysis and mapping of vegetation
- Specialist consultant for environmental management projects

Membership
Professional Natural Scientist, South African Council for Natural Scientific Professions, 16 August 2005 – present. Reg. no. 400221/05 (Ecology, Botany)
Member, International Association of Vegetation Scientists

Employment history
1 February 1998 – 30 November 2004, Researcher, Agricultural Research Council, Range and Forage Institute, Private Bag X05, Lynn East, 0039. Duties: project management, general vegetation ecology, remote sensing image processing.
1 December 2004 – present, Member, David Hoare Consulting cc no. 2001/034446/23. Consultant, specialist consultant contracted to a number of existing companies and organisations.
1January 2009 – 30 June 2009, Lecturer, University of Pretoria, Botany Dept.
1January 2013 – 30 June 2013, Lecturer, University of Pretoria, Botany Dept.

Experience as consultant
Ecological consultant since 1995. Author of over 340 specialist ecological consulting reports. Wide experience in ecological studies within grassland, savanna and fynbos, as well as riparian, coastal and wetland vegetation.

Publication record:
Refereed scientific articles (in chronological order):
Journal articles:
HOARE, D.B. & BREDENKAMP, G.J. 1999. Grassland communities of the Amatola / Winterberg mountain region of the Eastern Cape, South Africa. *South African Journal of Botany* 64:

44-61.

HOARE, D.B., VICTOR, J.E., LUBKE, R.A. & MUCINA, L., 2000. Vegetation of the coastal fynbos and rocky headlands south of George, South Africa. *Bothalia* 30: 87-96.

VICTOR, J.E., **HOARE, D.B.** & LUBKE, R.A., 2000. Checklist of plant species of the coastal fynbos and rocky headlands south of George, South Africa. *Bothalia* 30: 97-101.

MUCINA, L, BREDENKAMP, G.J., **HOARE, D.B** & MCDONALD, D.J. 2000. A National Vegetation Database for South Africa *South African Journal of Science* 96: 1-2.

HOARE, D.B. & BREDENKAMP, G.J. 2001. Syntaxonomy and environmental gradients of the grasslands of the Stormberg / Drakensberg mountain region of the Eastern Cape, South Africa.. *South African Journal of Botany* 67: 595 – 608.

LUBKE, R.A., **HOARE, D.B.**, VICTOR, J.E. & KETELAAR, R. 2003. The vegetation of the habitat of the Brenton blue butterfly, Orachrysops niobe (Trimen), in the Western Cape, South Africa. *South African Journal of Science* 99: 201–206.

HOARE, D.B & FROST, P. 2004. Phenological classification of natural vegetation in southern Africa using AVHRR vegetation index data. *Applied Vegetation Science* 7: 19-28.

FOX, S.C., HOFFMANN, M.T. and HOARE, D. 2005. The phenological pattern of vegetation in Namaqualand, South Africa and its climatic correlates using NOAA-AVHRR NDVI data. South African Geographic Journal, 87: 85–94.

Book chapters and conference proceedings:

HOARE, D.B. 2002. Biodiversity and performance of grassland ecosystems in communal and commercial farming systems in South Africa. Proceedings of the FAO's Biodiversity and Ecosystem Approach in Agriculture, Forestry and Fisheries Event: 12–13 October, 2002. Food and Agriculture Organisation of the United Nations, Viale delle Terme di Caracalla, Rome, Italy. pp. 10 - 27.

STEENKAMP, Y., VAN WYK, A.E., VICTOR, J.E., **HOARE, D.B.**, DOLD, A.P., SMITH, G.F. & COWLING, R.M. 2005. Maputaland-Pondoland-Albany Hotspot. In: Mittermeier, R.A., Gil, P.R., Hoffmann, M., Pilgrim, J., Brooks, T., Mittermeier, C.G., Lamoreux, J. & Fonseca, G.A.B. da (eds.) *Hotspots revisited.* CEMEX, pp.218–229. ISBN 968-6397-77-9

STEENKAMP, Y., VAN WYK, A.E., VICTOR, J.E., **HOARE, D.B.**, DOLD, A.P., SMITH, G.F. & COWLING, R.M. 2005. Maputaland-Pondoland-Albany Hotspot. http://www.biodiversityhotspots.org/xp/hotspots/maputaland/.

HOARE, D.B., MUCINA, L., RUTHERFORD, M.C., VLOK, J., EUSTON-BROWN, D., PALMER, A.R., POWRIE, L.W., LECHMERE-OERTEL, R.G., PROCHES, S.M., DOLD, T. and WARD, R.A. *Albany Thickets.* in Mucina, L. and Rutherford, M.C. (eds.) 2006. The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19, South African National Biodiversity Institute, Pretoria.

MUCINA, L., **HOARE, D.B.**, LÖTTER, M.C., DU PREEZ, P.J., RUTHERFORD, M.C., SCOTT-SHAW, C.R., BREDENKAMP, G.J., POWRIE, L.W., SCOTT, L., CAMP, K.G.T., CILLIERS, S.S., BEZUIDENHOUT, H., MOSTERT, T.H., SIEBERT, S.J., WINTER, P.J.D., BURROWS, J.E., DOBSON, L., WARD, R.A., STALMANS, M., OLIVER, E.G.H., SIEBERT, F., SCHMIDT, E., KOBISI, K., KOSE, L. 2006. *Grassland Biome.* In: Mucina, L. & Rutherford, M.C. (eds.) The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19. South African National Biodiversity Institute, Pretoria.

RUTHERFORD, M.C., MUCINA, L., LÖTTER, M.C., BREDENKAMP, G.J., SMIT, J.H.L., SCOTT-SHAW, C.R., **HOARE, D.B.**, GOODMAN, P.S., BEZUIDENHOUT, H., SCOTT, L. & ELLIS, F., POWRIE, L.W., SIEBERT, F., MOSTERT, T.H., HENNING, B.J., VENTER, C.E., CAMP, K.G.T., SIEBERT, S.J., MATTHEWS, W.S., BURROWS, J.E., DOBSON, L., VAN ROOYEN, N., SCHMIDT, E., WINTER, P.J.D., DU PREEZ, P.J., WARD, R.A., WILLIAMSON, S. and HURTER, P.J.H. 2006. *Savanna Biome.* In: Mucina, L. & Rutherford, M.C. (eds.) The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19. South African National Biodiversity Institute, Pretoria.

MUCINA, L., RUTHERFORD, M.C., PALMER, A.R., MILTON, S.J., SCOTT, L., VAN DER MERWE, B., **HOARE, D.B.**, BEZUIDENHOUT, H., VLOK, J.H.J., EUSTON-BROWN, D.I.W., POWRIE, L.W. & DOLD, A.P. 2006. *Nama-Karoo Biome.* In: Mucina, L. & Rutherford, M.C. (eds.) The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19. South African National Biodiversity Institute, Pretoria.

MUCINA, L., SCOTT-SHAW, C.R., RUTHERFORD, M.C., CAMP, K.G.T., MATTHEWS, W.S., POWRIE, L.W. and **HOARE, D.B.** 2006. *Indian Ocean Coastal Belt.* In: Mucina, L. & Rutherford, M.C. (eds.) The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19. South African National Biodiversity Institute, Pretoria.

Conference Presentations:

HOARE, D.B. & LUBKE, R.A. *Management effects on diversity at Goukamma Nature Reserve, Southern Cape*; Paper presentation, Fynbos Forum, Bienne Donne, July 1994

HOARE, D.B., VICTOR, J.E. & LUBKE, R.A. *Description of the coastal fynbos south of George, southern Cape*; Paper presentation, Fynbos Forum, Bienne Donne, July 1994

HOARE, D.B. & LUBKE, R.A. *Management effects on fynbos diversity at Goukamma Nature Reserve, Southern Cape*; Paper presentation, South African Association of Botanists Annual Congress, Bloemfontein, January 1995

HOARE, D.B. & BOTHA, C.E.J. *Anatomy and ecophysiology of the dunegrass Ehrharta villosa var. maxima*; Poster presentation, South African Association of Botanists Annual Congress, Bloemfontein, January 1995

HOARE, D.B., PALMER, A.R. & BREDENKAMP, G.J. 1996. *Modelling grassland community distributions in the Eastern Cape using annual rainfall and elevation*; Poster presentation, South African Association of Botanists Annual Congress, Stellenbosch, January 1996

HOARE, D.B. *Modelling vegetation on a past climate as a test for palaeonological hypotheses on vegetation distributions*; Paper presentation, Randse Afriakaanse Universiteit postgraduate symposium, 1997

HOARE, D.B., VICTOR, J.E. & BREDENKAMP, G.J. *Historical and ecological links between grassy fynbos and afromontane fynbos in the Eastern Cape*; Paper presentation, South African Association of Botanists Annual Congress, Cape Town, January 1998

LUBKE, R.A., HOARE, D.B., VICTOR, J.E. & KETELAAR, R. *The habitat of the Brenton Blue Butterfly*. Paper presentation, South African Association of Botanists Annual Congress, Cape Town, January 1998

HOARE, D.B. & PANAGOS, M.D. Satellite stratification of vegetation − structure or floristic composition? Poster presentation at the 34th Annual Congress of the Grassland Society of South Africa, Warmbaths, 1-4 February 1999.

HOARE, D.B. & WESSELS, K. Conservation status and threats to grasslands of the northern regions of South Africa, Poster presentation at the South African Association of Botanists Annual Congress, Potchefstroom, January 2000.

HOARE, D.B. Phenological dynamics of Eastern Cape vegetation. Oral paper presentation at the South African Association of Botanists Annual Congress, Grahamstown, January 2002.

HOARE, D.B., MUCINA, L., VAN DER MERWE, J.P.H. & PALMER, A.R. Classification and digital mapping of grasslands of the Eastern Cape Poster presentation at the South African Association of Botanists Annual Congress, Grahamstown, January 2002.

HOARE, D.B. Deriving phenological variables for Eastern Cape vegetation using satellite data Poster presentation at the South African Association of Botanists Annual Congress, Grahamstown, January 2002.

MUCINA, L., RUTHERFORD, M.C., HOARE, D.B. & POWRIE, L.W. 2003. VegMap: The new vegetation map of South Africa, Lesotho and Swaziland. In: Pedrotti, F. (ed.) Abstracts: Water Resources and Vegetation, 46th Symposium of the International Association for Vegetation Science, June 8 to 14 − Napoli, Italy.

HOARE, D.B. 2003. Species diversity patterns in moist temperate grasslands of South Africa. Proceedings of the VIIth International Rangeland Congress, 26 July − 1 August 2003, Durban South Africa. African Journal of Range and Forage Science. 20: 84.

Unpublished technical reports:

PALMER, A.R., HOARE, D.B. & HINTSA, M.D., 1999. Using satellite imagery to map veld condition in Mpumalanga: A preliminary report. Report to the National Department of Agriculture (Directorate Resource Conservation). ARC Range and Forage Institute, Grahamstown.

HOARE, D.B. 1999. The classification and mapping of the savanna biome of South Africa:

methodology for mapping the vegetation communities of the South African savanna at a scale of 1:250 000. Report to the National Department of Agriculture (Directorate Resource Conservation). ARC Range and Forage Institute, Pretoria.
HOARE, D.B. 1999. The classification and mapping of the savanna biome of South Africa: size and coverage of field data that exists on the database of vegetation data for South African savanna. Report to the National Department of Agriculture (Directorate Resource Conservation). ARC Range and Forage Institute, Pretoria.
THOMPSON, M.W., VAN DEN BERG, H.M., NEWBY, T.S. & HOARE, D.B. 2001. Guideline procedures for national land-cover mapping and change monitoring. Report no. ENV/P/C 2001-006 produced for Department of Water Affairs and Forestry, National Department of Agriculture and Department of Environment Affairs and Tourism. Copyright: Council for Scientific and Industrial Research (CSIR) and Agricultural Research Council (ARC).
HOARE, D.B. 2003. Natural resource survey of node O R Tambo, using remote sensing techniques, Unpublished report and database of field data for ARC Institute for Soil, Climate & Water, ARC Range and Forage Institute, Grahamstown.
HOARE, D.B. 2003. Short-term changes in vegetation of Suikerbosrand Nature Reserve, South Africa, on the basis of resampled vegetation sites. Gauteng Department of Agriculture, Conservation, Environment and Land Affairs, Conservation Division.
BRITTON , D. , SILBERBAUER, L., ROBERTSON, H., LUBKE, R., HOARE, D., VICTOR, J., EDGE, D. & BALL, J. 1997. The Life-history, ecology and conservation of the Brenton Blue Butterfly (*Orachrysops niobe*) (Trimen)(*Lycaenidea*) at Brenton-on-Sea. Unpublished report for the Endangered Wildlife Trust of Southern Africa, Johannesburg. 38pp.
HOARE, D.B., VICTOR, J.E. & MARNEWIC, G. 2005. Vegetation and flora of the wetlands of Nylsvley River catchment as component of a project to develop a framework for the sustainable management of wetlands in Limpopo Province.

Consulting reports:

Total of over 340 specialist consulting reports for various environmental projects from 1995 – 2014.

Workshops / symposia attended:

Workshop on remote sensing of rangelands presented by Paul Tueller, University of Nevada Reno, USA, VIIth International Rangeland Congress, 26 July – 1 August 2003, Durban South Africa.
VIIth International Rangeland Congress, 26 July – 1 August 2003, Durban South Africa.
BioMap workshop, Stellenbosch, March 2002 to develop strategies for studying vegetation dynamics of Namaqualand using remote sensing techniques
South African Association of Botanists Annual Congress, Grahamstown, January 2002.
28th International Symposium on Remote Sensing of Environment, Somerset West, 27-31 March 2000.
Workshop on Vegetation Structural Characterisation: Tree Cover, Height and Biomass, 28th International Symposium on Remote Sensing of Environment, Strand, 26 March 2000.
South African Association of Botanists Annual Congress, Potchefstroom, January 2000
National Botanical Institute Vegmap Workshop, Kirstenbosch, Cape Town, 30 September-1 October 1999.
Sustainable Land Management – Guidelines for Impact Monitoring, Orientation Workshop: Sharing Impact Monitoring Experience, Zithabiseni, 27-29 September 1999.
WWF Macro Economic Reforms and Sustainable Development in Southern Africa, Environmental Economic Training Workshop, development Bank, Midrand, 13-14 September 1999.
34th Annual Congress of the Grassland Society of South Africa, Warmbaths, 1-4 February 1999
Expert Workshop on National Indicators of Environmental Sustainable Development, Dept. of Environmental Affairs and Tourism, Roodevallei Country Lodge, Roodeplaat Dam, Pretoria, 20-21 October 1998.
South African Association of Botanists Annual Congress, Cape Town, January 1998
Randse Afriakaanse Universiteit postgraduate symposium, 1997.
South African Association of Botanists Annual Congress, Bloemfontein, January 1995.

Referees:

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