

# Terrestrial Biodiversity Assessment

prepared in accordance with the  
*"Protocol for the Specialist Assessment and minimum report content requirements for  
environmental impacts on Terrestrial Biodiversity"*

## Camden II Wind Energy Facility near Ermelo in Mpumalanga Province



David Hoare Consulting (Pty) Ltd



David Hoare  
Consulting (Pty) Ltd

Address:

Postnet Suite #116  
Private Bag X025  
Lynnwood Ridge  
0040

41 Soetdoring Avenue  
Lynnwood Manor  
Pretoria

Cell: 083 284 5111  
Fax: 086 550 2053  
Email:  
david@davidhoareconsulting.co.za

# Terrestrial Biodiversity Assessment report for the proposed Camden II Wind Energy Facility near Ermelo in Mpumalanga Province.

Location:

South of Ermelo in Mpumalanga Province

for

Camden II Wind Energy Facility (RF) Propriety Limited  
53 Dudley Road,  
Parkwood,  
Johannesburg  
South Africa

4 July 2022

Final version

# TABLE OF CONTENTS

<b>TABLE OF CONTENTS .....</b>	<b>2</b>
<b>LIST OF FIGURES .....</b>	<b>4</b>
<b>SPECIALIST DETAILS &amp; DECLARATION .....</b>	<b>5</b>
DECLARATION OF INDEPENDENCE:.....	5
DISCLOSURE: .....	5
<b>TERMS OF REFERENCE .....</b>	<b>6</b>
<b>LIMITATIONS, ASSUMPTIONS &amp; UNCERTAINTIES .....</b>	<b>9</b>
<b>INTRODUCTION .....</b>	<b>10</b>
BACKGROUND.....	10
PROJECT DESCRIPTION .....	10
<b>SENSITIVITIES IDENTIFIED FROM DFFE ONLINE SCREENING TOOL .....</b>	<b>12</b>
TERRESTRIAL BIODIVERSITY THEME.....	12
<b>METHODOLOGY .....</b>	<b>14</b>
APPROACH .....	14
SOURCES OF INFORMATION .....	15
<i>Regional Vegetation .....</i>	<i>15</i>
<i>Threatened Ecosystems .....</i>	<i>15</i>
<i>Regional plans.....</i>	<i>15</i>
<i>Aerial imagery.....</i>	<i>15</i>
HABITAT SENSITIVITY .....	15
FIELD SURVEYS .....	16
<b>RELEVANT LEGISLATIVE AND PERMIT REQUIREMENTS.....</b>	<b>17</b>
CONVENTION ON BIODIVERSITY (CBD) .....	17
NATIONAL ENVIRONMENTAL MANAGEMENT ACT, ACT NO. 107 OF 1998 (NEMA) .....	17
NATIONAL ENVIRONMENTAL MANAGEMENT: BIODIVERSITY ACT (ACT NO 10 OF 2004) (NEMBA) .....	17
<i>Alien and Invasive Species.....</i>	<i>18</i>
<i>Government Notice No. 1002 of 2011: National List of Ecosystems that are Threatened and in need of protection .....</i>	<i>19</i>
<i>GNR 151: Critically Endangered, Endangered, Vulnerable and Protected Species List .....</i>	<i>19</i>
<i>GNR 1187: Amendment of Critically Endangered, Endangered, Vulnerable and Protected Species List .....</i>	<i>19</i>
<i>Government Notice No. 40733 of 2017: Draft National Biodiversity Offset Policy.....</i>	<i>19</i>
NATIONAL FORESTS ACT (ACT NO 84 OF 1998) .....	20
NATIONAL WATER ACT (ACT 36 OF 1998) .....	20
CONSERVATION OF AGRICULTURAL RESOURCES (ACT NO. 43 OF 1983) AS AMENDED IN 2001 .....	20
NATIONAL VELD AND FOREST FIRE ACT (ACT NO. 101 OF 1998).....	20
MPUMALANGA NATURE CONSERVATION ACT, NO. 10 OF 1998 .....	20
NATIONAL ENVIRONMENTAL MANAGEMENT PROTECTED AREAS ACT, NO. 57 OF 2003 .....	21
OTHER ACTS.....	21
<b>DESCRIPTION OF STUDY AREA.....</b>	<b>22</b>
LOCATION .....	22
SITE CONDITIONS.....	22
REGIONAL VEGETATION PATTERNS .....	23
<i>Eastern Highveld Grassland .....</i>	<i>23</i>
<i>Wakkerstroom Montane Grassland.....</i>	<i>24</i>
<i>Amersfoort Highveld Clay Grassland .....</i>	<i>25</i>

CONSERVATION STATUS OF REGIONAL VEGETATION TYPES .....	27
BIODIVERSITY CONSERVATION PLANS .....	29
PROPOSED PROTECTED AREAS (NPAES FOCUS AREAS) .....	30
HABITATS ON SITE .....	32
<i>Grassland</i> .....	34
<i>Wetlands</i> .....	34
<i>Current cultivation</i> .....	34
<i>Old lands</i> .....	34
<i>Exotic trees</i> .....	35
<i>Degraded areas</i> .....	35
<i>Transformed areas</i> .....	35
HABITAT SENSITIVITY .....	36
<b>POSSIBLE IMPACTS .....</b>	<b>40</b>
PROPOSED INFRASTRUCTURE IN RELATION TO SENSITIVITIES .....	40
<i>WTGs x 45</i> .....	40
<i>Construction camp and batching plants</i> .....	42
<i>SS &amp; BESS (2 alternative sites)</i> .....	42
<i>Temporary laydown areas x 2</i> .....	43
<i>Internal road infrastructure</i> .....	43
ANTICIPATED IMPACTS .....	43
CONSTRUCTION PHASE IMPACTS .....	43
<i>Direct impacts</i> .....	43
<i>Indirect impacts</i> .....	44
OPERATIONAL PHASE IMPACTS .....	44
<i>Direct impacts</i> .....	44
<i>Indirect impacts</i> .....	44
DECOMMISSIONING PHASE IMPACTS .....	44
<i>Direct impacts</i> .....	44
<i>Indirect impacts</i> .....	44
CUMULATIVE IMPACTS .....	44
<b>ASSESSMENT OF SIGNIFICANCE OF ECOLOGICAL IMPACTS .....</b>	<b>45</b>
DESIGN PHASE IMPACTS .....	45
CONSTRUCTION PHASE IMPACTS .....	45
<i>Loss of indigenous natural vegetation due to clearing</i> .....	45
<i>Impact on integrity of Critical Biodiversity Areas</i> .....	46
<i>Establishment and spread of declared weeds and alien invader plants due to the clearing and disturbance of indigenous vegetation</i> .....	48
OPERATIONAL PHASE IMPACTS .....	49
<i>Continued disturbance to natural habitats due to general operational activities and maintenance</i> .....	49
<i>Continued establishment and spread of alien invasive plant species due to the presence of migration corridors and disturbance vectors</i> .....	50
<i>Runoff and erosion due to the presence of hard surfaces that change the infiltration and runoff properties of the landscape (Substation only)</i> .....	51
DECOMMISSIONING PHASE IMPACTS .....	51
<i>Loss and disturbance of natural vegetation due to the removal of infrastructure and need for working sites</i> .....	52
<i>Continued establishment and spread of alien invasive plant species due to the presence of migration corridors and disturbance vectors</i> .....	52
CUMULATIVE IMPACTS .....	54
<i>Cumulative impacts on indigenous natural vegetation</i> .....	54
<i>Cumulative impacts on ecological processes</i> .....	54
<i>Cumulative impacts due to spread of declared weeds and alien invader plants</i> .....	55
<i>Cumulative impacts on CBAs and conservation planning</i> .....	56
ASSESSMENT OF NO-GO ALTERNATIVE .....	57
SUMMARY OF MITIGATION MEASURES .....	59
SUMMARY OF MONITORING RECOMMENDATIONS .....	59

<b>DISCUSSION .....</b>	<b>60</b>
<b>CONCLUSIONS .....</b>	<b>61</b>
<b>BIBLIOGRAPHY AND REFERENCES: .....</b>	<b>62</b>
<b>APPENDICES: .....</b>	<b>64</b>
APPENDIX 1: CURRICULUM VITAE: DR DAVID HOARE .....	64

## LIST OF FIGURES

Figure 1: DFFE Screening Tool extract: terrestrial biodiversity theme.....	13
Figure 2: Recommended survey periods for different biomes (Species Environmental Assessment Guidelines). ....	14
Figure 3: Location of the study area to the south of Ermelo in Mpumalanga Province.....	22
Figure 4: Regional vegetation types of the study area. ....	23
Figure 5: Distribution of listed ecosystems relative to the study area. ....	28
Figure 6: Mpumalanga CBA map for the study area. ....	29
Figure 7: Mpumalanga Protected Area Expansion Strategy (Lotter 2015) arrow points to site. ....	30
Figure 8: Main habitats of the study area. ....	33
Figure 9: Habitat sensitivity of the study area, including consideration of CBAs. ....	37
Figure 10: Proposed infrastructure in relation to habitat sensitivity on site. ....	41
Figure 11: Proposed infrastructure in relation to CBAs on site. ....	47

# SPECIALIST DETAILS & DECLARATION

This report has been prepared in accordance with the "Protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial animal species, terrestrial plant species and terrestrial biodiversity", as promulgated in terms of Section 24 (5) of the National Environmental Management Act, 1998 (Act No. 107 of 1998), published in GN. No. 320 dated 20 March 2020. It has been prepared independently of influence or prejudice by any parties.

The details of Specialists are as follows:

Specialist	Qualification and accreditation
Dr David Hoare	<ul style="list-style-type: none"><li>• PhD Botany</li><li>• Pr.Sci.Nat. 400221/05 (Ecological Science, Botanical Science)</li></ul>

## Declaration of independence:

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

## Disclosure:

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

Based on information provided to David Hoare Consulting (Pty) Ltd by the client and in addition to information obtained during the course of this study, David Hoare Consulting (Pty) Ltd present the results and conclusion within the associated document to the best of the author's professional judgement and in accordance with best practice.



Dr David Hoare

27 June 2022

Date

# TERMS OF REFERENCE

The specialist study is required to follow the published Protocols, provided in full below for the assessment of impacts on Terrestrial Biodiversity. Note that the Protocols require determination of the level of sensitivity, which then determines the level of assessment required, either a full assessment, or a Compliance Statement.

## PROTOCOL FOR THE SPECIALIST ASSESSMENT AND MINIMUM REPORT CONTENT REQUIREMENTS FOR ENVIRONMENTAL IMPACTS ON TERRESTRIAL BIODIVERSITY

This site sensitivity assessment follows the requirements of The Environmental Impact Assessment Regulations, as promulgated in terms of Section 24 (5) of the National Environmental Management Act, 1998 (Act No. 107 of 1998), published in GN. No. 320 dated 20 March 2020.

### **General information**

1.1. An applicant intending to undertake an activity identified in the scope of this protocol, on a site identified on the screening tool as being of “**very high sensitivity**” for terrestrial biodiversity, must submit a Terrestrial Biodiversity Specialist Assessment.

1.2. An applicant intending to undertake an activity identified in the scope of this protocol on a site identified by the screening tool as being “**low sensitivity**” for terrestrial biodiversity, must submit a Terrestrial Biodiversity Compliance Statement.

1.3. However, where the information gathered from the site sensitivity verification differs from the designation of “very high” terrestrial biodiversity sensitivity on the screening tool and it is found to be of a “low” sensitivity, then a Terrestrial Biodiversity Compliance Statement must be submitted.

1.4. Similarly, where the information gathered from the site sensitivity verification differs from that identified as having a “low” terrestrial biodiversity sensitivity on the screening tool, a Terrestrial Biodiversity Specialist Assessment must be conducted.

1.5. If any part of the proposed development footprint falls within an area of “very high” sensitivity, the assessment and reporting requirements prescribed for the “very high” sensitivity apply to the entire footprint, **excluding linear activities** for which impacts on terrestrial biodiversity are temporary and the land in the opinion of the terrestrial biodiversity specialist, based on the mitigation and remedial measures, can be returned to the current state within two years of the completion of the construction phase, in which case a compliance statement applies. Development footprint in the context of this protocol means the area on which the proposed development will take place and includes any area that will be disturbed.

### **Terrestrial Biodiversity Specialist Assessment**

2.1. The assessment must be prepared by a specialist registered with the South African Council for Natural Scientific Professionals (SACNASP) with expertise in the field of terrestrial biodiversity.

2.2. The assessment must be undertaken on the preferred site and within the proposed development footprint.

2.3. The assessment must provide a baseline description of the site which includes, as a minimum, the following aspects:

2.3.1. a description of the ecological drivers or processes of the system and how the proposed development will impact these;

2.3.2. ecological functioning and ecological processes (e.g. fire, migration, pollination, etc.) that operate within the preferred site;

2.3.3. the ecological corridors that the proposed development would impede including migration and movement of flora and fauna;

2.3.4. the description of any significant terrestrial landscape features (including rare or important flora-faunal associations, presence of strategic water source areas (SWSAs) or freshwater ecosystem priority area (FEPA) sub catchments;

2.3.5. a description of terrestrial biodiversity and ecosystems on the preferred site, including:

- (a) main vegetation types;
- (b) threatened ecosystems, including listed ecosystems as well as locally important habitat types identified;
- (c) ecological connectivity, habitat fragmentation, ecological processes and fine-scale habitats; and
- (d) species, distribution, important habitats (e.g. feeding grounds, nesting sites, etc.) and movement patterns identified;

2.3.6. the assessment must identify any alternative development footprints within the preferred site which would be of a “low” sensitivity as identified by the screening tool and verified through the site sensitivity verification; and

2.3.7. the assessment must be based on the results of a site inspection undertaken on the preferred site and must identify:

2.3.7.1. terrestrial critical biodiversity areas (CBAs), including:

- (a) the reasons why an area has been identified as a CBA;
- (b) an indication of whether or not the proposed development is consistent with maintaining the CBA in a natural or near natural state or in achieving the goal of rehabilitation;
- (c) the impact on species composition and structure of vegetation with an indication of the extent of clearing activities in proportion to the remaining extent of the ecosystem type(s);
- (d) the impact on ecosystem threat status;
- (e) the impact on explicit subtypes in the vegetation;
- (f) the impact on overall species and ecosystem diversity of the site; and
- (g) the impact on any changes to threat status of populations of species of conservation concern in the CBA;

2.3.7.2. terrestrial ecological support areas (ESAs), including:

- (a) the impact on the ecological processes that operate within or across the site;
- (b) the extent the proposed development will impact on the functionality of the ESA; and
- (c) loss of ecological connectivity (on site, and in relation to the broader landscape) due to the degradation and severing of ecological corridors or introducing barriers that impede migration and movement of flora and fauna;

2.3.7.3. protected areas as defined by the National Environmental Management: Protected Areas Act, 2004 including-

- (a) an opinion on whether the proposed development aligns with the objectives or purpose of the protected area and the zoning as per the protected area management plan;

2.3.7.4. priority areas for protected area expansion, including-

- (a) the way in which the proposed development will compromise or contribute to the expansion of the protected area network;

2.3.7.5. SWSAs including:

- (a) the impact(s) on the terrestrial habitat of a SWSA; and
- (b) the impacts of the proposed development on the SWSA water quality and quantity (e.g. describing potential increased runoff leading to increased sediment load in water courses);

2.3.7.6. FEPA subcatchments, including-

- (a) the impacts of the proposed development on habitat condition and species in the FEPA sub catchment;

2.3.7.7 indigenous forests, including:



- (a) impact on the ecological integrity of the forest; and
- (b) percentage of natural or near natural indigenous forest area lost and a statement on the implications in relation to the remaining areas.

2.4. The findings of the assessment must be written up in a Terrestrial Biodiversity Specialist Assessment Report.

### **Terrestrial Biodiversity Specialist Assessment Report**

- 3.1. The Terrestrial Biodiversity Specialist Assessment Report must contain, as a minimum, the following information:
- 3.1.1. contact details of the specialist, their SACNASP registration number, their field of expertise and a curriculum vitae;
  - 3.1.2. a signed statement of independence by the specialist;
  - 3.1.3. a statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;
  - 3.1.4. a description of the methodology used to undertake the site verification and impact assessment and site inspection, including equipment and modelling used, where relevant;
  - 3.1.5. a description of the assumptions made and any uncertainties or gaps in knowledge or data as well as a statement of the timing and intensity of site inspection observations;
  - 3.1.6. a location of the areas not suitable for development, which are to be avoided during construction and operation (where relevant);
  - 3.1.7. additional environmental impacts expected from the proposed development;
  - 3.1.8. any direct, indirect and cumulative impacts of the proposed development;
  - 3.1.9. the degree to which impacts and risks can be mitigated;
  - 3.1.10. the degree to which the impacts and risks can be reversed;
  - 3.1.11. the degree to which the impacts and risks can cause loss of irreplaceable resources;
  - 3.1.12. proposed impact management actions and impact management outcomes proposed by the specialist for inclusion in the Environmental Management Programme (EMPr);
  - 3.1.13. a motivation must be provided if there were development footprints identified as per paragraph 2.3.6 above that were identified as having a “low” terrestrial biodiversity sensitivity and that were not considered appropriate;
  - 3.1.14. a substantiated statement, based on the findings of the specialist assessment, regarding the acceptability, or not, of the proposed development, if it should receive approval or not; and
  - 3.1.15. any conditions to which this statement is subjected.
- 3.2. The findings of the Terrestrial Biodiversity Specialist Assessment must be incorporated into the Basic Assessment Report or the Environmental Impact Assessment Report, including the mitigation and monitoring measures as identified, which must be incorporated into the EMPr where relevant.
- 3.3. A signed copy of the assessment must be appended to the Basic Assessment Report or Environmental Impact Assessment Report.

# LIMITATIONS, ASSUMPTIONS & UNCERTAINTIES

The following assumptions, limitations, uncertainties are listed regarding the ecological assessment of the Camden site:

- The assessment is based on a field survey conducted 3-7 February 2020. The current study is based on an extensive site visit as well as a desktop study of the available information. The time spent on site was adequate for understanding general patterns across affected areas. The seasons in which the fieldwork (peak summer flowering period) was conducted was ideal for assessing the composition and condition of the vegetation.
- The vegetation was in good condition for sampling at the time of the field assessment, and the species lists obtained are considered reliable and relatively comprehensive.
- Compiling the list of species that could potentially occur on site is limited by the paucity of collection records for the area. The list of plant species that could potentially occur on site was therefore taken from a wider area and from literature sources that may include species that do not occur on site and may miss species that do occur on site. In order to compile a comprehensive site-specific list of the biota on site, studies would be required that would include different seasons, be undertaken over a number of years and include extensive sampling. Due to time constraints inherent in the EIA process, this was not possible for this study. However the comprehensive field survey is sufficient for the purposes of this report and towards sufficiently informing the decision making process by the Competent Authority.

# INTRODUCTION

## Background

ENERTRAG SOUTH AFRICA, a subsidiary of ENERTRAG AG, the German-based renewable energy company, via the Camden II Wind Energy Facility (RF) Propriety Limited is proposing to develop a wind energy facility of an up to 200 MW (the Project) near Camden Power Station in the Mpumalanga Province. This will be part of the Camden Renewable Energy Complex that will include:

1. Camden I Wind Energy Facility (up to 200MW).
2. Camden I Wind Grid Connection (up to 132kV).
3. Camden up to 400kV Grid Connection and Collector substation.
4. Camden I Solar (up to 100MW).
5. Camden I Solar up to 132kV Grid Connection.
6. Camden Green Hydrogen and Ammonia Facility, including grid connection infrastructure and water pipeline.
- 7. Camden II Wind Energy Facility (up to 200MW).**
8. Camden II Wind Energy Facility up to 132kV Grid Connection.

Enertrag SA has appointed WSP as the independent Environmental Assessment Practitioner (EAP) to facilitate the Environmental Impact Assessment (EIA) Process.

## Project description

The Camden II Wind Energy Facility is summarised as follows:

<b>Facility Name</b>	Camden II Wind Energy Facility
<b>Applicant</b>	Camden II Wind Energy Facility (RF) Propriety Limited
<b>Municipalities</b>	Msukaligwa Local Municipality of the Gert Sibande District Municipality
<b>Affected Farms</b>	<ul style="list-style-type: none"><li>○ Adrianople 296 IT (Portion 0, 1, 2 and 3)</li><li>○ Buhrmansvallei 297 IT (Portion 3, 4 and 5)</li><li>○ Klipfontein 326 IT (Portion 5)</li><li>○ De Emigratie 327 IT (Portion 3 and 6)</li></ul>
<b>Extent</b>	4300 ha
<b>Buildable area</b>	Approximately 200 ha, subject to finalization based on technical and environmental requirements
<b>Capacity</b>	Up to 200MW
<b>Number of turbines</b>	Up to 45
<b>Turbine hub height:</b>	Up to 200m
<b>Rotor Diameter:</b>	Up to 200m
<b>Foundation</b>	<ul style="list-style-type: none"><li>• Concrete foundations of approximately of 25m diameter x 4.5m deep will be required for each turbine, requiring approximately 2500m<sup>3</sup> concrete. Please note these dimensions may be larger as required by the geotechnical conditions.</li><li>• Concrete foundation will be constructed to support a mounting ring.</li></ul>
<b>O&amp;M building footprint:</b>	Located near the substation.

	<p>Septic tanks (operational phase) with portable toilets for construction phase. Typical areas include:</p> <ul style="list-style-type: none"> <li>- Operations building – 20m x 10m = 200m<sup>2</sup></li> <li>- Workshop – 15m x 10m = 150m<sup>2</sup></li> <li>- Stores - 15m x 10m = 150m<sup>2</sup></li> </ul>
<b>Construction camp laydown</b>	<p>Typical area 100m x 50m = 5000m<sup>2</sup>. Sewage: Portable toilets.</p>
<b>Temporary laydown or staging area:</b>	<p>Typical area 220m x 100m = 22000m<sup>2</sup>. Laydown area could increase to 30000m<sup>2</sup> for concrete towers, should they be required.</p>
<b>Cement batching plant (temporary):</b>	<p>Gravel and sand will be stored in separate heaps whilst the cement will be contained in a silo.</p>
<b>Internal Roads:</b>	<p>Width of internal road – Between 5m and 6m. Length of internal road – Approximately 60km. Where required for turning circle/bypass areas, access or internal roads may be up to 20m to allow for larger component transport.</p>
<b>Cables:</b>	<p>The medium voltage collector system will comprise of cables up to and include 33kV that run underground, except where a technical assessment suggest that overhead lines are required, in the facility connecting the turbines to the onsite substation.</p>
<b>IPP site substation and battery energy storage system (BESS):</b>	<p>Total footprint will be up to 6.5ha in extent (5ha for the BESS and 1.5ha for the IPP portion of the substation). The substation will consist of a high voltage substation yard to allow for multiple (up to) 132kV feeder bays and transformers, control building, telecommunication infrastructure, access roads, etc.</p> <p>The BESS storage capacity will be up to 200MW/800MWh with up to four hours of storage. It is proposed that Lithium Battery Technologies, such as Lithium Iron Phosphate, Lithium Nickel Manganese Cobalt oxides or Vanadium Redox flow technologies will be considered as the preferred battery technology. The main components of the BESS include the batteries, power conversion system and transformer which will all be stored in various rows of containers.</p>

# SENSITIVITIES IDENTIFIED FROM DFFE ONLINE SCREENING TOOL

## Terrestrial Biodiversity theme

The national web-based Environmental Screening Tool was queried in relation to the following infrastructure:

Utilities Infrastructure => Electricity => Generation => Renewable => Wind

The terrestrial biodiversity theme indicates that the site is within one sensitivity class, namely **VERY HIGH** (Figure 1).

Sensitivity features are indicated as follows:

Sensitivity	Feature(s)
Very High	Critical biodiversity area 1
Very High	Critical biodiversity area 2
Very High	Ecological Support Area: local corridor
Very High	FEPA Sub-catchments
Very High	Langcarel Private Nature Reserve
Very High	Endangered ecosystem
Very High	Protected Areas Expansion Strategy
Very High	Strategic Water Source Areas



Figure 1: DFFE Screening Tool extract: terrestrial biodiversity theme

# METHODOLOGY

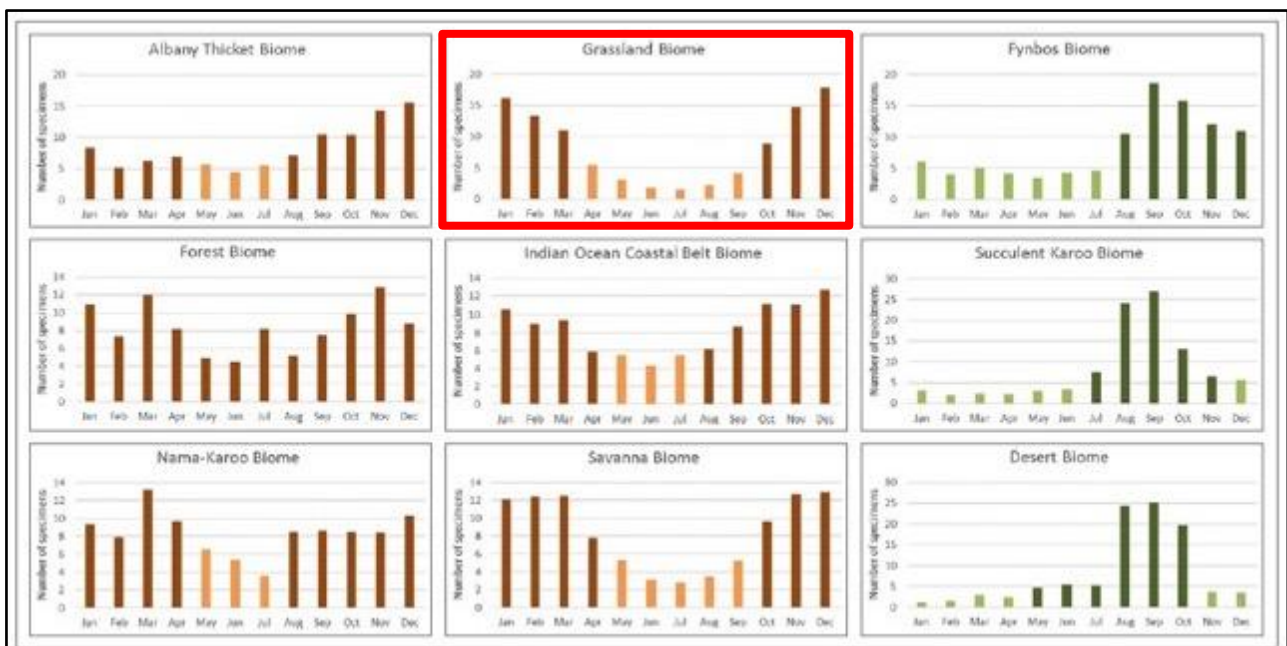
The detailed methodology followed as well as the sources of data and information used as part of this assessment is described below.

## Approach

The study commenced as a desktop-study followed by a site-specific field study from 3– 7 February 2020. The site is within the grassland biome with a peak rainfall season in summer, which occurs from October to March. There is, however, a delay between rainfall and vegetation growth, which means the peak growing season is from November to May (Figure 2), with most perennial species characteristic of the vegetation being easily identifiable from January to March. The timing of the field survey was therefore ideal in terms of assessing the vegetation condition and flora composition of the site.

During the field survey, all major natural variation on site was assessed and select locations were traversed on foot. A hand-held Garmin GPSMap 64s was used to record a track within which observations were made. Digital photographs were taken of features and habitats on site, as well as of all plant species that were seen. All plant species recorded were uploaded to the iNaturalist website.

Aerial imagery from Google Earth was used to identify and assess habitats on site. Patterns identified from satellite imagery were verified on the ground. From this ground survey, as well as ad hoc observations on site, a checklist of plant species occurring on site was compiled. Digital photographs were taken at locations where features of interest were observed.



**Figure 2: Recommended survey periods for different biomes (Species Environmental Assessment Guidelines).**

## Sources of information

### **Regional Vegetation**

- Broad vegetation types occurring on site were obtained from Mucina and Rutherford (2006), with updates according to the SANBI BGIS website (<http://bgis.sanbi.org>) as follows:
  - Mucina, L. and Rutherford, M.C. (editors) 2006. Vegetation map of South Africa, Lesotho and Swaziland: an illustrated guide. Strelitzia 19, South African National Biodiversity Institute, Pretoria.
  - South African National Biodiversity Institute 2018 Final Vegetation Map of South Africa, Lesotho and Swaziland [Vector] 2018. Available from the Biodiversity GIS website, downloaded on 23 September 2021.

### **Threatened Ecosystems**

- The conservation status of the vegetation types were obtained from Mucina and Rutherford (2006) and the National List of Ecosystems that are Threatened and in need of protection (GN1002 of 2011), published under the National Environmental Management: Biodiversity Act (Act No. 10, 2004).
- The plant species checklist of species that could potentially occur on site was compiled from a plant species checklist extracted from the NewPosa database of the South African National biodiversity Institute (SANBI) for the quarter degree grid 2629BA.
- The IUCN Red List Category for plant species, as well as supplementary information on habitats and distribution, was obtained from the SANBI Threatened Species Programme (Red List of South African Plants, <http://redlist.sanbi.org>).

### **Regional plans**

- The Mpumalanga Biodiversity Sector Plan (MBSP) retrieved from the SANBI BGIS website (<https://bgis.sanbi.org/MBSP>). Information on this map is found in Lötter & Ferrar (2006) and Ferrar & Lötter (2007).
- South Africa Protected Areas Database (SAPAD\_OR\_2021\_Q2) retrieved from the Department of Forestry, Fisheries and the Environment website ([https://egis.environment.gov.za/data\\_egis/data\\_download/current](https://egis.environment.gov.za/data_egis/data_download/current)).
- Information from the National Protected Areas Expansion Strategy (NPAES) was consulted for possible inclusion of the site into a protected area in future (available on <http://bgis.sanbi.org>).

### **Aerial imagery**

- Recent satellite imagery (courtesy of Google Earth Pro). Google Earth Pro also provides historical imagery for a period up to 15 years ago, which aided in the determination of certain vegetation types and land use historically and currently present 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 estimated as still being 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.



## Field surveys

The study area was visited and assessed to confirm patterns identified from the desktop assessment. The site visit was undertaken on 3–7 February 2020. The site is within the Grassland Biome with a peak rainfall season in summer, which occurs from November to April. The site visit was therefore undertaken at the height of the summer growing season. Vegetation was in a good state following good rains over the previous three months. Many plant species could be identified, and habitats were generally in a good state to assess. This means that botanical diversity and species composition were possible to assess. The site visit was therefore considered to be successful, as well as representative of the study area.

Specific features of potential concern were investigated in the field, including the following:

- General vegetation status, i.e. whether the vegetation was natural, disturbed/secondary or transformed;
- Presence of habitats of conservation concern in terms of high biodiversity, presence of species of conservation concern, specific sensitivities, e.g. wetlands, and any other factors that would indicate an elevated biodiversity or functional value that could not be determined from the desktop assessment;
- Presence of protected trees; and
- Potential presence of species of conservation concern, including observation of individual plants found on site or habitats that are suitable for any of the species identified from the desktop assessment.

Key parts of the development site were visited during the reconnaissance site visit in such a way as to ensure all major variation was covered and that any unusual habitats or features were observed. Plant and animal species observed were recorded. The season of the survey was favourable, and there is high confidence that many of species present on site were identifiable at the time of the survey. The survey was of adequate duration and intensity to characterise the flora of the development site as per the regulations.

# 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.

## Convention on Biodiversity (CBD)

South Africa became a signatory to the United Nations Convention on Biological Diversity (CBD) in 1993, which was ratified in 1995. The CBD requires signatory states to implement objectives of the Convention, which are the conservation of biodiversity; the sustainable use of biological resources and the fair and equitable sharing of benefits arising from the use of genetic resources. According to Article 14 (a) of the CBD, each Contracting Party, as far as possible and as appropriate, must introduce appropriate procedures, such as environmental impact assessments of its proposed projects that are likely to have significant adverse effects on biological diversity, to avoid or minimize these effects and, where appropriate, to allow for public participation in such procedures.

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

NEMA is the framework environmental management legislation, enacted as part of the government's mandate to ensure every person's constitutional right to an environment that is not harmful to his or her health or wellbeing. It is administered by the Department of Forestry, Fisheries and the Environment (DFFE) but several functions have been delegated to the provincial environment departments. One of the purposes of NEMA is to provide for co-operative environmental governance by establishing principles for decision-making on matters affecting the environment. The Act further aims to provide for institutions that will promote cooperative governance and procedures for coordinating environmental functions exercised by organs of state and to provide for the administration and enforcement of other environmental management laws.

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.”

This report considers the Environmental Impact Assessment (EIA) Regulations of 2014 (NEMA, 2014) as amended. According to these Regulations under Listing Notice 1 (GRN No. 983, as amended), Listing Notice 2 (GRN No 984, as amended) and Listing Notice 3 (GRN No 985, as amended), the activities listed are identified as activities that require Environmental Authorisation prior to commencement of that activity and to identify competent authorities in terms of sections 24(2) and 24D of the Act.

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

As the principal national act regulating biodiversity protection, NEMBA, which is administered by DFFE, is concerned with the management and conservation of biological diversity, as well as the use of indigenous biological resources in a sustainable manner. The term biodiversity according to the Convention on Biodiversity (CBD) refers to the variability among living organisms from all sources including, inter alia terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity in genes, species and ecosystems.

In terms of NEMBA, 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".

### ***Alien and Invasive Species***

Chapter 5 of NEMBA relates to species and organisms posing a potential threat to biodiversity. The Act defines alien species and provides lists of invasive species in regulations. The Alien and Invasive Species (AIS) Regulations, in terms of Section 97(1) of NEMBA, was published in Government Notice R598 in Government Gazette 37885 in 2014 (NEMBA, 2014). The Alien and Invasive Species (AIS) lists were subsequently published in Government Notice R 864 of 29 July 2016 (NEMBA, 2016).

NEMBA regulates all invasive organisms in South Africa, including a wide range of fauna and flora. Chapter 5 of the Act relates to species and organisms posing a potential threat to biodiversity. The purpose of Chapter 5 is:

- a) to prevent the unauthorized introduction and spread of alien species and invasive species to ecosystems and habitats where they do not naturally occur;
- b) to manage and control alien species and invasive species to prevent or minimize harm to the environment and to biodiversity in particular;
- c) to eradicate alien species and invasive species from ecosystems and habitats where they may harm such ecosystems or habitats;

According to Section 65 of the Act, "Restricted activities involving alien species":

- 1) A person may not carry out a restricted activity involving a specimen of an alien species without a permit issued in terms of Chapter 7. Restricted activities include the following:
  - a. Importing into the Republic, including introducing from the sea, any specimen of a listed invasive species.
  - b. Having in possession or exercising physical control over any specimen of a listed invasive species.
  - c. Growing, breeding or in any other way propagating any specimen of a listed invasive species, or causing it to multiply.
  - d. Conveying, moving or otherwise translocating any specimen of a listed invasive species.
  - e. Selling or otherwise trading in, buying, receiving, giving, donating or accepting as a gift, or in any other way acquiring or disposing of any specimen of a listed invasive species.
  - f. Spreading or allowing the spread of any specimen of a listed invasive species.
  - g. Releasing any specimen of a listed invasive species.
  - h. Additional activities that apply to aquatic species.
- 2) A permit referred to in subsection (1) may be issued only after a prescribed assessment of risks and potential impacts on biodiversity is carried out.

An "**alien species**" is defined in the Act as:

- a) a species that is not an indigenous species; or
- b) an indigenous species translocated or intended to be translocated to a place outside its natural distribution range in nature, but not an indigenous species that has extended its natural distribution range by means of migration or dispersal without human intervention.

According to Section 71 of the Act, "Restricted activities involving listed invasive species":

- 1) A person may not carry out a restricted activity involving a specimen of a listed invasive species without a permit issued in terms of Chapter 7.
- 2) A permit referred to in subsection (1) may be issued only after a prescribed assessment of risks and potential impacts on biodiversity is carried out.

An "**invasive species**" is defined in the Act as any species whose establishment and spread outside of its natural distribution range:

- a) threaten ecosystems, habitats or other species or have demonstrable potential to threaten ecosystems, habitats or other species; and
- b) may result in economic or environmental harm or harm to human health.

A "**listed invasive species**" is defined in the Act as any invasive species listed in terms of section 70(1).

According to Section 73 of the Act, "Duty of care relating to listed invasive species":

- 2) A person who is the owner of land on which a listed invasive species occurs must-
  - a) notify any relevant competent authority, in writing, of the listed invasive species occurring on that land;
  - b) take steps to control and eradicate the listed invasive species and to prevent it from spreading; and
  - c) take all the required steps to prevent or minimize harm 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***

This notice, published under Section 52(1)(a) of NEMBA, 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).

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

Published under Section 56(1) of NEMBA.

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

Published under Section 56(1) of NEMBA.

***Government Notice No. 40733 of 2017: Draft National Biodiversity Offset Policy***

Published under NEMA. The aim of the Policy is to ensure that significant residual impacts of developments are remedied as required by NEMA, thereby ensuring sustainable development as required by section 24 of the Constitution of the Republic of South Africa, 1996. This policy should be taken into consideration with every development application that still has significant residual impact after the Mitigation Sequence has been followed. The mitigation sequence entails the consecutive application of avoiding or preventing loss, then at minimizing or mitigating what cannot be avoided, rehabilitating where possible and, as a last resort, offsetting the residual impact. The Policy specifies that one impact that has come across consistently as unmitigatable is the rapid and consistent transformation of certain ecosystems and vegetation types, leading to the loss of ecosystems and extinction of species. The Policy specifically targets ecosystems where the ability to reach protected area targets is lost or close to being lost. However, the Policy states that "[w]here ecosystems remain largely untransformed, intact and functional, an offset would not be required for developments that lead to transformation, provided they have not been identified as a biodiversity priority". Biodiversity offsets should be considered to remedy residual negative impacts on biodiversity of 'medium' to 'high' significance. Residual impacts of 'very high' significance are a fatal flaw for development and residual biodiversity impacts of 'low' significance would usually not require offsets. The Policy indicates that impacts should preferably be

avoided in protected areas, Critical Biodiversity Areas (CBA), verified wetland and river features and areas earmarked for protected area expansion.

## 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 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 water resource require 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.

## 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 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.

## Mpumalanga Nature Conservation Act, No. 10 of 1998

This Act provides for the sustainable utilisation of wild animals, aquatic biota and plants; provides for the implementation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora; provides for offences and penalties for contravention of the Act; provides for the appointment of nature conservators to implement the provisions of the Act; and provides for the issuing of permits and other authorisations. Amongst other regulations, the following may apply to the current project:

- Various species are protected;
- The owner of land upon which an invasive species is found (plant or animal) must take the necessary steps to eradicate or destroy such species.

The Act provides lists of protected species for the Province. According to the Mpumalanga Nature Conservation Act, a permit is required for the removal of any species on this list.

## National Environmental Management Protected Areas Act, No. 57 of 2003

The National Environmental Management: Protected Areas Act 57 of 2003 has the following objectives:

- to provide for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes;
- to provide for the establishment of a national register of all national, provincial and local protected areas;
- to provide for the management of those areas in accordance with national norms and standards;
- to provide for intergovernmental co-operation and public consultation in matters concerning protected areas; and
- to provide for matters in connection therewith.

It has been amended several times:

- National Environmental Management: Protected Areas Amendment Act 21 of 2014
- National Environmental Management: Protected Areas Amendment Act 15 of 2009
- National Environmental Management: Protected Areas Amendment Act 15 of 2009
- National Environmental Laws Amendment Act 14 of 2009
- National Environmental Management: Protected Areas Amendment Act 31 of 2004

## Other Acts

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

- 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)

# DESCRIPTION OF STUDY AREA

## Location

The project is located about 23 km south-east of Ermelo in Mpumalanga Provinces, South Africa (Figure 3). The site is just off the N2 (Ermelo to Piet Retief) road. The Eskom Camden Power Station is approximately 7 km to the north-north-east of the site. The roads on site are all gravel farm access roads.

## Site conditions

Within the study area are significant parts that are either currently or previously cultivated, the exception being drainage valleys and small areas of grassland with shallow soils that are not suitable for cultivation. Natural areas on site are used for animal production, but the primary activity within the study area is crop cultivation. There are various secondary roads leading from the main access roads, and a number of homestead complexes. There are groves of exotic trees scattered throughout the study area, but mostly clustered around homesteads and farm infrastructure, where they act as shelter and wind-breaks. The vegetation in the study area is used primarily for livestock grazing and is affected heavily by this useage, with as many as 700 heads of cattle (not counting sheep) on Portions 1 and 2 of the Farm Welgelegen 322, by way of example. The long-term grazing capacity of the broader area is fairly high at 4.5 hectares per large stock unit (DAFF, 2018). Welgelen 1 and 2 comprises ca. 2018 ha. The sustainable grazing in the broader region would then be 448 heads of cattle, whereas the landowner reports it is now around 700 heads of cattle (not counting the sheep), and so is on a long term over-grazing trajectory. With the exception of cultivated areas and

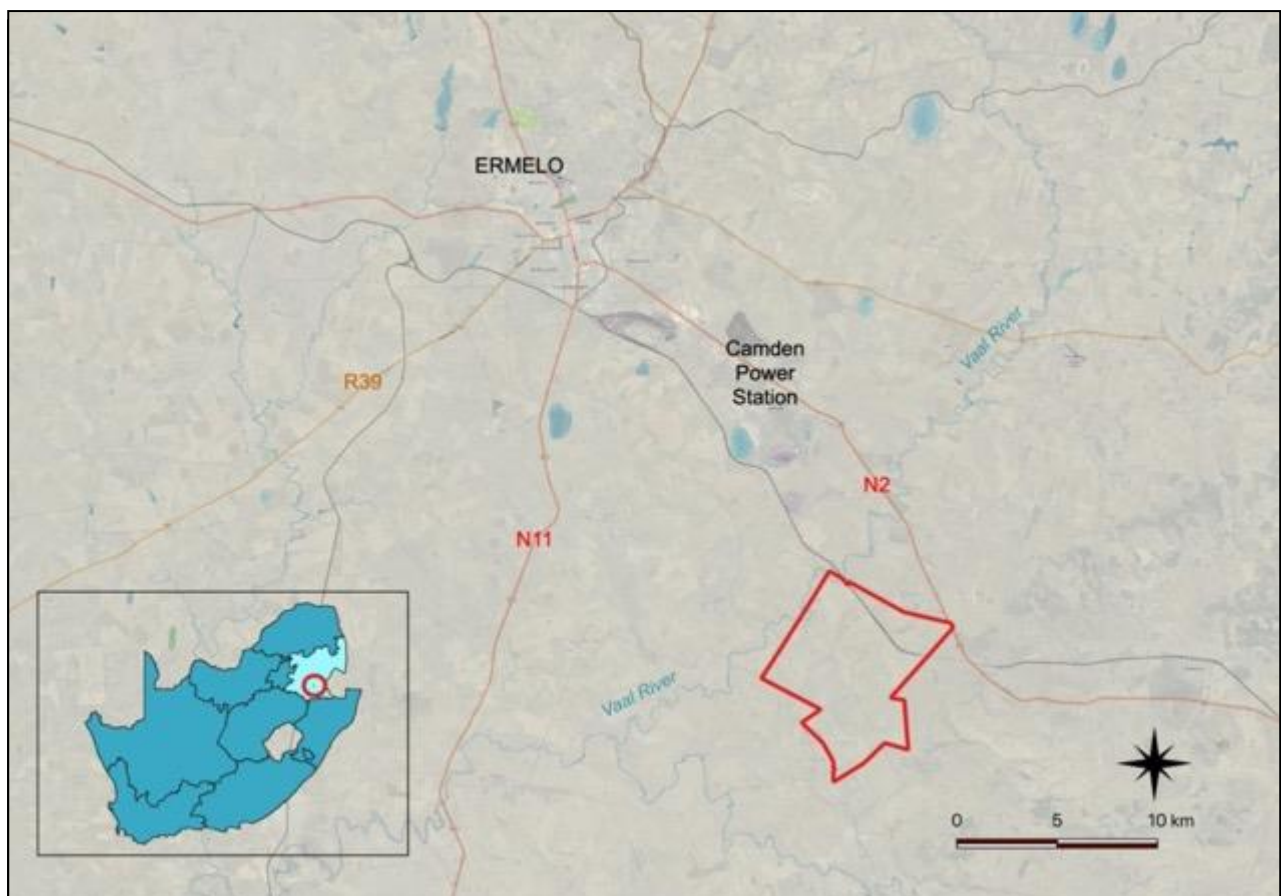


Figure 3: Location of the study area to the south of Ermelo in Mpumalanga Province.

infrastructure, the remaining vegetation and habitats in the study area is fragmented and moderately to heavily degraded with few areas of intact habitat remaining.

## Regional vegetation patterns

There are two regional vegetation types occurring in the study area, namely Eastern Highveld Grassland and Wakkerstroom Montane Grassland (Figure 4). Terrestrial vegetation patterns reflect these vegetation types, described below. Amersfoort Highveld Clay Grassland occurs in nearby neighbouring regions. The descriptions are from Mucina & Rutherford (2006), extracted from the SANBI BGIS website (<http://bgis.sanbi.org/vegmap>).

### ***Eastern Highveld Grassland***

#### *Distribution*

Found in Mpumalanga and Gauteng Provinces, on the plains between Belfast in the east and the eastern side of Johannesburg in the west and extending southwards to Bethal, Ermelo and west of Piet Retief. The vegetation type occurs at an altitude of between 1 520–1 780 m.

#### *Vegetation & Landscape Features*

The vegetation occurs on slightly to moderately undulating plains, including some low hills and pan depressions. The vegetation is short dense grassland dominated by the usual highveld grass composition (*Aristida*, *Digitaria*, *Eragrostis*, *Themeda*, *Tristachya*, etc.) with small, scattered rocky outcrops with wiry, sour grasses and some woody species (*Acacia*

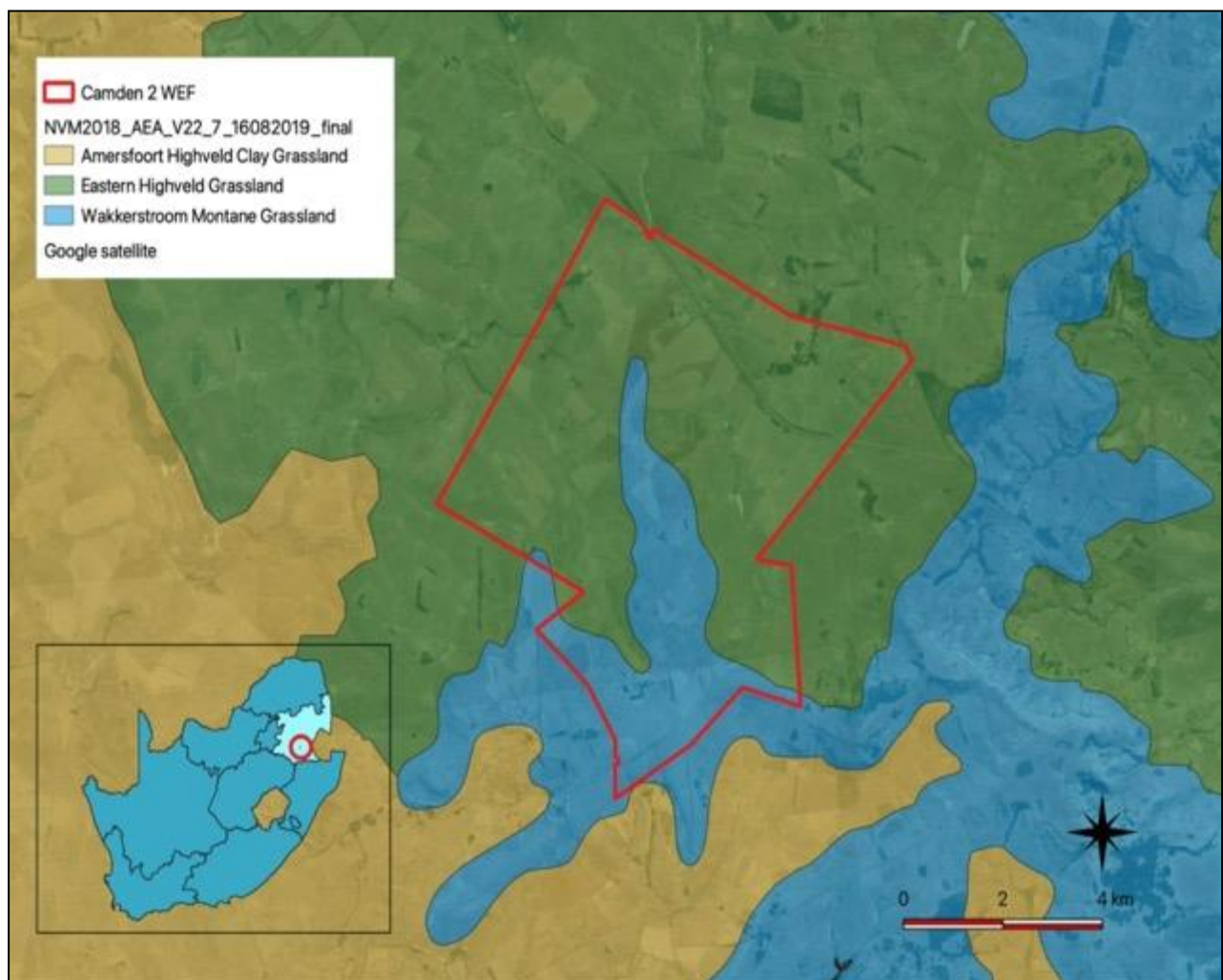


Figure 4: Regional vegetation types of the study area.



*caffra*, *Celtis africana*, *Diospyros lycioides* subsp. *lycioides*, *Parinari capensis*, *Protea caffra*, *P. welwitschii* and *Searsia magalismontanum*).

#### Geology & Soils

Red to yellow sandy soils of the Ba and Bb land types found on shales and sandstones of the Madzaringwe Formation (Karoo Supergroup). Land types Bb (65%) and Ba (30%).

#### Climate

Strongly seasonal summer rainfall, with very dry winters. MAP 650–900 mm (overall average: 726 mm), MAP relatively uniform across most of this unit, but increases significantly in the extreme southeast. The coefficient of variation in MAP is 25% across most of the unit, but drops to 21% in the east and southeast. Incidence of frost from 13–42 days, but higher at higher elevations.

#### Important Taxa

<b>Low Shrubs</b>	<i>Anthospermum rigidum</i> subsp. <i>pumilum</i> , <i>Stoebe plumosa</i>
<b>Herbs</b>	<i>Berkheya setifera</i> (d), <i>Haplocarpha scaposa</i> (d), <i>Justicia anagalloides</i> (d), <i>Pelargonium luridum</i> (d), <i>Acalypha angustata</i> , <i>Chamaecrista mimosoides</i> , <i>Dicoma anomala</i> , <i>Euryops gilfillanii</i> , <i>E. transvaalensis</i> subsp. <i>setilobus</i> , <i>Helichrysum aureonitens</i> , <i>H. caespititium</i> , <i>H. callicomum</i> , <i>H. oreophilum</i> , <i>H. rugulosum</i> , <i>Ipomoea crassipes</i> , <i>Pentanisia prunelloides</i> subsp. <i>latifolia</i> , <i>Selago densiflora</i> , <i>Senecio coronatus</i> , <i>Vernonia oligocephala</i> , <i>Wahlenbergia undulata</i> .
<b>Geophytic Herbs</b>	<i>Gladiolus crassifolius</i> , <i>Haemanthus humilis</i> subsp. <i>hirsutus</i> , <i>Hypoxis rigidula</i> var. <i>pilosissima</i> , <i>Ledebouria ovatifolia</i> .
<b>Succulent Herbs</b>	<i>Aloe ecklonis</i>
<b>Graminoids</b>	<i>Aristida aequiglumis</i> (d), <i>A. congesta</i> (d), <i>A. junciformis</i> subsp. <i>galpinii</i> (d), <i>Brachiaria serrata</i> (d), <i>Cynodon dactylon</i> (d), <i>Digitaria monodactyla</i> (d), <i>D. tricholaenoides</i> (d), <i>Elionurus muticus</i> (d), <i>Eragrostis chloromelas</i> (d), <i>E. curvula</i> (d), <i>E. plana</i> (d), <i>E. racemosa</i> (d), <i>E. sclerantha</i> (d), <i>Heteropogon contortus</i> (d), <i>Loudetia simplex</i> (d), <i>Microchloa caffra</i> (d), <i>Monocymbium cerasiiforme</i> (d), <i>Setaria sphacelata</i> (d), <i>Sporobolus africanus</i> (d), <i>S. pectinatus</i> (d), <i>Themeda triandra</i> (d), <i>Trachypogon spicatus</i> (d), <i>Tristachya leucothrix</i> (d), <i>T. rehmannii</i> (d), <i>Alloteropsis semialata</i> subsp. <i>eckloniana</i> , <i>Andropogon appendiculatus</i> , <i>A. schirensis</i> , <i>Bewisia biflora</i> , <i>Ctenium concinnum</i> , <i>Diheteropogon amplexens</i> , <i>Eragrostis capensis</i> , <i>E. gummiflua</i> , <i>E. patentissima</i> , <i>Harporchloa falx</i> , <i>Panicum natalense</i> , <i>Rendlia altera</i> , <i>Schizachyrium sanguineum</i> , <i>Setaria nigrirostris</i> , <i>Urelytrum agropyroides</i> .

### **Wakkerstroom Montane Grassland**

#### Distribution

KwaZulu-Natal and Mpumalanga Provinces: Occurring from the Escarpment just north of Sheepmoor (north), to southeast of Utrecht, and then from the vicinity of Volksrust in the west to Mandhlangampisi Mountain near Luneburg in the east. Altitude 1 440–2 200 m.

#### Vegetation & Landscape Features

This unit is a less obvious continuation of the Escarpment that links the southern and northern Drakensberg escarpments. It straddles this divide and is comprised of low mountains and undulating plains. The vegetation comprises predominantly short montane grasslands on the plateaus and the relatively flat areas, with short forest and *Leucosidea* thickets occurring along steep, mainly east-facing slopes and drainage areas. *L. sericea* is the dominant woody pioneer species that invades areas as a result of grazing mismanagement.

#### Geology & Soils

The mudstones, sandstones and shale of the Madzaringwe and Volksrust Formations (Karoo Supergroup) were intruded by voluminous Jurassic dolerite dykes and sills. Ac land type dominant, while Fa and Ca are of subordinate importance.

#### Climate

Rainfall peaks in midsummer. Rainfall 800–1 250 mm per year (MAP 902 mm). This unit experiences an orographic effect which results in a locally higher precipitation than the adjacent areas. Winters very cold and summers mild (MAT 14°C).

#### Important Taxa

<b>Small trees</b>	<i>Canthium ciliatum</i> , <i>Protea subvestita</i>
<b>Tall Shrubs</b>	<i>Buddleja salviifolia</i> (d), <i>Leucosidea sericea</i> (d), <i>Buddleja auriculata</i> , <i>Diospyros lycioides</i> subsp. <i>guerkei</i> , <i>Euclea crispa</i> subsp. <i>crispa</i> , <i>Rhus montana</i> , <i>R. rehmanniana</i> , <i>R. transvaalensis</i> .
<b>Low shrubs</b>	<i>Asparagus devenishii</i> (d), <i>Cliffortia linearifolia</i> (d), <i>Helichrysum melanacme</i> (d), <i>H. splendium</i> (d), <i>Anthospermum rigidum</i> subsp. <i>pumilum</i> , <i>Clutia natalensis</i> , <i>Erica oatesii</i> , <i>Felicia filifolia</i>

	subsp. <i>filifolia</i> , <i>Gymnosporia heterophylla</i> , <i>Helichrysum hypoleucum</i> , <i>Hermannia geniculata</i> , <i>Inulathera dregeana</i> , <i>Metalasia densa</i> , <i>Printzia pyrifolia</i> , <i>Rhus discolor</i> , <i>Rubus ludwigii</i> subsp. <i>ludwigii</i> .
<b>Graminoids</b>	<i>Andropogon schirensis</i> (d), <i>Ctenium concinnum</i> (d), <i>Cymbopogon caesius</i> (d), <i>Digitaria tricholaenoides</i> (d), <i>Diheteropogon amplexans</i> (d), <i>Eragrostis chloromelas</i> (d), <i>E. plana</i> (d), <i>E. racemosa</i> (d), <i>Harpochloa falx</i> (d), <i>Heteropogon contortus</i> (d), <i>Hyparrhenia hirta</i> (d), <i>Microchloa caffra</i> (d), <i>Themeda triandra</i> (d), <i>Trachypogon spicatus</i> (d), <i>Tristachya leucothrix</i> (d), <i>Alloteropsis semialata</i> subsp. <i>eckloniana</i> , <i>Aristida junciformis</i> subsp. <i>galpinii</i> , <i>Brachiaria serrata</i> , <i>Diheteropogon filifolius</i> , <i>Elionurus muticus</i> , <i>Eragrostis capensis</i> , <i>Eulalia villosa</i> , <i>Festuca scabra</i> , <i>Loudetia simplex</i> , <i>Rendlia altera</i> , <i>Setaria nigrirostris</i> .
<b>Herbs</b>	<i>Berkheya onopordifolia</i> var. <i>glabra</i> (d), <i>Cephalaria natalensis</i> (d), <i>Pelargonium luridum</i> (d), <i>Acalypha depressinerva</i> , <i>A. peduncularis</i> , <i>A. wilmsii</i> , <i>Aster bakerianus</i> , <i>Berkheya setifera</i> , <i>Euryops transvaalensis</i> subsp. <i>setilobus</i> , <i>Galium thunbergianum</i> var. <i>thunbergianum</i> , <i>Geranium ornithopodioides</i> , <i>Helichrysum cephaloideum</i> , <i>H. cooperi</i> , <i>H. monticola</i> , <i>H. nudifolium</i> var. <i>nudifolium</i> , <i>H. oreophilum</i> , <i>H. simillimum</i> , <i>Pentanisia prunelloides</i> subsp. <i>latifolia</i> , <i>Plectranthus laxiflorus</i> , <i>Sebaea leiostyla</i> , <i>S. sedoides</i> var. <i>sedoides</i> , <i>Selago densiflora</i> , <i>Vernonia hirsuta</i> , <i>V. natalensis</i> , <i>Wahlenbergia cuspidata</i> .
<b>Geophytic Herbs</b>	<i>Hypoxis costata</i> (d), <i>Agapanthus inapertus</i> subsp. <i>intermedius</i> , <i>Asclepias aurea</i> , <i>Cheilanthes hirta</i> , <i>Corycium dracomontanum</i> , <i>C. nigrescens</i> , <i>Cyrtanthus tuckii</i> var. <i>transvaalensis</i> , <i>Disa versicolor</i> , <i>Eriospermum cooperi</i> var. <i>cooperi</i> , <i>Eucomis bicolor</i> , <i>Geum capense</i> , <i>Gladiolus ecklonii</i> , <i>G. sericeovillosus</i> subsp. <i>sericeovillosus</i> , <i>Hesperantha coccinea</i> , <i>Hypoxis rigidula</i> var. <i>pilosissima</i> , <i>Moraea brevistyla</i> , <i>Rhodohypoxis baurii</i> var. <i>confecta</i> .
<b>Semiparasitic herb</b>	<i>Striga bilabiata</i> subsp. <i>bilabiata</i> .

Biogeographically Important Taxa (<sup>L</sup>Low Escarpment endemic, <sup>N</sup>Northern sourveld endemic)

<b>Low shrubs</b>	<i>Bowkeria citrina</i> <sup>L</sup> , <i>Lotononis amajubica</i> <sup>L</sup> , <i>Protea parvula</i> <sup>N</sup> .
<b>Succulent herb</b>	<i>Aloe modesta</i> <sup>N</sup>

Endemic Taxa

<b>Herbs</b>	<i>Helichrysum aureum</i> var. <i>argenteum</i> , <i>Selago longicalyx</i>
<b>Geophytic herbs</b>	<i>Kniphofia</i> sp. nov. (' <i>laxiflora</i> Form C'), <i>Nerine platypetala</i> .
<b>Woody climber</b>	<i>Asparagus fractiflexus</i>

#### Remarks

Overgrazing leads to invasion of *Seriphium plumosum*. Parts of this unit were once cultivated and now lie fallow and have been left to re-vegetate with pioneer species. These transformed areas are not picked up by satellite for transformation coverage and the percentage of grasslands still in a natural state may be underestimated

### **Amersfoort Highveld Clay Grassland**

#### Distribution

Mpumalanga and KwaZulu-Natal Provinces: This unit extends in a north-south band from just south of Ermelo, down through Amersfoort to the Memel area in south. Altitude 1 580–1 860 m.

#### Vegetation & Landscape Features

Comprised of undulating grassland plains, with small scattered patches of dolerite outcrops in areas. The vegetation is comprised of a short closed grassland cover, largely dominated by a dense *Themeda triandra* sward, often severely grazed to form a short lawn.

#### Geology & Soils

Restricted to vertic clay soils derived from dolerite that is intrusive in the Karoo sediments of the Madzaringwe Formation in the north and the Volksrust Formation and the Adelaide Subgroup in the south. Dominant land type Ca, while Ea land type is of subordinate importance.

#### Climate

Rainfall mainly in early summer, from 620 mm in the west to 830 mm in the east (MAP 694 mm). MAT 14°C, with temperatures higher in the west than the east. Winters are cold and summers are mild. Incidence of frost very high.

#### Important Taxa

<b>Graminoids</b>	<i>Andropogon appendiculatus</i> (d), <i>Brachiaria serrata</i> (d), <i>Digitaria monodactyla</i> (d), <i>D. tricholaenoides</i> (d), <i>Elionurus muticus</i> (d), <i>Eragrostis capensis</i> (d), <i>E. chloromelas</i> (d), <i>E. plana</i> (d), <i>E. racemosa</i> (d), <i>Harpochloa falx</i> (d), <i>Heteropogon contortus</i> (d), <i>Microchloa caffra</i> (d), <i>Panicum natalense</i> (d), <i>Setaria nigrirostris</i> (d), <i>S. sphacelata</i> (d), <i>Themeda triandra</i> (d), <i>Trichoneura grandiglumis</i> (d), <i>Tristachya leucothrix</i> (d), <i>Abildgaardia ovata</i> , <i>Andropogon schirensis</i> , <i>Aristida bipartita</i> , <i>A. congesta</i> , <i>A. junciformis</i> subsp. <i>galpinii</i> , <i>A. stipitata</i> subsp. <i>graciliflora</i> , <i>Bulbostylis contexta</i> , <i>Chloris virgata</i> , <i>Cymbopogon caesius</i> , <i>C. pospischilii</i> , <i>Cynodon dactylon</i> , <i>Digitaria diagonalis</i> , <i>D. ternata</i> , <i>Diheteropogon amplexans</i> , <i>Eragrostis curvula</i> , <i>Koeleria capensis</i> , <i>Panicum coloratum</i> , <i>Setaria incrassata</i> .
<b>Herbs</b>	<i>Berkheya setifera</i> (d), <i>Vernonia natalensis</i> , <i>V. oligocephala</i> (d), <i>Acalypha peduncularis</i> , <i>A. wilmsii</i> , <i>Berkheya insignis</i> , <i>B. pinnatifida</i> , <i>Crabbea acaulis</i> , <i>Cynoglossum hispidum</i> , <i>Dicoma anomala</i> , <i>Haplocarpha scaposa</i> , <i>Helichrysum caespitium</i> , <i>H. rugulosum</i> , <i>Hermannia coccocarpa</i> , <i>H. depressa</i> , <i>H. transvaalensis</i> , <i>Ipomoea crassipes</i> , <i>I. oblongata</i> , <i>Jamesbrittenia silenoides</i> , <i>Pelargonium luridum</i> , <i>Pentanisia prunelloides</i> subsp. <i>latifolia</i> , <i>Peucedanum magalismontanum</i> , <i>Pseudognaphalium luteo-album</i> , <i>Rhynchosia effusa</i> , <i>Salvia repens</i> , <i>Schistostephium crataegifolium</i> , <i>Sonchus nanus</i> , <i>Wahlenbergia undulata</i> .
<b>Herbaceous climber</b>	<i>Rhynchosia totta</i> .
<b>Geophytic Herbs</b>	<i>Boophone disticha</i> , <i>Eucomis autumnalis</i> subsp. <i>clavata</i> , <i>Hypoxis villosa</i> var. <i>obliqua</i> , <i>Zantedeschia albomaculata</i> subsp. <i>macrocarpa</i> .
<b>Tall Shrubs</b>	<i>Diospyros austro-africana</i> , <i>D. lycioides</i> subsp. <i>guerkei</i> .
<b>Low shrubs</b>	<i>Anthospermum rigidum</i> subsp. <i>pumilum</i> (d), <i>Helichrysum melanacme</i> (d), <i>Chaetacanthus costatus</i> , <i>Euphorbia striata</i> var. <i>cuspidata</i> , <i>Gnidia burchellii</i> , <i>G. capitata</i> , <i>Polygala uncinata</i> , <i>Rhus discolor</i> .
<b>Succulent shrubs</b>	<i>Euphorbia clavarioides</i> var. <i>truncata</i> .

#### Remarks

Overgrazing leads to invasion of *Seriphium plumosum*. Parts of this unit were once cultivated and now lie fallow and have been left to re-vegetate with pioneer species. These transformed areas are not picked up by satellite for transformation coverage and the percentage of grasslands still in a natural state may be underestimated

## Conservation status of regional vegetation types

On the basis of a scientific 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 4 below, 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).

**Determining ecosystem status (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

### Conservation status of vegetation types occurring in the study area:

Vegetation Type	Target (%)	Conserved (%)	Transformed (%)	Conservation status	
				Driver <i>et al.</i> 2005; Mucina <i>et al.</i> , 2006	National Ecosystem List (NEMBA)
Eastern Highveld Grassland	24	0.3	44	Endangered	Vulnerable
Wakkerstroom Montane Grassland	24	5.6	7	Least threatened	Not listed
Amersfoort Highveld Clay Grassland	27	0	25	Vulnerable	Not listed
Chrissiesmeer Panveld				<i>Not regarded as a vegetation type by Mucina et al.</i>	Endangered

According to scientific literature (Driver *et al.*, 2005; Mucina *et al.*, 2006), Eastern Highveld Grassland is listed as Endangered.

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, and other ecosystems defined in the Act, 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. Eastern Highveld Grassland is listed as Vulnerable in the National List of Ecosystems that are Threatened and need of protection (GN1002 of 2011).

There is an additional listed ecosystem defined under the National Ecosystem List, called Chrissiesmeer Panveld, which is listed as Endangered. This covers the entire site (see Figure 5). It spatially co-incides partially with Eastern Highveld Grassland, but is defined on different criteria.

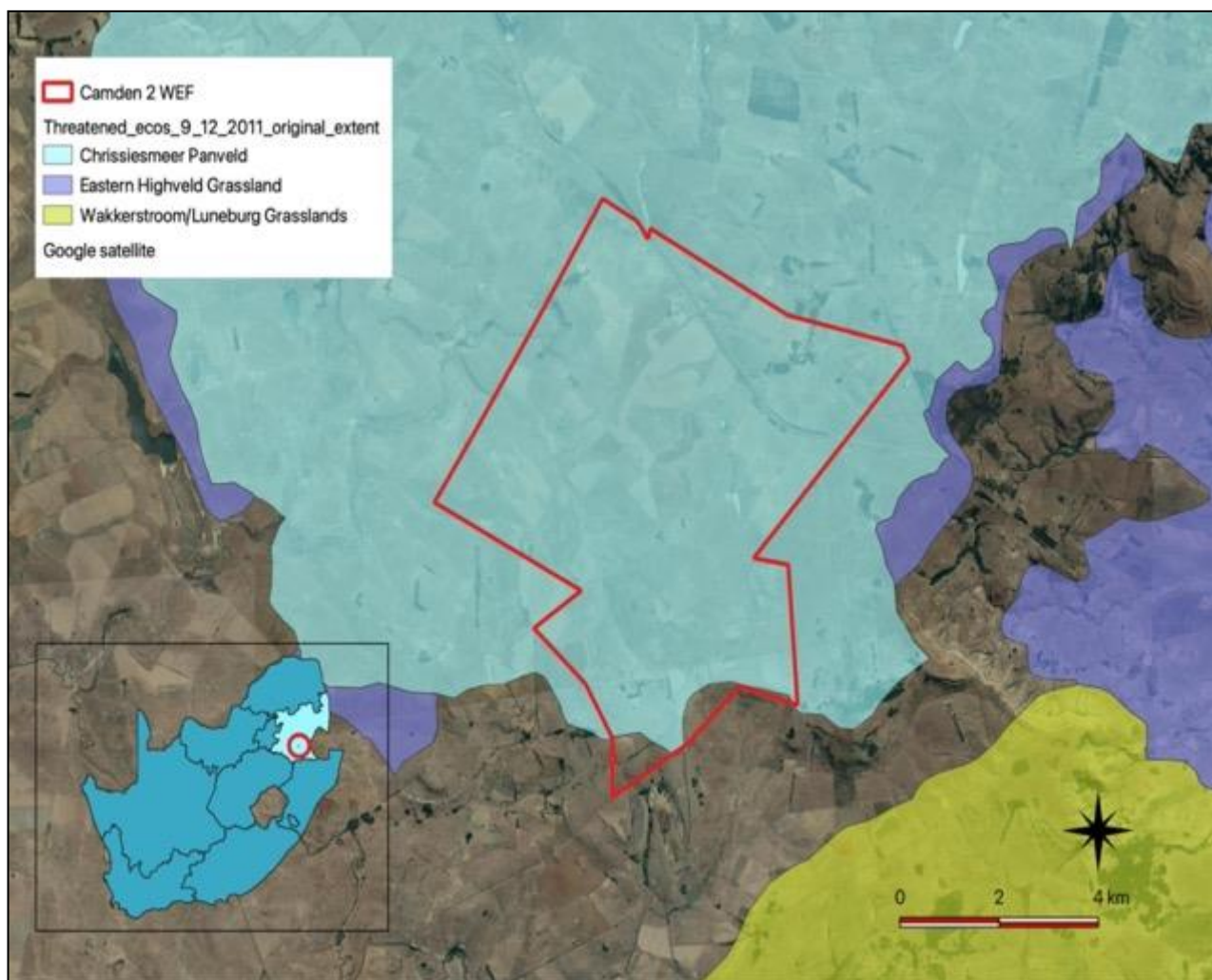


Figure 5: Distribution of listed ecosystems relative to the study area.

## Biodiversity Conservation Plans

The Mpumalanga Biodiversity Sector Plan (MBSP) (Mpumalanga Parks and Tourism Agency 2014) classifies the natural vegetation of the Province according to the following categories:

1. Protected Areas (sub-divided into three categories);
2. Critical Biodiversity Areas (sub-divided into “Irreplaceable” and “Optimal”);
3. Other natural areas;
4. Ecological Support Area (sub-divided into four categories); and
5. Modified (sub-divided into Heavily or Moderately modified).

Figure 6 shows features within the study area within three of these classes, as follows:

1. Protected Areas: (National Parks and Nature Reserves): The area shown as a protected area is not on the site but on the north-western boundary of the site. This is, however, in the process of change (see discussion below).
2. Critical Biodiversity Areas (CBA): Irreplaceable: two small patches.
3. Critical Biodiversity Areas (CBA): Optimal: a small nearby patch.

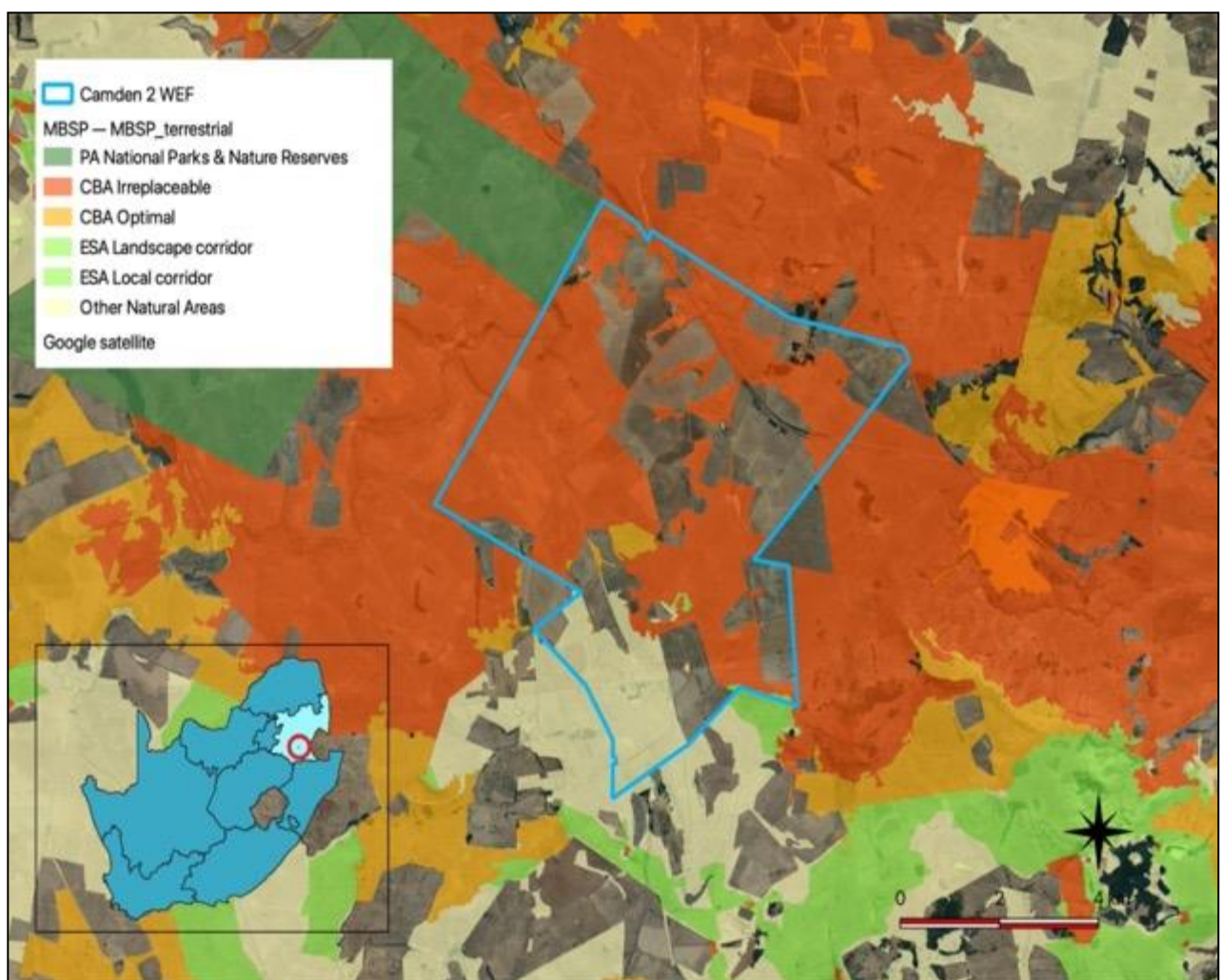


Figure 6: Mpumalanga CBA map for the study area.

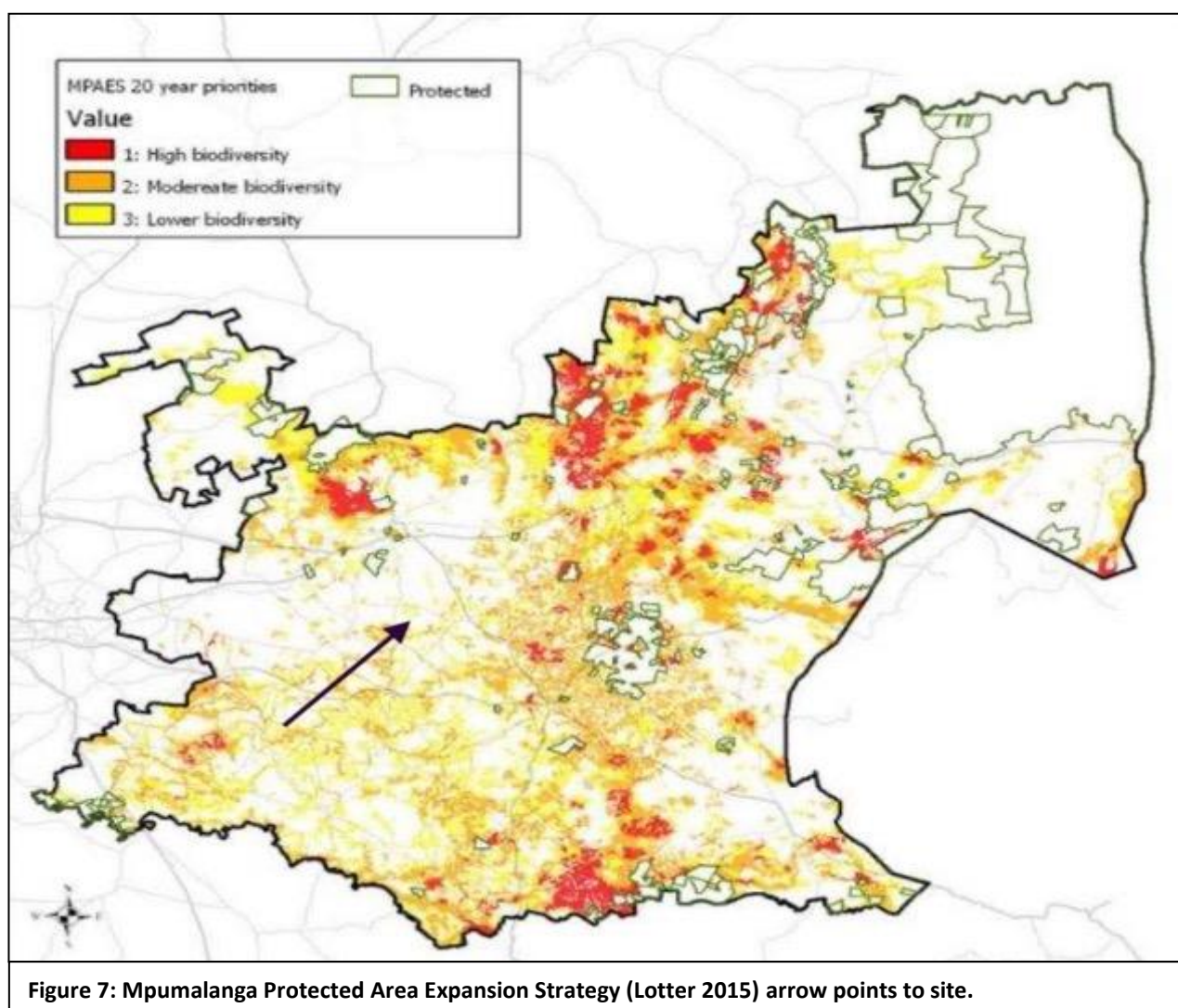


According to the description for the MBSP Terrestrial Assessment categories, Critical Biodiversity Areas are areas that are required to meet biodiversity targets (for biodiversity pattern and ecological process features). The MBSP policy is that they should remain in a natural state. CBAs are areas of high biodiversity value which are usually at risk of being lost and usually identified as important in meeting biodiversity targets, except for Critically Endangered Ecosystems or Critical Linkages.

The part of the border of the site is shown as a Protected Area. This is the Langcarel Private Nature Reserve, proclaimed in 1967, which occupies the north-western border of the site, on the Farm Welgelegen 322 IT (green area in Figure 6). This is not being managed as a nature reserve and a separate process is underway to have it (or part thereof) de-proclaimed as part of ongoing province-wide reserve verification efforts by the provincial authorities. No evidence was observed on site of any conservation activities during the field assessment.

## Proposed protected areas (NPAES Focus Areas)

According to the National Protected Areas Expansion Strategy 2008 (NPAES2008), there are no areas within the study area that have been identified as priority areas for inclusion in future protected areas. The study area is therefore **outside the NPAES focus area**. A draft National Protected Areas Expansion Strategy was published for public comment in 2018, but is deliberately not available as a spatial dataset. It does, however, reference the Mpumalanga Protected Area Expansion Strategy, in which priority areas are identified in terms of High, Medium and Low priorities. A map



within this PDF document shows areas around Camden within the Low priority class that may include the site, but a spatial dataset to confirm this could not be sourced at the time of producing this report. On the basis of the Screening Tool output, which identifies "Protected Areas Expansion Strategy" (Figure 7) as a factor within the study area, it is assumed that natural areas within the study area fall within this category (Low Priority - Mpumalanga Protected Area Expansion Strategy).



## Habitats on site

A map of habitats within the study area is provided in Figure 8. The site is within an area of natural grassland but degraded (from heavily to light). The grassland contains variation due to changes in topography, slope inclination, surface rockiness and the influence of water-flow and water retention in the landscape. A broad classification of the habitat units on site, which also reflects relatively uniform plant species compositional units, is as follows:

Natural habitats:

1. **Natural grassland** (open grassland on undulating plains – the condition is not indicated in the habitat map although there is a gradient from heavily grazed poor condition to moderate condition);
2. **Wetlands** (permanent and seasonal wetlands in drainage valleys, including channels, where they occur);

Transformed and degraded areas:

3. **Old lands** (secondary grasslands on previously cultivated areas);
4. **Exotic trees** (stands of exotic trees);
5. **Degraded areas** (disturbed areas with bare ground, weeds or waste ground).
6. **Current cultivation** (areas currently cultivated and fallow lands);
7. **Transformed** (areas such as roads and buildings where there is no vegetation).

NATURAL VERSUS SECONDARY GRASSLAND	
Natural grassland	Areas of original vegetation in which the soil has not been mechanically disturbed, including areas that are in poor condition due to <b>overgrazing, trampling, invasion</b> by weeds or alien invasive species, <b>inappropriate fire regimes</b> , or any other factor that drives natural change in species composition or vegetation structure. The key factor is that the original plants continue to exist, often resprouting after defoliation from sub-surface stems or other storage organs.
Secondary grassland	Areas of vegetation where the original grassland vegetation has been lost through direct <b>disturbance of the soil</b> that results in physical removal of the original plants, the most common cause of which is ploughing, but could be other mechanical factors. The vegetation that then develops is a result of recolonisation of the area through propagation.

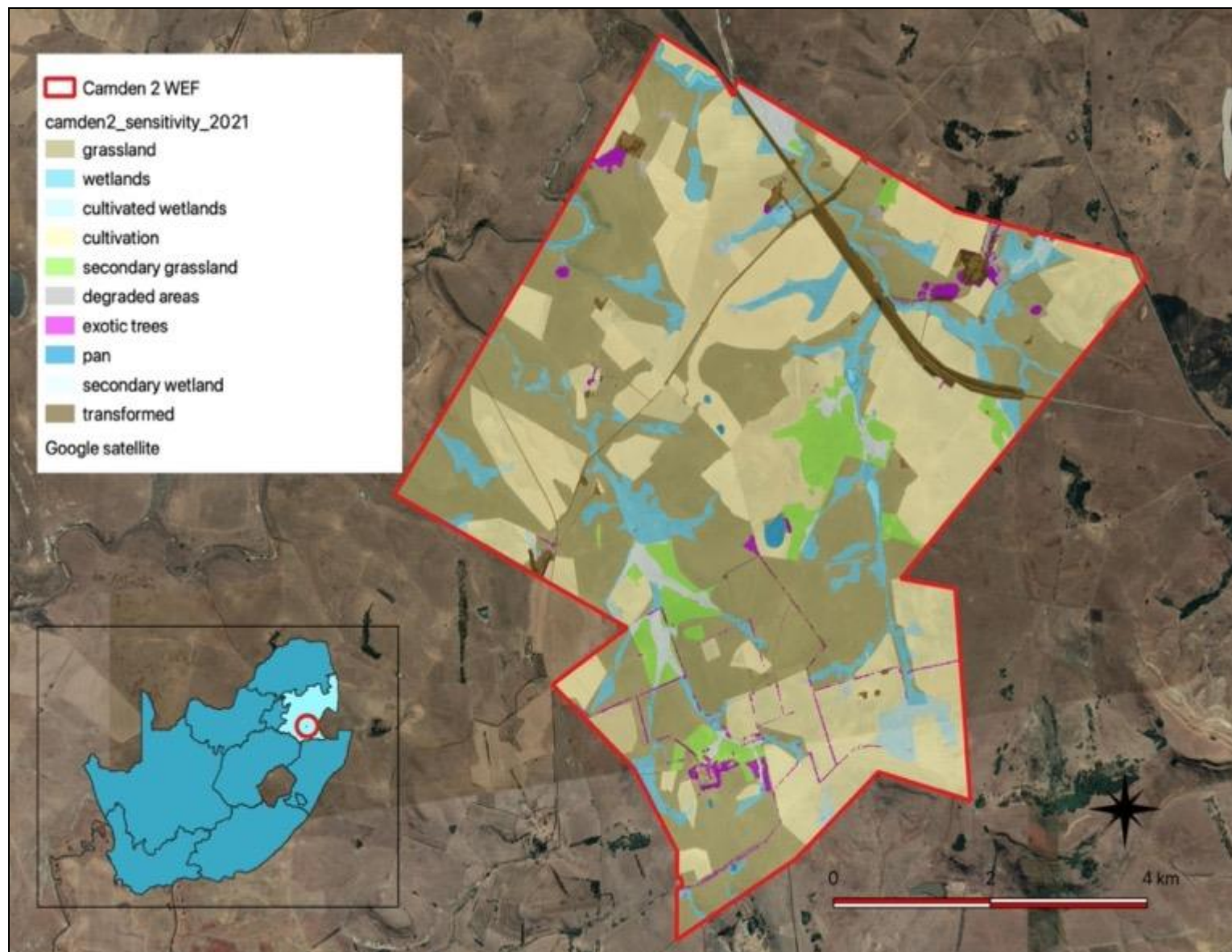


Figure 8: Main habitats of the study area.

### **Grassland**

The general study area is characterised by an open grassland on the undulating hills and plains. It is generally a short to moderate height tussock grassland with closed canopy cover. The soil depth varies, as does the amount of surface rock cover, but tends to have shallow soil.

The general floristic character of this vegetation on site is fairly uniform across wide areas, often dominated by the same suite of species, including the grasses, *Alloteropsis semialata*, *Aristida diffusa*, *Aristida junciformis*, *Bewisia biflora*, *Brachiaria serrata*, *Diheteropogon amplexans*, *Elionurus muticus*, *Eragrostis capensis*, *Eragrostis chloromelas*, *Eragrostis plana*, *Eragrostis racemosa*, *Harpochloa falx*, *Heteropogon contortus*, *Microchloa caffra*, *Panicum natalense*, *Setaria sphacelata* var. *torta*, *Themeda triandra*, and *Tristachya leucothrix*, and the forbs, *Acalypha angustata*, *Anthospermum rigidum* subsp. *rigidum*, *Berkheya setifera*, *Chaetacanthus costatus*, *Commelina africana*, *Crabbea acaulis*, *Cucumis hirsutus*, *Cucumis zeyheri*, *Cyanotis speciosa*, *Gerbera viridifolia*, *Haplocarpha scaposa*, *Helichrysum rugulosum*, *Hemizygia pretoriae*, *Hermannia transvaalensis*, *Hibiscus aethiopicus*, *Hypoxis obtusa*, *Hypoxis rigidula*, *Indigofera comosa*, *Ipomoea ommaneyi*, *Justicia anagalloides*, *Kohautia amatymbica*, *Ledebouria ovatifolia*, *Monsonia attenuata*, *Nidorella hottentotta*, *Pentanisia angustifolia*, *Pollichia campestris*, *Scabiosa columbaria*, *Selago densiflora*, *Seriphium plumosum*, *Vernonia galpinii*, *Vernonia oligocephala*, and *Zornia milneana*. Overall diversity in this unit was high and included a full list of over 100 species. Local species richness was also high at 56 species per 400m<sup>2</sup> sampling area. This rivals the local richness of some of the most species-rich grasslands anywhere in the country.

### **Wetlands**

Wetlands were mapped from Google Earth imagery dated 28/03/2019, a date which shows the wetness signal very well as darker green areas. This also corresponds well to black and white historical aerial photographs from 1955, where wetlands appear as darker areas.

Valley bottom wetlands in this general area around Ermelo, such as this one, are generally dominated by a variety of grasses, sedges and herbaceous plants, including the graminoids, *Kyllinga erecta*, *Leersia hexandra*, *Agrostis lachnantha*, *Andropogon appendiculatus*, *Helictotrichon turgidulum*, *Scirpoides burkei*, *Cyperus teneristolon*, *Cyperus macranthus*, *Typha capensis*, *Agrostis erianthe*, *Hemarthria altissima*, *Panicum schinzii*, *Cyperus rigidifolius* and *Arundinella nepalensis*, the herbs, *Centella asiatica*, *Senecio polyodon*, *Senecio erubescens*, *Haplocarpha scaposa*, *Pelargonium luridum*, *Commelina africana*, *Lobelia flaccida*, *Monopsis decipiens*, and *Helichrysum aureonitens*. The species composition depends entirely on the hydrological characteristics of the site, with a greater number of obligate wetland species occurring in more permanently damp areas, whereas dryer areas more closely resembling terrestrial grassland in species composition.

### **Current cultivation**

These are areas that, according to recent satellite imagery, are currently being cultivated, or were recently cultivated (within the last five years). If not under crops, they would be a ploughed land, or a fallow land with either weeds or a cover crop. From an ecological or biodiversity perspective, these areas have no natural habitat and have no plant or vegetation biodiversity value. The soil profile has been completely disturbed, removing all original vegetation, including geophytic and resprouting plant species. In the Grassland Biome of South Africa, a large proportion of the indigenous biodiversity consists of herbaceous and low shrubby species that re-sprout seasonally, after fire, or after defoliation from grazing animals, and can persist under these conditions. In cultivated areas, it is possible through natural succession, or through active rehabilitation, to restore a perennial cover of grasses, but the original biodiversity is permanently lost. They also have little value for animal biodiversity, except for species that forage in cultivated areas.

### **Old lands**

These are areas that were previously ploughed for cultivation but have been left for an extended period without ploughing. Through natural succession processes, they generally develop a perennial cover of grasses, but these secondary grasslands are species poor and the original diversity of resprouting species is usually entirely absent. Non-grass species diversity usually consists of re-seeding and weedy species, and sometimes animal- and/or bird-dispersed woody species.

On aerial photographs and satellite images with adequate resolution, these areas are often recognisable by the presence of residual plough lines and other structural features often present in cultivated fields.

***Exotic trees***

There are planted windrows on the roadsides in various parts of the site, as well as within homestead complex areas. These are mostly deliberately planted some decades ago and are not alien invasive species. There are, however, various places on site where alien invasive species have become established in previously disturbed areas. In both cases, the underlying natural grassland is lost.

***Degraded areas***

Any areas where the original vegetation is lost due to continuous degradation, such as trampling, severe overgrazing, or some other factor, it is mapped as degraded. These areas are unlikely to restore to natural grassland, even with removal of the drivers of the degradation.

***Transformed areas***

Areas where natural habitat no longer exists due to development of infrastructure, such as roads, buildings, and other hard surfaces. Current cultivation is also transformed, but has not been replaced by built infrastructure, therefore the soil surface can be colonized by plants, if cultivation is stopped.

## Habitat sensitivity

To determine ecological sensitivity in the study area, site-specific, local and regional factors were taken into account. There are some habitats in the study area that have been described as sensitive in their own right, irrespective of regional assessments. This includes primarily the stream beds and associated riparian zones and adjacent floodplains. A detailed assessment and delineation of these areas was undertaken by an aquatic specialist and they are only considered here in terms of being important habitat for flora and fauna.

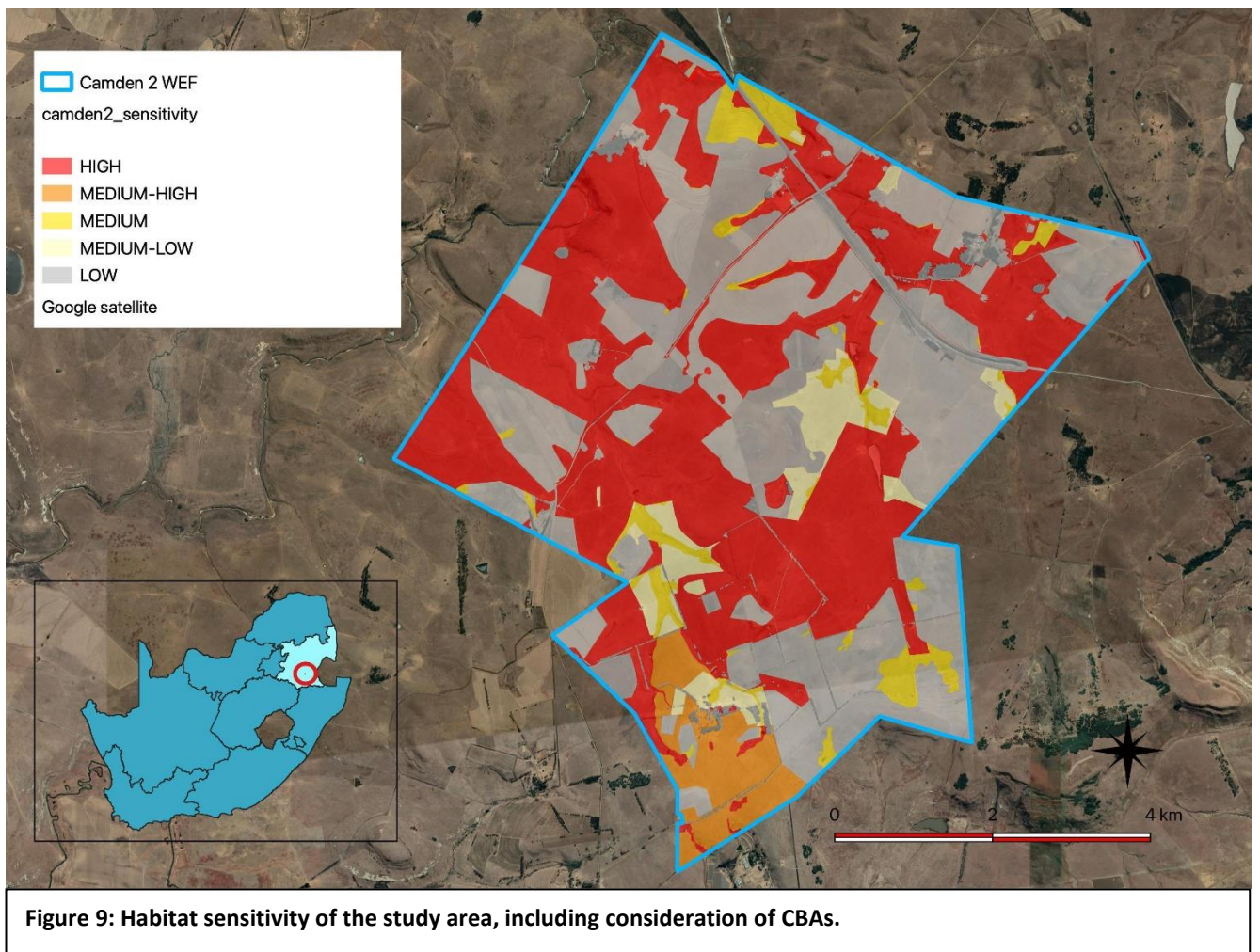
At a regional level, the Critical Biodiversity Area (CBA) map for Mpumalanga indicates various parts of the study area as being important for conservation.

A summary of sensitivities that occur on site and that may be vulnerable to damage from the proposed project are as follows:

1. Wetlands: These are described here only in terms of being a unique botanical habitat and not in the sense of a formal wetland delineation, which is normally assessed in a separate specialist study. The wetlands must be delineated according to "DWAF, 2003: A Practical Guideline Procedure for the Identification and Delineation of Wetlands and Riparian Zones". **Restrictions in terms of infrastructure within these areas should be according to the National Water Act (Act 36 of 1998).**
2. Listed ecosystems: Chrissiesmeer Panveld is listed as Endangered, and Eastern Highveld Grassland and Eastern Temperate Freshwater Wetlands are both listed as Vulnerable in the National List of Ecosystems that are Threatened and need of protection (GN1002 of 2011).
3. Critical Biodiversity Areas: Almost all remaining natural habitat on site is within a Critical Biodiversity Area: Irreplaceable, equivalent to CBA1. There is also a small patch within Critical Biodiversity Area: Optimal, equivalent to CBA2.
4. Grasslands: Grassland vegetation, in a general sense has been identified as threatened nationally as a habitat type. Indications are that loss of any grassland habitat is permanent in an ecological and biodiversity sense, and it is not possible to restore grassland to a natural state after they have been disturbed. They should therefore be treated as sensitive and all efforts made to minimize impacts on any area of grassland. **If possible, the footprint of any proposed infrastructure should be kept to a minimum within any undisturbed, natural grasslands, especially those in a moderate to good condition.**

This information was used in conjunction with methodology to calculate Site Ecological Importance, described below. A map of habitat sensitivity on site is provided in Figure 9.





## SITE ECOLOGICAL IMPORTANCE

The Species Environmental Assessment Guidelines (SANBI 2020) require that a Site Ecological Importance is calculated for each habitat on site, and provides methodology for making this calculation.

1. **Natural grassland** (open grassland on undulating plains, including moderately to heavily grazed areas);
2. **Wetlands** (seasonal wetlands in drainage valleys);
3. **Pans** (seasonally inundated areas on the river floodplain);
4. **Old lands** (secondary grasslands on old lands);
5. **Current cultivation** (areas currently cultivated and fallow lands);
6. **Exotic trees** (stands of exotic trees);
7. **Degraded areas** (disturbed areas with weeds or waste ground);
8. **Transformed areas** (no vegetation, due to complete removal and replacement with hard surface or structure).

As per the Species Environmental Assessment Guidelines (SANBI 2020), Site Ecological Importance (SEI) is calculated as a function of the Biodiversity Importance (BI) of the receptor and its resilience to impacts ( $SEI = BI + RR$ ). The Biodiversity Importance (BI) in turn is a function of Conservation Importance (CI) and Functional Integrity (FI), i.e.  $BI = CI + FI$ .

### Site ecological importance for habitats found on site:

Habitat	Conservation importance	Functional integrity	Receptor resilience	Site Ecological Importance (BI)
Natural grassland	<b>High</b> Small area (> 0.01% but < 0.1% of the total ecosystem type extent) of natural habitat of EN ecosystem type or large area (> 0.1%) of natural habitat of VU ecosystem type.	<b>Medium</b> Large (> 20 ha but < 100 ha) intact area for any conservation status of ecosystem type or > 10 ha for EN ecosystem types. (Chrissiesmeer Panveld is listed as EN) BUT Mostly minor current negative ecological impacts with some major impacts (e.g. established population of alien and invasive flora) and a few signs of minor past disturbance. Moderate rehabilitation potential.	<b>Very low</b> Habitat that is unable to recover from major impacts	<b>High</b> (BI = Medium)
Wetlands	<b>High</b> Any area of natural habitat of threatened ecosystem type with status of VU.	<b>Medium</b> (> 5 ha but < 20 ha) semi-intact area for any conservation status of ecosystem type or > 20 ha for VU ecosystem types	<b>Low</b> Habitat that is unlikely to be able to recover fully after a relatively long period: > 15 years required to restore less than 50% of the original species composition and functionality	<b>High</b> (BI = Medium)
Old lands	<b>Low</b> No confirmed or highly likely populations of SCC or range-restricted species.	<b>Very low</b> Several major current negative ecological impacts.	<b>High</b> Habitat that can recover relatively quickly (5-10 years) to restore >75% to restore the original species composition and functionality	<b>Very low</b> (BI = Very low)

Current cultivation	Very low No confirmed or highly likely populations of SCC or range-restricted species. No natural habitat remaining.	Very low Several major current negative ecological impacts.	Very high Habitat that can recover rapidly	Very low (BI = Very low)
Exotic trees	Very low No confirmed or highly likely populations of SCC or range-restricted species. No natural habitat remaining.	Very low Several major current negative ecological impacts.	Very high Habitat that can recover rapidly	Very low (BI = Very low)
Degraded	Very low No confirmed or highly likely populations of SCC or range-restricted species. No natural habitat remaining.	Very low Several major current negative ecological impacts.	Very high Habitat that can recover rapidly	Very low (BI = Very low)
Transformed	Very low No confirmed or highly likely populations of SCC or range-restricted species. No natural habitat remaining.	Very low Several major current negative ecological impacts.	Very high Habitat that can recover rapidly	Very low (BI = Very low)

The calculation of Site Ecological Importance matches the sensitivity classification given in the previous section of this report, but includes an explicit recognition of the ability of each ecosystem to tolerate and recover from disturbance. Guidelines for development activities within different importance levels are given in the Table below.

**Guidelines for interpreting SEI in the context of the proposed development activities:**

Site ecological importance	Interpretation in relation to proposed development activities
Very high	Avoidance mitigation – no destructive development activities should be considered. Offset mitigation not acceptable/ not possible (i.e. last remaining populations of species, last remaining good condition patches of ecosystems/ unique species assemblages). Destructive impacts for species/ecosystems where persistence target remains.
High	Avoidance mitigation wherever possible. Minimisation mitigation – changes to project infrastructure design to limit the amount of habitat impacted; limited development activities of low impact acceptable. Offset mitigation may be required for high impact activities.
Medium	Minimisation and restoration mitigation – development activities of medium impact acceptable followed by appropriate restoration activities.
Low	Minimisation and restoration mitigation – development activities of medium to high impact acceptable followed by appropriate restoration activities
Very low	Minimisation mitigation – development activities of medium to high impact acceptable and restoration activities may not be required.



# POSSIBLE IMPACTS

## Proposed infrastructure in relation to sensitivities

Infrastructure locations relative to mapped sensitivities are shown in Figure 10. The proposed infrastructure includes the following:

### **WTGs x 45**

These are located within grasslands and in cultivated areas. They therefore affect areas either with LOW sensitivity, or MEDIUM-HIGH sensitivity (cultivated wetlands), or HIGH sensitivity (grassland), as follows (summary table provided below):

1. HIGH sensitivity - grassland, CBA1
2. LOW sensitivity – cultivated land
3. LOW + HIGH sensitivity – mostly cultivated land, small piece of grassland
4. LOW + HIGH sensitivity – mostly cultivated land, small piece of grassland
5. LOW sensitivity – cultivated land
6. LOW sensitivity – cultivated land
7. LOW sensitivity – cultivated land
8. HIGH sensitivity - grassland, CBA1
9. LOW + HIGH sensitivity – mostly cultivated land, small piece of grassland
10. LOW sensitivity – cultivated land
11. HIGH sensitivity - grassland, CBA1
12. LOW sensitivity – cultivated land
13. LOW sensitivity – cultivated land
14. LOW sensitivity – cultivated land
15. LOW sensitivity – cultivated land
16. LOW sensitivity – cultivated land
17. LOW sensitivity – cultivated land
18. HIGH sensitivity - grassland, CBA1
19. LOW sensitivity – cultivated land
20. MEDIUM-LOW sensitivity –old land
21. HIGH sensitivity - grassland, CBA1
22. LOW sensitivity – cultivated land
23. LOW sensitivity – cultivated land
24. LOW + HIGH sensitivity – mostly cultivated land, small piece of grassland
25. HIGH sensitivity - grassland, CBA1
26. HIGH sensitivity - grassland, CBA1
27. HIGH sensitivity - grassland, CBA1
28. LOW sensitivity – cultivated land
29. LOW sensitivity – cultivated land
30. LOW sensitivity – cultivated land
31. LOW sensitivity – cultivated land
32. HIGH sensitivity - grassland, CBA1
33. HIGH sensitivity - grassland, CBA1
34. LOW sensitivity – cultivated land
35. LOW sensitivity – cultivated land
36. LOW sensitivity – cultivated land
37. LOW sensitivity – cultivated land
38. HIGH sensitivity - grassland, CBA1
39. MEDIUM-LOW sensitivity –old land
40. HIGH sensitivity - grassland, CBA1
41. HIGH sensitivity - grassland, CBA1
42. HIGH sensitivity - grassland, CBA1
43. HIGH sensitivity - grassland, CBA1

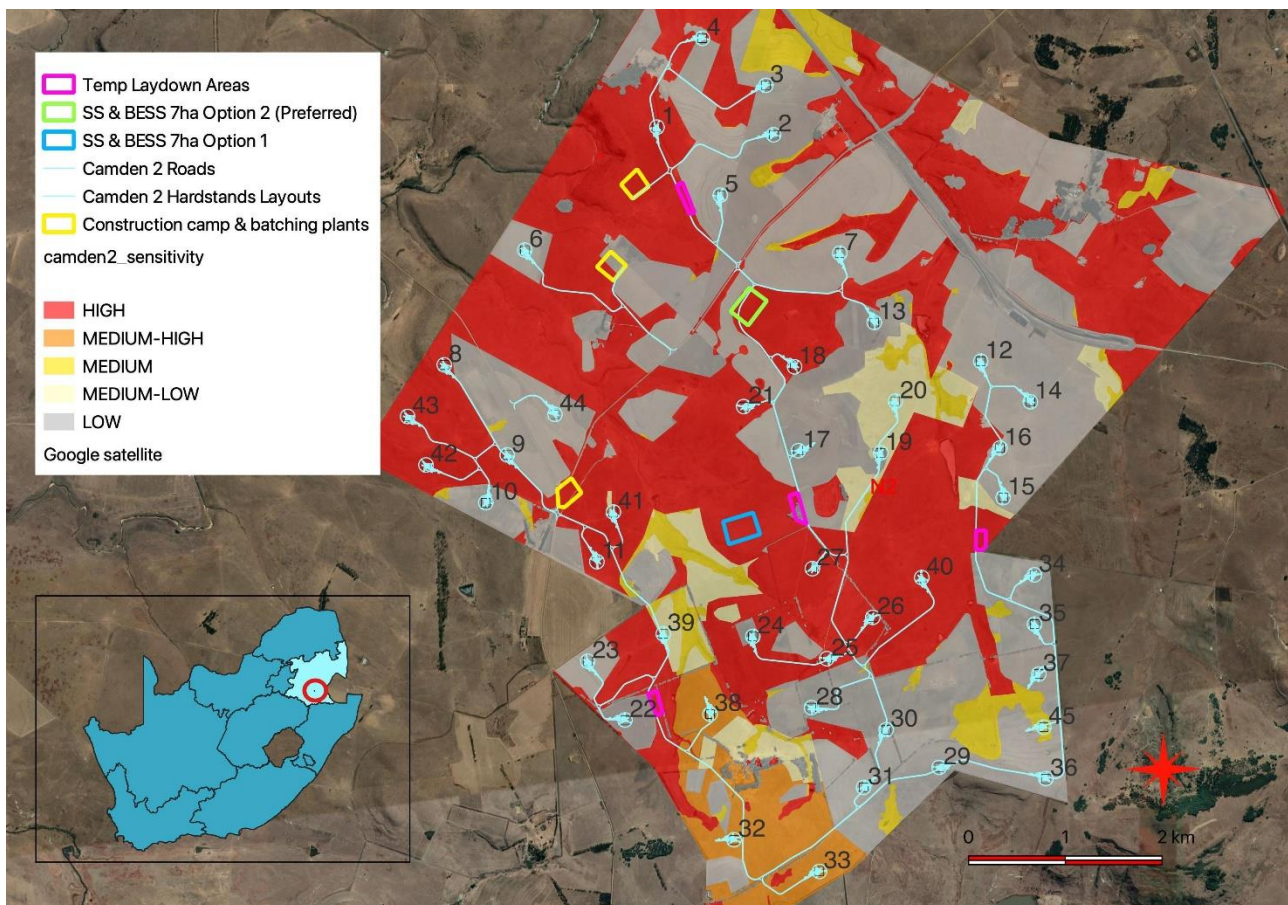
44. LOW sensitivity - cultivated land  
45. MEDIUM sensitivity - cultivated wetland

**Number of WTGs in each sensitivity class**

Sensitivity Class	Number of WTGs
LOW sensitivity	23
MEDIUM-LOW	2
MEDIUM	1
LOW + HIGH sensitivity	4
HIGH sensitivity – grassland, CBA	15

**Amount of each habitat affected by WTGs**

Habitat	Status	Total area of habitat (ha)	Footprint affected (ha)
Grassland	Natural	1926.33	20.43
Wetlands	Natural	463.51	
Pans	Natural	10.40	
Exotic trees	Degraded	67.01	0.18
Degraded areas	Degraded	24.37	0.19
Old lands	Secondary	313.94	2.43
Current cultivation	Transformed	2006.03	32.39
Transformed	Transformed	139.79	0.06
<b>TOTAL</b>		<b>4951.38 ha</b>	<b>55.68 ha</b>



**Figure 10: Proposed infrastructure in relation to habitat sensitivity on site.**

**Construction camp and batching plants**

There are two construction camp and batching plant locations, both in grassland, one in CBA2 and one in grassland. It therefore affects an area with HIGH and MEDIUM-HIGH sensitivity.

**Amount of each habitat affected by construction camps / batching plants.**

Habitat	Status	Total area of habitat (ha)	Footprint affected (ha)
Grassland	Natural	1926.33	11.03
Wetlands	Natural	463.51	
Pans	Natural	10.40	
Exotic trees	Degraded	67.01	
Degraded areas	Degraded	24.37	
Old lands	Secondary	313.94	
Current cultivation	Transformed	2006.03	2.50
Transformed	Transformed	139.79	
<b>TOTAL</b>		<b>4951.38 ha</b>	<b>13.53 ha</b>

**SS & BESS (2 alternative sites)**

Alternative 1 is half in grassland (HIGH sensitivity) and half in cultivated land (LOW sensitivity). Alternative 2 (preferred) is in grassland (HIGH sensitivity) next to a wetland (VERY HIGH sensitivity).

**Amount of habitat affected by SS & BESS Option 1.**

Habitat	Status	Total area of habitat (ha)	Footprint affected (ha)
Grassland	Natural	1926.33	7.92
Wetlands	Natural	463.51	
Pans	Natural	10.40	
Exotic trees	Degraded	67.01	
Degraded areas	Degraded	24.37	
Old lands	Secondary	313.94	
Current cultivation	Transformed	2006.03	
Transformed	Transformed	139.79	
<b>TOTAL</b>		<b>4951.38 ha</b>	<b>7.92 ha</b>

**Amount of habitat affected by SS & BESS Option 2.**

Habitat	Status	Total area of habitat (ha)	Footprint affected (ha)
Grassland	Natural	1926.33	7.18
Wetlands	Natural	463.51	
Pans	Natural	10.40	
Exotic trees	Degraded	67.01	
Degraded areas	Degraded	24.37	
Old lands	Secondary	313.94	
Current cultivation	Transformed	2006.03	0.06
Transformed	Transformed	139.79	
<b>TOTAL</b>		<b>4951.38 ha</b>	<b>7.24</b>

### **Temporary laydown areas x 2**

The northern temporary laydown area is within a secondary grassland area (MEDIUM-LOW sensitivity). The southern temporary laydown area is within a cultivated area and therefore affects an area with LOW sensitivity.

#### **Amount of habitat affected by temporary laydown areas.**

Habitat	Status	Total area of habitat (ha)	Footprint affected (ha)
Grassland	Natural	1926.33	3.23
Wetlands	Natural	463.51	
Pans	Natural	10.40	
Exotic trees	Degraded	67.01	1.75
Degraded areas	Degraded	24.37	3.84
Old lands	Secondary	313.94	
Current cultivation	Transformed	2006.03	
Transformed	Transformed	139.79	
<b>TOTAL</b>		<b>4951.38 ha</b>	<b>8.82 ha</b>

### **Internal road infrastructure**

This is potentially the infrastructure component with the largest footprint, in terms of effects on natural habitat. These roads occasionally traverse habitat in HIGH and VERY HIGH sensitivity classes, but the majority of the roads are placed where there are existing roads, or are within areas of lower sensitivity.

#### **Amount of habitat affected by road infrastructure (including a 3m buffer to account for possible edge effects).**

Habitat	Status	Total habitat (ha)	Footprint affected (ha)
Grassland	Natural	1926.33	25.04
Wetlands	Natural	463.51	0.40
Pans	Natural	10.40	
Exotic trees	Degraded	67.01	0.79
Degraded areas	Degraded	24.37	0.30
Old lands	Secondary	313.94	2.42
Current cultivation	Transformed	2006.03	23.25
Transformed	Transformed	139.79	0.66
<b>TOTAL</b>		<b>4951.38 ha</b>	<b>52.86 ha</b>

## **Anticipated impacts**

The main impacts associated with construction of the proposed infrastructure are anticipated to be as follows:

1. Direct loss of habitat within the footprint of the proposed infrastructure, and associated impacts on CBAs.
2. Impacts on specific habitats of biodiversity value.
3. Invasion by alien invasive plant species, leading to degradation of habitat. This could occur anywhere on site where disturbance is introduced and alien plants are not specifically controlled. The reason is that they already occur in the area and would opportunistically colonise any area of soil where they are not vigorously controlled.

The main mitigation measures, other than required Management Plans for plant rescue, rehabilitation, and alien plant management, are related to infrastructure location, which is a planning phase measure.

## **Construction Phase impacts**

### **Direct impacts**

Direct impacts include the following:

1. Loss and/or fragmentation of indigenous natural vegetation due to clearing;

#### ***Indirect impacts***

Indirect impacts during the construction phase include the following:

1. Establishment and spread of alien invasive plants due to the clearing and disturbance of indigenous vegetation;
2. Increased runoff and erosion due to clearing of vegetation, construction of hard surfaces and compaction of surfaces, leading to soil erosion, followed by vegetation loss, in downslope areas.

## Operational Phase Impacts

#### ***Direct impacts***

Ongoing direct impacts will include the following:

1. Sporadic disturbance to natural habitats due to unforeseen events during general operational activities and maintenance (e.g. fires, driving off-road); and

#### ***Indirect impacts***

These will include the following:

1. Continued establishment and spread of alien invasive plant species due to the presence of disturbance;
2. Continued erosion due to the presence of hard surfaces that change the infiltration and runoff properties of the landscape.

## Decommissioning Phase Impacts

#### ***Direct impacts***

These will include the following:

1. Loss and disturbance of natural vegetation due to the removal of infrastructure and need for working sites;

#### ***Indirect impacts***

These will occur due to renewed disturbance due to decommissioning activities, as follows:

1. Continued establishment and spread of alien invasive plant species due to the presence of disturbance.

## Cumulative impacts

These include the following:

1. Cumulative impacts on indigenous natural vegetation due to clearing;
2. Cumulative impacts on ecological processes;
3. Cumulative impacts due to establishment and spread of alien invasive plant species;

# ASSESSMENT OF SIGNIFICANCE OF ECOLOGICAL IMPACTS

Detailed discussion of each impact, including justification for assigned scores, is provided below.

## Design Phase Impacts

No negative impacts occur during the Design Phase of the project, since no physical construction activities take place. Nevertheless, measures taken during the Design Phase of the project can potentially have a significant positive effect on the nature, extent and intensity of impacts experienced during the Construction Phase. This is usually as a response to identified issues, leading to design modifications to avoid negative impacts where possible.

## Construction Phase Impacts

### ***Loss of indigenous natural vegetation due to clearing***

The regional vegetation type in the broad study area is Eastern Highveld Grassland, classified in the scientific literature as Endangered (Mucina *et al.*, 2008) and listed as Vulnerable in the National List of Ecosystems that are Threatened and need of protection (GN1002 of 2011). Any areas of natural habitat (specifically natural grassland, as described above) within this regional vegetation type are therefore considered to have high conservation value.

Vegetation on site is within the Grassland Biome. Mesic grasslands in South Africa have a life-form composition that includes a high number of resprouting sub-terrestrial species that constitute more than 50% of the species richness at any single location and a higher proportion, if counted across a wider area. Secondary grassland that develops in previously cleared areas (for example, cultivated lands) usually develop a perennial grass cover, but the resprouting component of the flora almost never recovers. This means that any clearing of grassland vegetation, even if temporary, results in permanent loss of the local species composition. Clearing of natural grassland is therefore a permanent impact.

Habitat loss refers to physical disturbance of habitats through clearing, grading and other permanent to semi-permanent loss or degradation. Loss of habitat on site could lead to loss of biodiversity as well as habitat important for the survival of populations of various species.

For powerlines, clearing of vegetation will only occur within the footprint of each pylon structure. This is a small localized impact. If carefully managed, it will recover.

Impact 1		Loss of indigenous natural vegetation	
Issue	Clearing of natural habitat for construction		
Description of Impact			
Construction activities will require clearing of natural habitat, to be replaced by the infrastructure. This will result in permanent local loss of habitat.			
Type of Impact	Direct		
Nature of Impact	Negative		
Phases	Construction		
Criteria	Without Mitigation		With Mitigation
Extent	1		1
Duration	5		5
Reversibility	3		3
Magnitude (severity of impact)	2		1
Probability	5		5

Significance	55 (MODERATE)	50 (MODERATE)
Mitigation actions		
The following measures are recommended:	1. Restrict impact to development footprint only and limit disturbance in surrounding areas. 2. Prior to commencement of construction, compile a Rehabilitation Plan including monitoring specifications, to be included into the EMPr during final approval. 3. Prior to commencement of construction, compile an Alien Plant Management Plan, to be included into the EMPr during final approval.	
Monitoring		
The following monitoring is recommended:	As per management plans.	

#### **Impact on integrity of Critical Biodiversity Areas**

CBAs on site constitute most of the remaining natural habitat (Figure 11). Less than half of the proposed infrastructure is within CBAs (CBA1). There are 15 (of the 45 WTGs) that are within CBA1 areas. The total footprint area (15 WTGs and associated roads) of this infrastructure component (including an approximate 3m buffer around all proposed infrastructure) is moderately small (estimated at 68.05 hectares within CBA1 areas). This is a fraction of the total area of CBA1 and CBA2 areas on site, which are estimated to cover over 2000 ha (around 3.4%).

Impact 2		Impact on integrity of Critical Biodiversity Areas	
Issue	Impact on integrity of Critical Biodiversity Areas		
Description of Impact			
Impact on integrity of Critical Biodiversity Areas			
Type of Impact	Direct		
Nature of Impact	Negative		
Phases	Construction		
Criteria	Without Mitigation		With Mitigation
Extent	1		1
Duration	5		5
Reversibility	3		3
Magnitude (severity of impact)	1		1
Probability	5		5
Significance	50 (MODERATE)		50 (MODERATE)
Mitigation actions			
The following measures are recommended:	As per previous impact: “Loss of indigenous natural vegetation”.		
Monitoring			
The following monitoring is recommended:	None required		



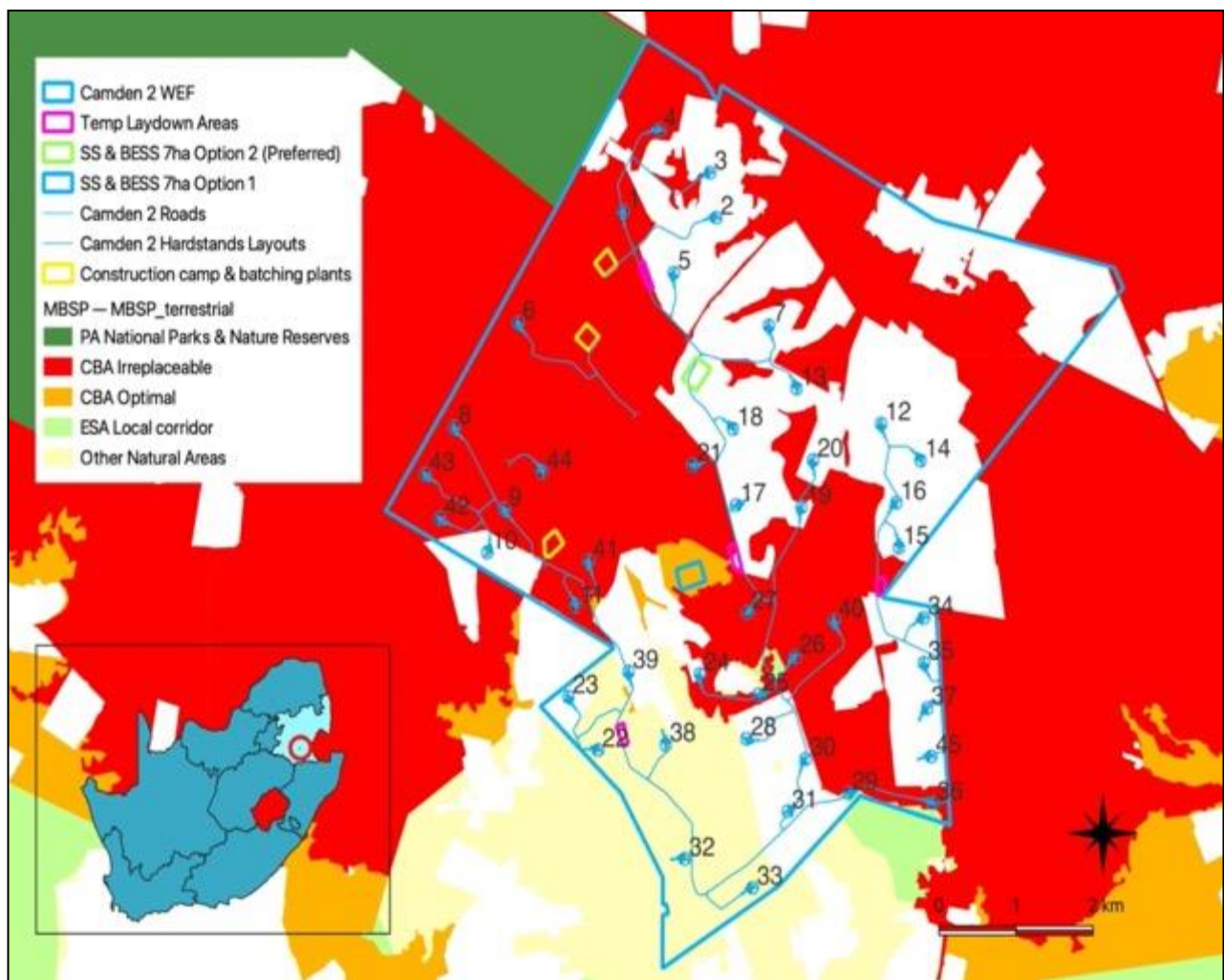


Figure 11: Proposed infrastructure in relation to CBAs on site.



***Establishment and spread of declared weeds and alien invader plants due to the clearing and disturbance of indigenous vegetation***

Major factors contributing to invasion by alien invader plants includes *inter alia* high disturbance (such as clearing for construction activities) and negative grazing practices. Exotic species are often more prominent near infrastructural disturbances than further away. 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.

Low existing populations of alien plants were seen on site, but areas of farm infrastructure were not investigated in detail during the field survey. There is a high possibility that alien plants could be introduced to areas within the footprint of the proposed activities from surrounding areas in the absence of control measures. The potential consequences may be of moderate seriousness for affected natural habitats. Control measures could prevent the impact from occurring. These control measures are relatively standard and well-known. Known alien invasive species recorded in the general geographical area that includes the site are as follows (in order of frequency observed):

- *Campuloclinium macrocephalum*
- *Acacia mearnsii*
- *Verbena bonariensis*
- *Solanum mauritianum*
- *Datura stramonium*
- *Cirsium vulgare*
- *Rumex acetosella*
- *Acacia dealbata*
- *Solanum sisymbriifolium*
- *Cortaderia selloana*
- *Arundo donax*
- *Sesbania punicea*
- *Ipomoea purpurea*
- *Melia azedarach*
- *Nicotiana glauca*
- *Eucalyptus camaldulensis*
- *Solanum elaeagnifolium*
- *Phytolacca octandra*
- *Robinia pseudoacacia*
- *Ailanthus altissima*
- *Xanthium spinosum*
- *Myriophyllum aquaticum*
- *Araujia sericifera*
- *Nasturtium officinale*
- *Verbena rigida*
- *Acacia melanoxylon*
- *Xanthium strumarium*
- *Azolla filiculoides*
- *Pinus taeda*
- *Alisma plantago-aquatica*
- *Rubus niveus*
- *Agave americana*

- *Acacia podalyriifolia*
- *Carduus nutans*
- *Ligustrum lucidum*
- *Ageratum houstonianum*
- *Spathodea campanulata*
- *Verbena brasiliensis*
- *Salvia tiliifolia*
- *Solanum pseudocapsicum*
- *Argemone ochroleuca*
- *Pinus patula*
- *Paspalum quadrifarium*
- *Austrocylindropuntia subulata*
- *Rumex usambarensis*

Impact 3		Establishment and spread of declared weeds and alien invader plants	
Issue	Establishment and spread of declared weeds and alien invader plants		
Description of Impact			
Establishment and spread of declared weeds and alien invader plants			
Type of Impact	Indirect		
Nature of Impact	Negative		
Phases	Construction		
Criteria	Without Mitigation	With Mitigation	
Extent	2	1	
Duration	1	1	
Reversibility	3	3	
Magnitude (severity of impact)	2	1	
Probability	3	2	
Significance	24 (LOW)	12 (VERY LOW)	
Mitigation actions			
The following measures are recommended:	1. Prior to commencement of construction, compile and implement an alien management plan, which highlights control priorities and areas and provides a programme for long-term control, including monitoring specifications. 2. Undertake regular monitoring to detect alien invasions early so that they can be controlled. 3. Implement control measures.		
Monitoring			
The following monitoring is recommended:	As per management plans		

## Operational Phase impacts

### ***Continued disturbance to natural habitats due to general operational activities and maintenance***

During the operational phase of the project, there will be continuous activity on site, including normal operational activities, maintenance and monitoring. There may also be minor additional construction. Rehabilitation of various sites, such as the construction camps, will also take place. These activities all have the potential to cause additional direct and/or indirect damage to natural habitat and vegetation.

Impact 4			Continued disturbance to natural habitats due to general operational activities and maintenance	
Issue		Sporadic unforeseen disturbance to natural habitats e.g. accidental fires, driving off-road, dumping etc. during general operational activities and maintenance.		
Description of Impact				
Continued disturbance to natural habitats due to general operational activities and maintenance				
Type of Impact		Direct		
Nature of Impact		Negative		
Phases		Operation		
Criteria		Without Mitigation		With Mitigation
Extent		2		1
Duration		5		5
Reversibility		3		3
Magnitude (severity of impact)		2		1
Probability		3		2
Significance		36 (MODERATE)		20 (LOW)
Mitigation actions				
The following measures are recommended:		As per impact 1		
Monitoring				
The following monitoring is recommended:		As per management plans		

***Continued establishment and spread of alien invasive plant species due to the presence of migration corridors and disturbance vectors***

The presence of disturbed surfaces on site creates ecological edges and corridors along which alien species can travel and become established.

Impact 5			Establishment and spread of declared weeds and alien invader plants		
Issue		Establishment and spread of declared weeds and alien invader plants			
Description of Impact					
Establishment and spread of declared weeds and alien invader plants					
Type of Impact		Indirect			
Nature of Impact		Negative			
Phases		Operation			
Criteria		Without Mitigation		With Mitigation	
Extent		2		1	
Duration		4		2	
Reversibility		3		3	
Magnitude (severity of impact)		3		1	
Probability		3		2	
Significance		36 (MODERATE)		14 (VERY LOW)	
Mitigation actions					
The following measures are recommended:		1. Prior to commencement of construction, compile and implement an alien management plan, which highlights control priorities and areas and provides a programme for long-term control.			

	2. Undertake regular monitoring to detect alien invasions early so that they can be controlled. 3. Implement control measures.
<b>Monitoring</b>	
<b>The following monitoring is recommended:</b>	As per management plans

***Runoff and erosion due to the presence of hard surfaces that change the infiltration and runoff properties of the landscape (Substation only)***

Increased erosion (water and wind) and water run-off will be caused by the clearing of indigenous vegetation, creation of new hard surfaces and compaction of soil. The substation will be the main source of disturbance and erosion if not properly constructed and provided with water run-off structures. The substation site will be levelled and compacted causing run-off that may lead to erosion. Increased run-off and erosion could affect hydrological processes in the area and will change water and silt discharge into drainage lines and streams.

Impact 6		Continued runoff and erosion	
Issue	Continued runoff and erosion		
Description of Impact			
Increased runoff and erosion due to clearing of vegetation, construction of hard surfaces and compaction of surfaces, leading to changes in downslope areas			
Type of Impact	Indirect		
Nature of Impact	Negative		
Phases	Operation		
Criteria	Without Mitigation	With Mitigation	
Extent	1	1	
Duration	5	5	
Reversibility	3	3	
Magnitude (severity of impact)	3	2	
Probability	3	2	
Significance	36 (MODERATE)	22 (LOW)	
Mitigation actions			
The following measures are recommended:	1. Prior to commencement of construction, compile and implement a stormwater management plan including monitoring specifications. 2. Monitor surfaces for erosion, repair and/or upgrade, where necessary.		
Monitoring			
The following monitoring is recommended:	As per management plans		

## Decommissioning Phase impacts

It is expected that the project will operate for a minimum of twenty to twenty-five years (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 at disturbed locations on site for a very long time thereafter. 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 difficult to undertake any assessment to determine possible impacts of decommissioning. It is recommended that a closure and rehabilitation plan be compiled near to the

decommissioning stage but in advance of when decommissioning is planned, and that this would be required to be implemented prior to closure of the project. The closure and rehabilitation plan must be in compliance with the regulatory requirements at the time of decommissioning. Possible impacts are described below.

***Loss and disturbance of natural vegetation due to the removal of infrastructure and need for working sites***

During the decommissioning phase of the project, there will be a flurry of activity on site over a period of time, similar to during the construction phase, including dismantling and removal of equipment and rehabilitation. There may also be minor additional construction. Rehabilitation of various sites will also take place. These activities all have the potential to cause additional direct and/or indirect damage to natural habitat and vegetation.

Impact 7		Loss and/or disturbance of indigenous natural vegetation during removal of infrastructure	
Issue		Disturbance of natural habitat during infrastructure removal	
Description of Impact			
Decommissioning activities may cause disturbance of natural habitat. This may result in permanent local loss of habitat.			
Type of Impact		Direct	
Nature of Impact		Negative	
Phases		Decommissioning	
Criteria		Without Mitigation	With Mitigation
Extent		1	1
Duration		5	5
Reversibility		3	3
Magnitude (severity of impact)		1	1
Probability		2	2
Significance		20 (LOW)	20 (LOW)
Mitigation actions			
The following measures are recommended:		1. Prior to decommissioning commencing, compile a Rehabilitation Plan in compliance with the regulatory requirements at the time of decommissioning.	
Monitoring			
The following monitoring is recommended:		As per management plans.	

***Continued establishment and spread of alien invasive plant species due to the presence of migration corridors and disturbance vectors***

The presence of disturbed surfaces on site creates ecological edges and corridors along which alien species can travel and become established.

Impact 8		Establishment and spread of declared weeds and alien invader plants	
Issue		Establishment and spread of declared weeds and alien invader plants	
Description of Impact			
Establishment and spread of declared weeds and alien invader plants			
Type of Impact		Indirect	
Nature of Impact		Negative	
Phases		Operation	
Criteria		Without Mitigation	With Mitigation
Extent		2	1

Duration	4	4
Reversibility	3	3
Magnitude (severity of impact)	2	1
Probability	4	3
Significance	44 (MODERATE)	27 (LOW)
Mitigation actions		
The following measures are recommended:	1. Rehabilitate disturbed areas in accordance with the specifications of a Rehabilitation Plan.	
Monitoring		
The following monitoring is recommended:	As per management plans	

## Cumulative impacts

Significance values for these impacts are included in the assessment of impacts in the sections above for Construction, Operation and Decommissioning, under the section for "Cumulative impacts".

### **Cumulative impacts on indigenous natural vegetation**

The regional terrestrial vegetation type in the broad study area is listed as Vulnerable and is impacted across its range by historical activities. Loss of habitat will definitely occur for the project, which will be a small area in comparison to the total area of the vegetation type. However, the total loss of habitat due to a number of projects together will be greater than for any single project, so a cumulative effect will occur. The area lost in total will be very small compared to the total area of the vegetation type concerned. The cumulative effect will therefore be low for vegetation loss.

Extent	The impact will affect natural vegetation on site and is rated as <b>site</b> . For a combination of projects, it affects a wider area and is rated as <b>regional</b> .
Probability	Loss and/or disturbance of vegetation is <b>definite</b> .
Reversibility	In all projects, loss of vegetation is effectively <b>irreversible</b> within the immediate footprint of permanent infrastructure, since construction of roads and other hard surfaces completely removes vegetation and modifies the substrate upon which it grows. For all the projects, in other areas (crane pads, construction camp and disturbed areas adjacent to construction activities) the impact is partially reversible in the sense that secondary vegetation in disturbed areas will probably never resemble the original vegetation found on site.
Duration	Within the immediate footprint of the permanent infrastructure (turbine foundations, roads and substation) the impact will be <b>Permanent</b> (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). In other areas (crane pads, construction camp and disturbed areas adjacent to construction activities) the impact will be of long-term duration. The assessment here is for the permanently affected areas.

Impact 9		Cumulative impacts on indigenous natural vegetation	
Issue		Clearing of natural habitat for construction	
Description of Impact			
Construction activities will require clearing of natural habitat, to be replaced by the infrastructure. This will result in permanent local loss of habitat, multiplied across multiple projects.			
Type of Impact		Direct	
Nature of Impact		Negative	
Phases		Construction	
Criteria		Current project	Combination of projects
Extent		1	3
Duration		5	5
Reversibility		3	3
Magnitude (severity of impact)		1	2
Probability		5	5
Significance		50 (MODERATE)	65 (HIGH)

### **Cumulative impacts on ecological processes**

There are various ecological processes that may be affected at a landscape level by the presence of multiple projects. This includes population processes, such as migration (movement of species through the landscape), pollination (can

be disrupted if insect pollinators are blocked from movement) and dispersal, but also more difficult to interpret factors, such as spatial heterogeneity (the diversity of habitats and their spatial relationship to one another), community composition (the species that occur in the landscape) and environmental gradients, that can become disrupted when landscapes are disturbed at a high level. Disturbance can alter the pattern of variation in the structure or function of ecosystems. Fragmentation is the breaking up of a habitat, ecosystem, or land-use type into smaller parcels. An important consequence of repeated, random clearing is that contiguous cover can break down into isolated patches. This happens when the area cleared exceeds a critical level and landscapes start to become disconnected. Spatially heterogeneous patterns can be interpreted as individualistic responses to environmental gradients and lead to natural patterns in the landscape. Disrupting gradients and creating disturbance edges across wide areas is very disruptive of natural processes and will lead to fundamental changes in ecosystem function.

The current project has been designed to mostly occupy areas that are already disturbed. Where infrastructure is located in natural areas, it is near to edges or follows existing roads. There are few places where it intrudes significantly into natural areas.

Extent	The extent of the combined projects taken together make this a regional effect.
Probability	Based on the number and the nature of the projects (mostly wind-energy projects), the impact may possibly happen.
Reversibility	Partly reversible, where disruptions to specific processes can be identified and rectified.
Irreplaceable loss of resources	Significant loss of resources could potentially occur, but it is more likely that marginal loss of resources will happen.
Duration	The impact will be long-term to permanent, depending on the process and the specific impact.
Intensity/magnitude	Based on the nature and number of projects and the ecological process affected, the impact is most likely to be of medium intensity.

Impact 10		Cumulative impacts on ecological processes	
Issue	Disruption of ecological processes at landscape level		
Description of Impact			
Construction activities will require clearing of natural habitat, to be replaced by the infrastructure. This will result in possible regional disruption of ecological processes.			
Type of Impact	Direct		
Nature of Impact	Negative		
Phases	Construction		
Criteria	Current project	Combination of projects	
Extent	1	3	
Duration	4	4	
Reversibility	3	3	
Magnitude (severity of impact)	2	3	
Probability	3	4	
Significance	30 (LOW)	52 (MODERATE)	

#### ***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 the current absence of invasive species on site and the high ability to control any additional impact. The significance will therefore be low, especially if control measures are implemented. However, the increased overall disturbance of the landscape will create opportunities and, if new invasions are not controlled, can create nodes that spread to new locations due to the heightened disturbance levels.



Extent	Habitat in the general area of all RE projects being considered will be affected, rated as <b>regional</b> .
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. With no control measures it could effectively be permanent, or alternatively, have impacts of high intensity.
Intensity/magnitude	Medium. Severe invasion can alter the functioning of natural ecosystems.

Impact 11		Cumulative impacts due to establishment and spread of declared weeds and alien invader plants	
Issue		Establishment and spread of declared weeds and alien invader plants	
Description of Impact			
Establishment and spread of declared weeds and alien invader plants			
Type of Impact		Indirect	
Nature of Impact		Negative	
Phases		Operation	
Criteria		Current project	Combination of projects
Extent		1	3
Duration		2	4
Reversibility		3	3
Magnitude (severity of impact)		1	3
Probability		2	4
Significance		14 (VERY LOW)	52 (MODERATE)

#### **Cumulative impacts on CBAs and conservation planning**

Large proportions of the site and surrounding sites are included in Critical Biodiversity Areas for Mpumalanga. Disruption of these areas means that conservation planners have to find alternative sites to include in future CBAs according to an algorithm that seeks a least-cost outcome for preserving biodiversity, i.e. the least amount of land space for preserving the greatest amount of area of biodiversity importance, as well as meeting specific conservation targets. At some point, the loss of suitable sites leads to a situation where it is no longer possible to plan effective conservation networks or the cost of doing so increases due to a lack of choice. The higher the density of similar projects in a uniform area, the less chance there is of finding sites suitable for conservation that contain all the attributes that are desired to be conserved, including both ecological processes and ecological patterns.

According to the calculation of that total area of each habitat being affected, the impact of the current project on CBAs on site was found to be relatively insignificant as less than 1% of the total area of CBAs on site will be affected (including a 3m buffer around all infrastructure that is assumed to be impacted). The impact assessment methodology assesses this as being of Moderate significance, (being definite and permanent), however the methodology disregards the size of the area affected. Therefore a very small area or very large area will both have Moderate significance according to the impact assessment methodology.

Extent	The impact will affect natural vegetation on site, but affects defined CBAs that extend regionally, effectively affecting conservation planning for the entire Province.
--------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Probability	Based on the location of other Renewable Energy Projects as well as the Mpumalanga CBA map, it is definite that areas classified as CBAs will be affected.
Reversibility	In all projects, loss of vegetation is effectively <b>irreversible</b> within the immediate footprint of permanent infrastructure, since construction of roads and other hard surfaces completely removes vegetation and modifies the substrate upon which it grows. For all the projects, in other areas (crane pads, construction camp and disturbed areas adjacent to construction activities) the impact is partially reversible in the sense that secondary vegetation in disturbed areas will probably never resemble the original vegetation found on site.
Irreplaceable loss of resources	For each individual project, <b>marginal</b> loss of resources will occur within the footprint of the proposed infrastructure since vegetation clearing is required prior to installation of infrastructure, but the overall loss of resources relative to the entire CBA is less significant.
Duration	Within the immediate footprint of the permanent infrastructure (turbine foundations, roads, FBGF and substation) the impact will be <b>Permanent</b> (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). In other areas (crane pads, construction camp and disturbed areas adjacent to construction activities) the impact will be of long-term duration. The assessment here is for the permanently affected areas.
Intensity/magnitude	Medium. The functional integrity of vegetation on site will be compromised to some degree (especially in the sense that the quality, integrity and functionality of CBA areas will be affected, which can be limited to some extent by implementation of mitigation measures.

Impact 12		Cumulative impacts on conservation planning	
Issue	Loss of areas within CBAs and ESAs.		
Description of Impact			
Construction activities will require clearing of natural habitat, to be replaced by the infrastructure. This will result in possible provincial disruption of conservation planning.			
Type of Impact	Direct		
Nature of Impact	Negative		
Phases	Construction		
Criteria	Current project	Combination of projects	
Extent	1	3	
Duration	5	5	
Reversibility	3	3	
Magnitude (severity of impact)	1	1	
Probability	5	5	
Significance	50 (MODERATE)	60 (MODERATE)	

## Assessment of No-Go alternative

If the project does not proceed then the current *status quo* will continue. This will involve continued use of the land for cultivation and livestock production, as well as the possibility of future mining. Historical aerial imagery shows that cultivation patterns have not changed much in recent history. This is probably due to the fact that most areas that were viable for crop production were already cultivated in the early 1900s and that there is no benefit to cultivating any new areas, usually due to soil depth limitations.

In terms of livestock production, the agricultural specialist report indicated that the long-term grazing capacity of the area is fairly high at 4.5 hectares per large stock unit (DAFF, 2018). Welgelen 1 and 2 comprises ca. 2018ha, which implies a sustainable grazing numbers on site of ca. 448 head of cattle. These two properties currently occupy ca. 700 head of cattle (not counting the sheep), and therefore the land is therefore heavily overstocked, which is reflected in the condition of the grasslands on site. These are obviously overgrazed and the site is on a long term over-grazing trajectory. This implies that stocking rates, and therefore profitability, will need to be reduced to avert land degradation, putting financial strain on producers. An alternative income stream associated with financial benefits from hosting renewable energy projects is likely to improve the financial viability of any land manager, which in turn reduces the pressure to carry unsustainable stock numbers. This reduces pressure on the land, which reduces the likelihood of grazing-induced degradation. In summary, the No-Go option will increase the rate of land degradation due to over-grazing, especially under adverse future climate scenarios, whereas there is a possibility of this effect being lessened in the case of the project promoting local economic diversity. There is also a moderate to high risk of loss of natural areas due to expansion of coal mining.

## Summary of mitigation measures

The following mitigation measures are recommended to address known potential impacts:

- Restrict impact to development footprint only and limit disturbance in surrounding areas.
- Prior to commencement of construction, compile a Rehabilitation Plan including monitoring specifications, to be included into the EMPr during final approval.
- Prior to commencement of construction, compile an Alien Plant Management Plan, to be included into the EMPr during final approval.
- Prior to commencement of construction, compile and implement an alien management plan, which highlights control priorities and areas and provides a programme for long-term control, including monitoring specifications.
- Undertake regular monitoring to detect alien invasions early so that they can be controlled.
- Prior to commencement of construction, compile and implement a stormwater management plan including monitoring specifications.
- Monitor surfaces for erosion, repair and/or upgrade, where necessary.
- Prior to decommissioning commencing, compile a Rehabilitation Plan in compliance with the regulatory requirements at the time of decommissioning.

## Summary of monitoring recommendations

Specific monitoring recommendations should be provided in the Alien Invasive Management Plan, and the Rehabilitation Plan. The following are broad recommendations:

Alien Invasive Species:

- Monitor for early detection, to find species when they first appear on site. This should be as per the frequency specified in the management plan, and should be conducted by an experienced botanist. Early detection should provide a list of species and locations where they have been detected. Summer (vegetation maximum growth period) is usually the most appropriate time, but monitoring can be adaptable, depending on local conditions – this must be specified in the management plan.
- Monitor for the effect of management actions on target species, which provides information on the effectiveness of management actions. Such monitoring depends on the management actions taking place. It should take place after each management action.
- Monitor for the effect of management actions on non-target species and habitats.

Rehabilitated areas:

- Rehabilitation Plan must be compiled by an approved ecologist prior to achieving COD and prior to the start of decommissioning.
- All management actions associated with rehabilitation must be recorded after each management action has taken place.
- All rehabilitated areas should be monitored to assess vegetation recovery. This should be for a minimum of three years after post-construction rehabilitation, but depends on the assessed trajectory of rehabilitation (whether it is following a favourable progression of vegetation establishment or not – this depends on the total vegetation cover present, and the proportion that consists of perennial growth of desired species). For each monitoring site, an equivalent comparative site in adjacent undisturbed vegetation should be similarly monitored. Monitoring data collection should include the following:
  - total vegetation cover and height, as well as for each major growth form;
  - species composition, including relative dominance;
  - soil stability and/or development of erosion features;
  - representative photographs should be taken at each monitoring period.
- Monitoring of rehabilitated areas should take place at the frequency and for the duration determined in the rehabilitation plan, or until vegetation stability has been achieved.

# DISCUSSION

The study area for the proposed project consists of a combination of natural vegetation and cultivated areas. The grassland in the general study area is degraded to various degrees from long-term over-grazing. One of the regional vegetation types that occurs on site, Eastern Highveld Grassland, is listed as Vulnerable in 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). The remaining natural habitat on site, therefore has to be considered to have high biodiversity value.

The DFFE online screening tool identifies Terrestrial Biodiversity as a theme of very high sensitivity. This is due to presence on site of areas included within Endangered Ecosystem, Vulnerable Ecosystem, FEPA sub-catchment, Strategic Water Source Area, and/or Protected Areas Expansion Strategy. The theme indicates almost the entire study area as being in the Very High sensitivity category, but there are significant areas that have been cultivated and impacted by heavy grazing that do not support this classification.

The Langcarel Nature Reserve is shown as occurring on the boundary of the site. This area is not being managed as a protected area and has undergone similar levels of degradation as surrounding areas, due primarily to overgrazing, but also partially due to alien invasive plants. In addition, no conservation management or activities were evident on site during the field assessment. This pattern of over-utilization affects all grasslands on site, resulting in them being in moderate to poor condition.

The proposed project consists of a 45 wind turbines and associated access roads, substations, laydown areas, and construction camps. For the most part, the road infrastructure follows existing roads or disturbance. Most wetland habitats on site are completely avoided. The proposed layout for turbines has a small footprint area, and those natural areas that are affected are generally in relatively poor condition due to overgrazing. It has been calculated here that the entire project, including a 3m buffer area around all proposed infrastructure for possible edge effects, only affects a total of 68 hectares of natural habitat of a total of 2400 hectares of natural habitat on site (approximately 3%). The entire project has a total footprint area (all sensitivity classes) of around 139 hectares within a site that is 4951 hectares in size. The project therefore has a very small footprint area which results in an insignificant impact.

An impact assessment using WSP methodology identified a small number of potential impacts, none of which are of major concern, with all rated Moderate to Very Low before and after mitigation. Some impacts related to loss of vegetation remain Moderate significance after mitigation because they are permanent and are considered unavoidable. However, as discussed above, the amount of habitat potentially affected is insignificant.

# CONCLUSIONS

1. One of the vegetation types that occurs on site is Eastern Highveld Grassland, is listed as Vulnerable. All areas on site within Eastern Highveld Grassland also fall within another listed ecosystem, Chrissiesmeer Panveld, listed as Vulnerable, and defined independently to the vegetation types. The site is therefore within two listed ecosystems that overlap.
2. There is a proclaimed conservation area immediately adjacent to (i.e. bordering) the site, the Langcarel Private Nature Reserve. This area has not been managed as a protected area and has undergone similar levels of degradation as surrounding areas due primarily to overgrazing, but also partially due to alien invasive plants. In addition, no conservation management activities were evident on site during the field assessment. This pattern of over-utilization affects all grasslands on site, resulting in them being in moderate to poor condition. A separate process is underway to have it (or part thereof) de-proclaimed as part of ongoing province-wide reserve verification efforts by the provincial authorities. The habitat has been used for livestock production and is impacted by this landuse. It is therefore the authors' opinion on the basis of the current land use and levels of modification, that the private nature reserve does not align with the objective and purpose of the protected area status.
3. Natural grassland on site is in moderate to poor condition, primarily due to heavy overgrazing. There are significant areas of low grass cover and bare areas, and plant species composition has been degraded by grazing effects.
4. There are some Critical Biodiversity Areas (CBA1 and CBA2) on site, but only a small part of these areas are directly affected by the proposed project (approximately 3.4% of area of CBAs on site).
5. The proposed layout avoids sensitivities as much as possible. Wetland crossings are at existing roads, and all other wetlands are avoided. There is some infrastructure within natural grasslands, but just over half of the road infrastructure, the component of wind energy projects that usually has the highest impact, is along existing roads or within disturbed or transformed areas. The proposed project (all infrastructure components together) affects less than 3% of the remaining natural habitat on site.
6. For the two substation options, both are entirely within natural areas. Either option can therefore be selected since they have similar effects on natural habitats.
7. Assessed impact with moderate significance after mitigation is "Loss of indigenous natural vegetation". However, these are only moderate because they are permanent and will definitely happen – the extent of the impact is negligible. On this basis, the project is therefore deemed acceptable from a terrestrial biodiversity perspective and it is recommended the Environmental Authorisation be granted. The author is of the opinion that the impacts associated with the project can be mitigated to acceptable levels provided the recommended mitigation measures identified are implemented.

# BIBLIOGRAPHY AND REFERENCES:

- ALEXANDER, G. & MARAIS, J. 2007. A guide to the reptiles of southern Africa. Struik, Cape Town.
- BARNES, K.N. (ed.) (2000) The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. Birdlife South Africa, Johannesburg.
- BATES, M.F., BRANCH, W.R., BAUER, A.M., BURGER, M., MARAIS, J., ALEXANDER, G.J. & DE VILLIERS, M.S. 2014. Atlas and Red List of the Reptiles of South Africa. Suricata 1, South African National Biodiversity Institute. ISBN 978-1-919976-84-6.
- BRANCH, W.R. (1988) South African Red Data Book—Reptiles and Amphibians. South African National Scientific Programmes Report No. 151.
- CHILD MF, ROXBURGH L, DO LINH SAN E, RAIMONDO D, DAVIES-MOSTERT HT, editors. The 2016 Red List of Mammals of South Africa, Swaziland and Lesotho. South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa.
- DRIVER, A., MAZE, K., ROUGET, M., LOMBARD, A.T., NEL, J., TURPIE, J.K., COWLING, R.M., DESMET, P., GOODMAN, P., HARRIS, J., JONAS, Z., REYERS, B., SINK, K. & STRAUSS, T. 2005. National Spatial Biodiversity Assessment 2004: priorities for biodiversity conservation in South Africa. Strelitzia 17. South African National Biodiversity Institute, Pretoria.
- DU PREEZ, L. & CARRUTHERS, V. 2009. A complete guide to the frogs of southern Africa. Random House Struik, Cape Town.
- FAIRBANKS, D.H.K., THOMPSON, M.W., VINK, D.E., NEWBY, T.S., VAN DEN BERG, H.M & EVERARD, D.A. 2000. The South African Land-Cover Characteristics Database: a synopsis of the landscape. *S.Afr.J.Science* 96: 69-82.
- FEY, M. 2010. With contributions by Jeff Hughes, Jan Lambrechts, Theo Dohse, Anton Milewski and Anthony Mills. *Soils of South Africa: their distribution, properties, classification, genesis, use and environmental significance*. Cambridge University Press, Cape Town.
- FRIEDMANN, Y. & DALY, B. (eds.) 2004. The Red Data Book of the Mammals of South Africa: A Conservation Assessment: CBSG Southern Africa, Conservation Breeding Specialist Group (SSC/IUCN), Endangered Wildlife Trust, South Africa.
- GROOMBRIDGE, B. (ed.) 1994. *1994 IUCN Red List of Threatened Animals*. IUCN, Gland, Switzerland.
- IUCN (2001). *IUCN Red Data List categories and criteria: Version 3.1*. IUCN Species Survival Commission: Gland, Switzerland.
- LOTTER, M. (2015) Spatial Assessment informing the Mpumalanga Protected Area Expansion Strategy - 20 and 5 year spatial priorities. Mpumalanga Tourism & Parks Agency, Mbombela (Nelspruit).
- MARAIS, J. 2004. A complete guide to the snakes of southern Africa. Struik Publishers, Cape Town.
- MILLS, G. & HES, L. 1997. The complete book of southern African mammals. Struik Publishers, Cape Town.
- MINTER, L.R., BURGER, M., HARRISON, J.A., BRAACK, H.H., BISHOP, P.J. and KLOEPFER, D. (eds.) 2004. Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland. SI/MAB Series #9. Smithsonian Institution, Washington, DC.
- MONADJEM, A., TAYLOR, P.J., COTTERILL, E.P.D. & SCHOEMAN, M.C. 2010. Bats of southern and central Africa. Wits University Press, Johannesburg.
- MOUTON, P. LE FRAS, N. (2014). *Ouroborus cataphractus* (Boie, 1828). In BATES, M.F., BRANCH, W.R., BAUER, A.M., BURGER, M., MARAIS, J., ALEXANDER, G.J. & DE VILLIERS, M.S. 2014. Atlas and Red List of the Reptiles of South Africa. Suricata 1, South African National Biodiversity Institute.
- MUCINA, L. AND RUTHERFORD, M.C. (editors) 2006. Vegetation map of South Africa, Lesotho and Swaziland: an illustrated guide. *Strelitzia* 19, South African National Biodiversity Institute, Pretoria.
- MUCINA, L., RUTHERFORD, M.C. AND POWRIE, I.W. (editors) 2005. Vegetation map of South Africa, Lesotho and Swaziland, 1:1 000 000 SCALE SHEET MAPS South African National Biodiversity Institute, Pretoria.
- PASSMORE, N.I. & CARRUTHERS, V.C. (1995) South African Frogs; a complete guide. Southern Book Publishers and Witwatersrand University Press. Johannesburg.
- PAVÓN, N.P., HERNÁNDEZ-TREJO, H. AND RICO-GRAY, V. 2000. Distribution of plant life forms along an altitudinal gradient in the semi-arid valley of Zapotitlán, Mexico. *Journal of Vegetation Science* 11, 39-42.
- RAUNKIAER, C. 1934. The life forms of plants and statistical plant geography. Oxford University Press, Oxford.
- RUTHERFORD, M.C. AND WESTFALL, R.H. 1994. Biomes of Southern Africa. An objective characterisation. *Memoirs of the Botanical Survey of South Africa* 63, 1-94.

- RUTHERFORD, M.C., MUCINA, L. AND POWRIE, L.W. 2006. Biomes and Bioregions of Southern Africa. In: L. Mucina and M.C. Rutherford (Eds). The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19, pp. 30-51. South African National Biodiversity Institute, Pretoria.
- SKELTON, P. 2001. A complete guide to the freshwater fishes of southern Africa. Struik Publishers, Cape Town.
- TOLLEY, K. & BURGER, M. 2007. Chameleons of southern Africa. Struik Publishers, Cape Town.
- LÖTTER, M.C. & FERRAR, A.A. 2006. Mpumalanga Biodiversity Conservation Plan Map. Mpumalanga Tourism & Parks Agency, Nelspruit
- FERRAR, A.A. & LÖTTER, M.C. 2007. Mpumalanga Biodiversity Conservation Plan Handbook. Mpumalanga Tourism & Parks Agency, Nelspruit
- SOUTH AFRICAN NATIONAL BIODIVERSITY INSTITUTE (SANBI). 2020. Species Environmental Assessment Guideline. Guidelines for the implementation of the Terrestrial Fauna and Terrestrial Flora Species Protocols for environmental impact assessments in South Africa. South African National Biodiversity Institute, Pretoria. Version 1.2020.



# APPENDICES:

## Appendix 1: Curriculum vitae: Dr David Hoare

### 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 plant species specialist.
- Alien plant identification and control / management plans.
- 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 (IAVS)  
Member, Ecological Society of America (ESA)  
Member, International Association for Impact Assessment (IAIA)  
Member, Herpetological Association of Africa (HAA)

### Employment history

1 December 2004 – present, Director, David Hoare Consulting (Pty) Ltd. Consultant, specialist consultant contracted to various companies and organisations.  
1 January 2009 – 30 June 2009, Lecturer, University of Pretoria, Botany Dept.  
1 January 2013 – 30 June 2013, Lecturer, University of Pretoria, Botany Dept.  
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.

### Experience as consultant

Ecological consultant since 1995. Author of over 380 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.
- Pfab, M.F., Compaan, P.C., Whittington-Jones, C.A., Engelbrecht, I., Dimalisile, L., Mills, L., West, S.D., Muller, P., Masterson, G.P.R., Nevhutalu, L.S., Holness, S.D., **Hoare, D.B.** 2017. The Gauteng Conservation Plan: Planning for biodiversity in a rapidly urbanising province. *Bothalia*, Vol. 47:1. a2182. <https://doi.org/10.4102/abc.v47i1.2182>.

**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. **Error! Hyperlink reference not valid..**
- 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 Afrikaanse Universiteit postgraduate symposium, 1997
- HOARE, D.B., VICTOR, J.E. & BREDENKAMP, G.J. *Historical and ecological links between grassy fynbos and afro-montane 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 34<sup>th</sup> 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*, 46<sup>th</sup> 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 VIth 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 380 specialist consulting reports for various environmental projects from 1995 – present.

#### **Workshops / symposia attended:**

- International Association for Impact Assessment Annual Congress, Durban, 16 – 19 May 2018.
- Workshop on remote sensing of rangelands presented by Paul Tueller, University of Nevada Reno, USA, VIth 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.
- 28<sup>th</sup> International Symposium on Remote Sensing of Environment, Somerset West, 27-31 March 2000.
- Workshop on Vegetation Structural Characterisation: Tree Cover, Height and Biomass, 28<sup>th</sup> 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.
- 34<sup>th</sup> 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 Afriikaanse Universiteit postgraduate symposium, 1997.
- South African Association of Botanists Annual Congress, Bloemfontein, January 1995.



David Hoare  
Consulting (Pty) Ltd

Address:  
Postnet Suite #116  
Private Bag X025  
Lynnwood Ridge  
0040

41 Soetdoring Avenue  
Lynnwood Manor  
Pretoria

Cell: 083 284 5111  
Fax: 086 550 2053  
Email:  
david@davidhoareconsulti  
ng.co.za

# Terrestrial Plant Species Assessment

prepared in accordance with the  
"Protocol for the Specialist Assessment and  
minimum report content requirements for  
environmental impacts on Terrestrial Plant  
Species"

## Camden II Wind Energy Facility near Ermelo in Mpumalanga Province

Prepared by: Dr David Hoare  
Pr.Sci.Nat. (Botany, Ecology) 400221/05

For: Camden II Wind (RF) Pty Ltd

29 June 2022

# TABLE OF CONTENTS

<b>TABLE OF CONTENTS .....</b>	<b>1</b>
<b>SPECIALIST DETAILS &amp; DECLARATION .....</b>	<b>3</b>
STATEMENT OF INDEPENDENCE: .....	3
<b>TERMS OF REFERENCE .....</b>	<b>4</b>
<b>INTRODUCTION .....</b>	<b>9</b>
PROJECT BACKGROUND.....	9
PROJECT DESCRIPTION.....	9
IDENTIFIED THEME SENSITIVITIES .....	12
<i>Plant Species theme</i> .....	12
<b>METHODOLOGY .....</b>	<b>14</b>
SURVEY TIMING .....	14
FIELD SURVEY APPROACH .....	15
SOURCES OF INFORMATION .....	15
LIMITATIONS.....	16
<b>RESULTS .....</b>	<b>17</b>
BROAD VEGETATION PATTERNS.....	17
<i>Eastern Highveld Grassland</i> .....	17
<i>Wakkerstroom Montane Grassland</i> .....	18
HABITATS ON SITE .....	20
<i>Grassland</i> .....	20
<i>Wetlands</i> .....	21
<i>Current cultivation</i> .....	21
<i>Old lands</i> .....	21
<i>Exotic trees</i> .....	22
<i>Degraded areas</i> .....	22
<i>Transformed areas</i> .....	22
PLANT SPECIES FLAGGED FOR THE STUDY AREA .....	24
<i>Sensitive species 1252</i> .....	24
<i>Khadia carolinensis</i> .....	24
<i>Sensitive species 1201</i> .....	24
<i>Aspidoglossum xanthosphaerum</i> .....	24
<i>Khadia alticola</i> .....	24
<i>Lotononis amajubica</i> .....	25
<i>Sensitive species 41</i> .....	25
<i>Sensitive species 691</i> .....	25
<i>Sensitive species 998</i> .....	25
<i>Sensitive species 1219</i> .....	25
<i>Pachycarpus suaveolens</i> .....	26
<i>Sensitive species 321</i> .....	26
<i>Sensitive species 851</i> .....	26
<i>Zaluzianskya distans</i> .....	26
<i>Additional listed plant species for the study area</i> .....	26
PROTECTED SPECIES RECORDED IN THE STUDY AREA .....	28
<b>POSSIBLE IMPACTS .....</b>	<b>29</b>
ANTICIPATED IMPACTS .....	29

PROPOSED INFRASTRUCTURE IN RELATION TO SENSITIVITIES .....	30
CONSTRUCTION PHASE IMPACTS.....	30
<b>ASSESSMENT OF IMPACTS .....</b>	<b>31</b>
CONSTRUCTION PHASE IMPACTS.....	31
CUMULATIVE IMPACTS .....	32
SUMMARY OF MITIGATION MEASURES.....	33
SUMMARY OF MONITORING RECOMMENDATIONS .....	34
<i>Rescued plants</i> .....	34
<i>Threatened species</i> .....	34
<b>CONCLUSIONS .....</b>	<b>35</b>
REQUIRED PRE-CONSTRUCTION SURVEY .....	35
<b>REFERENCES .....</b>	<b>36</b>
<b>APPENDICES .....</b>	<b>37</b>
APPENDIX 1: LIST OF PROTECTED TREE SPECIES (NATIONAL FORESTS ACT, 1998).....	37
APPENDIX 2: PLANT SPECIES RECORDED ON SITE AND NEARBY. ....	40
APPENDIX 3: FLORA PROTECTED UNDER THE MPUMALANGA NATURE CONSERVATION ACT No. 10 OF 1998.....	64
APPENDIX 4: FLORA PROTECTED UNDER THE NATIONAL ENVIRONMENTAL MANAGEMENT: BIODIVERSITY ACT, 2004 (ACT 10 OF 2004) .....	66
APPENDIX 5: CURRICULUM VITAE: DR DAVID HOARE .....	67

## SPECIALIST DETAILS & DECLARATION

This report has been prepared in accordance with the "Protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial plant species", as promulgated in terms of Section 24 (5) of the National Environmental Management Act, 1998 (Act No. 107 of 1998), published in GN. No. 320 dated 20 March 2020. It has been prepared independently of influence or prejudice by any parties.

The details of the specialist are as follows:

Specialist	Qualification and accreditation
Dr David Hoare	PhD Botany SACNASP (Pr.Sc.Nat.) Reg. no. 400221/05 (Ecology, Botany)

### Statement of independence:

I, David Hoare, as the appointed plant species specialist, hereby declare/affirm the correctness of the information provided in this compliance statement, and that I:

1. meet the general requirements to be independent and
2. have no business, financial, personal, or other interest in the proposed development and that no circumstances have occurred that may have compromised my objectivity; and
3. am aware that a false declaration is an offence in terms of regulation 48 of the EIA Regulations (2014).



Dr David Hoare

29/06/2022

Date



# TERMS OF REFERENCE

The specialist study is required to follow the published Protocols, provided in full below for the assessment of impacts on Terrestrial Plant Species. Note that the Protocols require determination of the level of sensitivity, which then determines the level of assessment required, either a full assessment, or a Compliance Statement.

## PROTOCOL FOR THE SPECIALIST ASSESSMENT AND MINIMUM REPORT CONTENT REQUIREMENTS FOR ENVIRONMENTAL IMPACTS ON TERRESTRIAL PLANT SPECIES

This site sensitivity assessment follows the requirements of The Environmental Impact Assessment Regulations, as promulgated in terms of Section 24 (5) of the National Environmental Management Act, 1998 (Act No. 107 of 1998), published in GN. No. 320 dated 20 March 2020.

### General information

1.1 An applicant intending to undertake an activity identified in the scope of this protocol, on a site identified by the screening tool as being of “**very high**” or “**high**” sensitivity for terrestrial plant species, must submit a Terrestrial Plant Species Specialist Assessment Report.

1.2 An applicant intending to undertake an activity identified in the scope of this protocol, on a site identified by the screening tool as being of “**medium**” sensitivity for terrestrial plant species, must submit either a Terrestrial Plant Species Specialist Assessment Report or a Terrestrial Plant Species Compliance Statement, depending on the outcome of a site inspection undertaken in accordance with paragraph 4.

1.3 An applicant intending to undertake an activity identified in the scope of this protocol, on a site identified by the screening tool as being of “**low**” sensitivity for terrestrial plant species, must submit a Terrestrial Plant Species Compliance Statement.

1.4 Where the information gathered from the site sensitivity verification differs from the screening tool designation of “very high” or “high” for terrestrial plant species sensitivity on the screening tool, and it is found to be of a “low” sensitivity, then a Terrestrial Plant Species Compliance Statement must be submitted.

1.5 Where the information gathered from the site sensitivity verification differs from the screening tool designation of “low” terrestrial plant species sensitivity and it is found to be of a “very high” or “high” terrestrial plant species sensitivity, a Terrestrial Plant Species Specialist Assessment must be conducted.

1.6 If any part of the development falls within an area of confirmed “very high” or “high” sensitivity, the assessment and reporting requirements prescribed for the “very high” or “high” sensitivity, apply to the entire development footprint. Development footprint in the context of this protocol, means the area on which the proposed development will take place and includes the area that will be disturbed or impacted.

1.7 The Terrestrial Plant Species Specialist Assessment and the Terrestrial Plant Species Compliance Statement must be undertaken within the study area.

1.8 Where the nature of the activity is not expected to have an impact on species of conservation concern (SCC) beyond the boundary of the preferred site, the study area means the proposed development footprint within the preferred site.

1.9 Where the nature of the activity is expected to have an impact on SCC beyond boundary of the preferred site, the project areas of influence (PAOI) must be determined by the specialist in accordance with Species Environmental Assessment Guideline, and the study area must include the PAOI, as determined.

#### Terrestrial Plant Species Specialist Assessment

2.1 The assessment must be undertaken by a specialist registered with the South African Council for Natural Scientific Professions (SACNASP), within a field of practice relevant to the taxonomic groups ("taxa") for which the assessment is being undertaken.

2.2 The assessment must be undertaken within the study area.

2.3 The assessment must be undertaken in accordance with the Species Environmental Assessment Guideline and must:

2.3.1 Identify the SCC which were found, observed or are likely to occur within the study area;

2.3.2 provide evidence (photographs) of each SCC found or observed within the study area, which must be disseminated by the specialist to a recognized online database facility immediately after the site inspection has been performed (prior to preparing the report contemplated in paragraph 3);

2.3.3 identify the distribution, location, viability and detailed description of population size of the SCC identified within the study area;

2.3.4 identify the nature and the extent of the potential impact of the proposed development to the population of the SCC located within the study area;

2.3.5 determine the importance of the conservation of the population of the SCC identified within the study area, based on information available in national and international databases including the IUCN Red List of Threatened Species, Red List of South African Plants, and/or other relevant databases;

2.3.6 determine the potential impact of the proposed development on the habitat of the SCC located within the study area;

2.3.7 include a review of relevant literature on the population size of the SCC, the conservation interventions as well as any national or provincial species management plans for the SCC. This review must provide information on the need to conserve the SCC and indicate whether the development is compliant with the applicable species management plans and if not, a motivation for the deviation;

2.3.8 identify any dynamic ecological processes occurring within the broader landscape, that might be disrupted by the development and result in negative impact on the identified SCC, for example, fires in fire-prone systems;

2.3.9 identify any potential impact on ecological connectivity within the broader landscape, and resulting impacts on the identified SCC and its long term viability;

2.3.10 determine buffer distances as per the Species Environmental Assessment Guidelines used for the population of each SCC; and

2.3.11 discuss the presence or likelihood of additional SCC including threatened species not identified by the screening tool, Data Deficient or Near Threatened Species, as well as any undescribed species; and

2.3.12 identify any alternative development footprints within the preferred development site which would be of “low” sensitivity” or “medium” sensitivity as identified by the screening tool and verified through the site sensitivity verification.

2.4 The findings of the assessment must be written up in a Terrestrial Plant Species Specialist Assessment Report.

#### Terrestrial Plant Species Specialist Assessment Report

3.1 This report must include as a minimum the following information:

3.1.1 contact details and relevant experience as well as the SACNASP registration number of the specialist preparing the assessment including a curriculum vitae;

3.1.2 a signed statement of independence by the specialist;

3.1.3 a statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;

3.1.4 a description of the methodology used to undertake the site sensitivity verification and impact assessment and site inspection, including equipment and modelling used where relevant;

3.1.5 a description of the assumptions made and any uncertainties or gaps in knowledge or data;

3.1.6 a description of the mean density of observations/number of samples sites per unit area of site inspection observations;

3.1.7 details of all SCC found or suspected to occur on site, ensuring sensitive species are appropriately reported;

3.1.8 the online database name, hyperlink and record accession numbers for disseminated evidence of SCC found within the study area;

3.1.9 the location of areas not suitable for development and to be avoided during construction where relevant;

3.1.10 a discussion on the cumulative impacts;

3.1.11 impact management actions and impact management outcomes proposed by the specialist for inclusion in the Environmental Management Programme (EMPr);

3.1.12 a reasoned opinion, based on the findings of the specialist assessment, regarding the acceptability or not, of the development related to the specific theme considered, and if the development should receive approval or not, related to the specific theme being considered, and any conditions to which the opinion is subjected if relevant; and

3.1.13 a motivation must be provided if there were any development footprints identified as per paragraph 2.3.12 above that were identified as having "low" or "medium" terrestrial plant species sensitivity and were not considered appropriate.

3.2 A signed copy of the assessment must be appended to the Basic Assessment Report or Environmental Impact Assessment Report.

#### Terrestrial plant species compliance statement

Where the sensitivity in the Screening Report from the web-based Online Screening Tool has been confirmed to be LOW, a Plant Species Compliance Statement is required, either (1) for areas where no natural habitat remains, or (2) in natural areas where there is no suspected occurrence of SCC.

The compliance statement must be prepared by a SACNASP registered specialist under one of the two fields of practice (Botanical Science or Ecological Science).

The compliance statement must:

1. be applicable within the study area
2. confirm that the study area is of "low" sensitivity for terrestrial plant species; and
3. indicate whether or not the proposed development will have any impact on SCC.

The compliance statement must contain, as a minimum, the following information:

1. contact details of the specialist, their SACNASP registration number, their field of expertise and a curriculum vitae;
2. a signed statement of independence by the specialist;
3. a statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;
4. a baseline profile description of biodiversity and ecosystems of the site;
5. the methodology used to verify the sensitivities of the terrestrial biodiversity and plant species features on the site including the equipment and modelling used where relevant;
6. in the case of a linear activity, confirmation from the terrestrial biodiversity specialist that, in their opinion, based on the mitigation and remedial measures proposed, the land can be returned to the current state within two years of completion of the construction phase;

7. where required, proposed impact management outcomes or any monitoring requirements for inclusion in the EMP; and
8. a description of the assumptions made as well as any uncertainties or gaps in knowledge or data; and
9. any conditions to which this statement is subjected.

A signed copy of the compliance statement must be appended to the Basic Assessment Report or Environmental Impact Assessment Report.

# INTRODUCTION

## Project Background

Camden II Wind Energy Facility (RF) Propriety Limited, a subsidiary of ENERTRAG AG, the German-based renewable energy company, is proposing to develop a wind energy facility near Camden Power Station in the Mpumalanga Province. This will be part of the Camden Renewable Energy Complex that will include:

1. Camden I Wind Energy Facility (up to 200MW).
2. Camden I Wind Grid Connection (up to 132kV).
3. Camden up to 400kV Grid Connection and Collector substation.
4. Camden I Solar up to 100MW.
5. Camden I Solar up to 132kV Grid Connection.
6. Camden Green Hydrogen and Ammonia Facility, including grid connection infrastructure and water pipeline.
- 7. Camden II Wind Energy Facility (up to 200MW).**
8. Camden II Wind Energy Facility up to 132kV Grid Connection.

Camden II Wind Energy Facility (RF) Propriety Limited has appointed WSP as the independent Environmental Assessment Practitioner (EAP) to facilitate the Environmental Impact Assessment (EIA) Process.

This report relates specifically to the **Camden II Wind Energy Facility (up to 200MW)** (the Project). ENERTRAG appointed David Hoare Consulting (Pty) Ltd to undertake this specialist assessment for the Project.

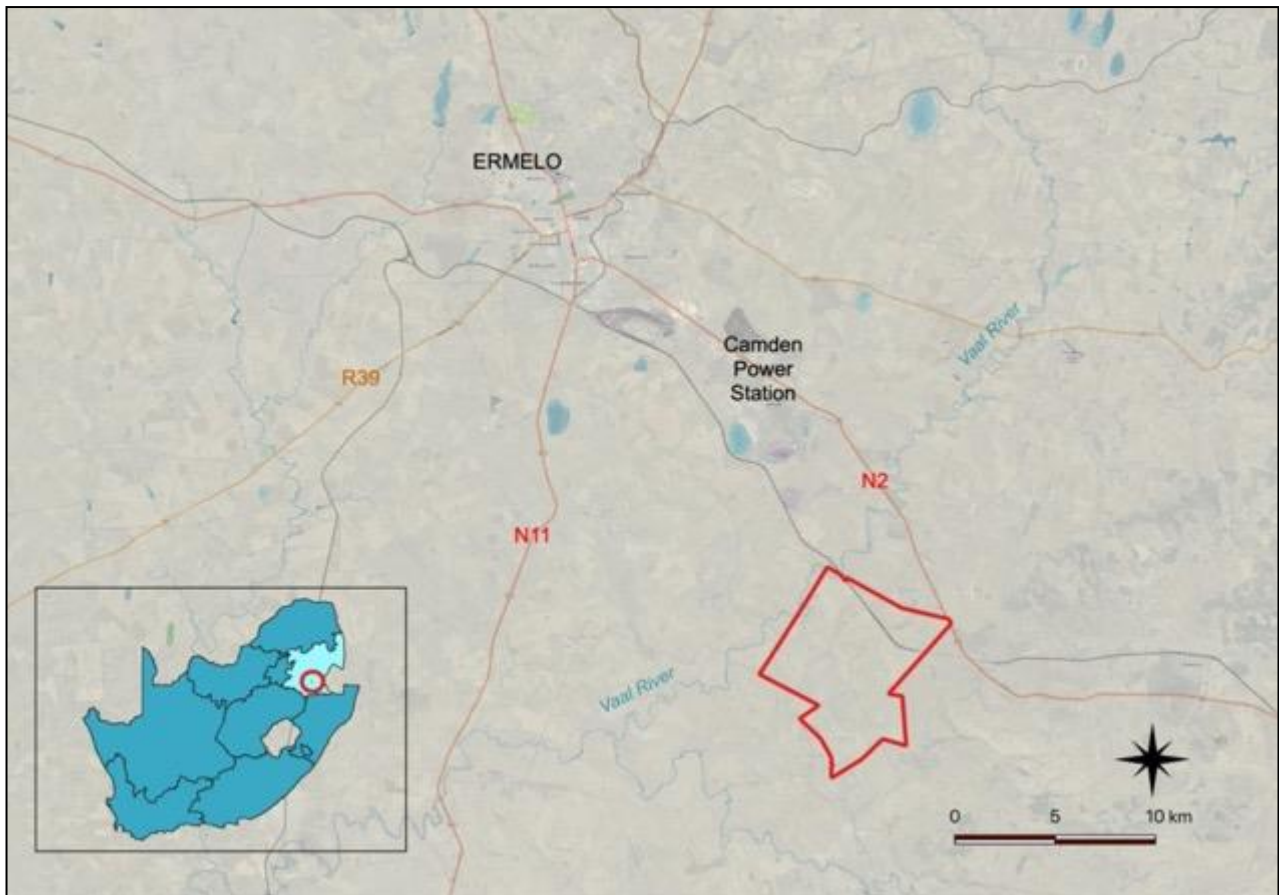
## Project description

The Camden II Wind Energy Facility is summarised as follows:

<b>Facility Name</b>	Camden II Wind Energy Facility
<b>Applicant</b>	Camden II Wind Energy Facility (RF) Propriety Limited
<b>Municipalities</b>	Msukaligwa Local Municipality of the Gert Sibande District Municipality
<b>Affected Farms</b>	<ul style="list-style-type: none"><li>o Adrianople 296 IT (Portion 0, 1, 2 and 3)</li><li>o Buhrmansvallei 297 IT (Portion 3, 4 and 5)</li><li>o Klipfontein 326 IT (Portion 5)</li><li>o De Emigratie 327 IT (Portion 3 and 6)</li></ul>
<b>Extent</b>	4300 ha
<b>Buildable area</b>	Approximately 200 ha, subject to finalization based on technical and environmental requirements
<b>Capacity</b>	Up to 200MW
<b>Number of turbines</b>	Up to 45
<b>Turbine hub height:</b>	Up to 200m
<b>Rotor Diameter:</b>	Up to 200m

<b>Foundation</b>	<ul style="list-style-type: none"> <li>• Concrete foundations of approximately of 25m diameter x 4.5m deep will be required for each turbine, requiring approximately 2500m<sup>3</sup> concrete. Please note these dimensions may be larger as required by the geotechnical conditions.</li> <li>• Concrete foundation will be constructed to support a mounting ring. Approximately 25m<sup>2</sup> diameter x 3m deep – 500 – 650m<sup>3</sup> concrete. Excavation approximately 1000m<sup>2</sup>, in sandy soils due to access</li> </ul>
<b>O&amp;M building footprint:</b>	<p>Located near the substation.</p> <p>Septic/conservancy tanks (operational phase) with portable toilets for construction phase. Typical areas include:</p> <ul style="list-style-type: none"> <li>- Operations building – 20m x 10m = 200m<sup>2</sup></li> <li>- Workshop – 15m x 10m = 150m<sup>2</sup></li> <li>- Stores - 15m x 10m = 150m<sup>2</sup></li> </ul>
<b>Construction camp laydown</b>	<p>Typical area 100m x 50m = 5000m<sup>2</sup>.</p> <p>Sewage: Portable toilets.</p>
<b>Temporary laydown or staging area:</b>	<p>Typical area 220m x 100m = 22000m<sup>2</sup>. Laydown area could increase to 30000m<sup>2</sup> for concrete towers, should they be required.</p>
<b>Cement batching plant (temporary):</b>	<p>Gravel and sand will be stored in separate heaps whilst the cement will be contained in a silo.</p>
<b>Internal Roads:</b>	<p>Width of internal road – Between 5m and 6m. Length of internal road – Approximately 60km. Where required for turning circle/bypass areas, access or internal roads may be up to 20m to allow for larger component transport.</p>
<b>Cables:</b>	<p>The medium voltage collector system will comprise of cables up to and include 33kV that run underground, except where a technical assessment suggest that overhead lines are required, in the facility connecting the turbines to the onsite substation.</p>
<b>IPP site substation and battery energy storage system (BESS):</b>	<p>Total footprint will be up to 6.5ha in extent (5ha for the BESS and 1.5ha for the IPP portion of the substation). The substation will consist of a high voltage substation yard to allow for multiple (up to) 132kV feeder bays and transformers, control building, telecommunication infrastructure, access roads, etc.</p> <p>The BESS storage capacity will be up to 200MW/800MWh with up to four hours of storage. It is proposed that Lithium Battery Technologies, such as Lithium Iron Phosphate, Lithium Nickel Manganese Cobalt oxides or Vanadium Redox flow technologies will be considered as the preferred battery technology. The main components of the BESS include the batteries, power conversion system and transformer which will all be stored in various rows of containers.</p>

The location of the proposed Project is shown in Figure 1.



**Figure 1: Location of the proposed Project.**



## Identified Theme Sensitivities

A sensitivity screening report from the Department of Forestry, Fisheries and the Environment (DFFE) Online Screening Tool was requested in the application category:

Utilities Infrastructure | Electricity | Generation | Renewable | Wind

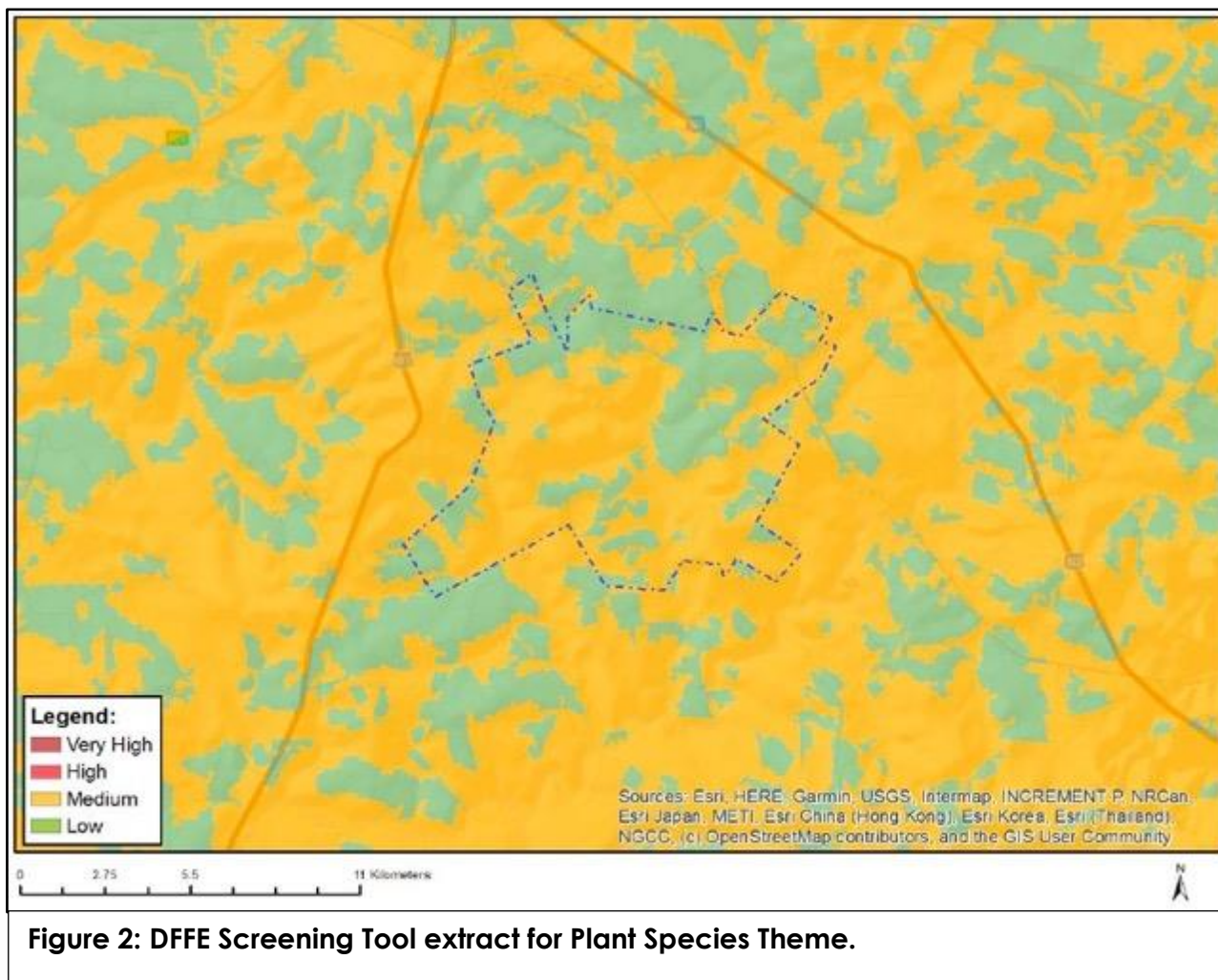
Figure 2 shows the DFFE Screening Tool report for the area, indicating the following ecological sensitivities:

Theme	Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
Plant Species Theme			X	

### ***Plant Species theme***

The plant species theme was highlighted as being of Medium sensitivity due the potential presence of the following species:

Sensitivity	Feature(s)
Low	Low sensitivity
Medium	Sensitive species 1252
Medium	Khadia carolinensis
Medium	Sensitive species 1201
Medium	Aspidoglossum xanthosphaerum
Medium	Khadia alticola
Medium	Lotononis amajubica
Medium	Sensitive species 41
Medium	Sensitive species 691
Medium	Sensitive species 998
Medium	Sensitive species 1219
Medium	Pachycarpus suaveolens
Medium	Sensitive species 321
Medium	Sensitive species 851
Medium	Zaluzianskya distans

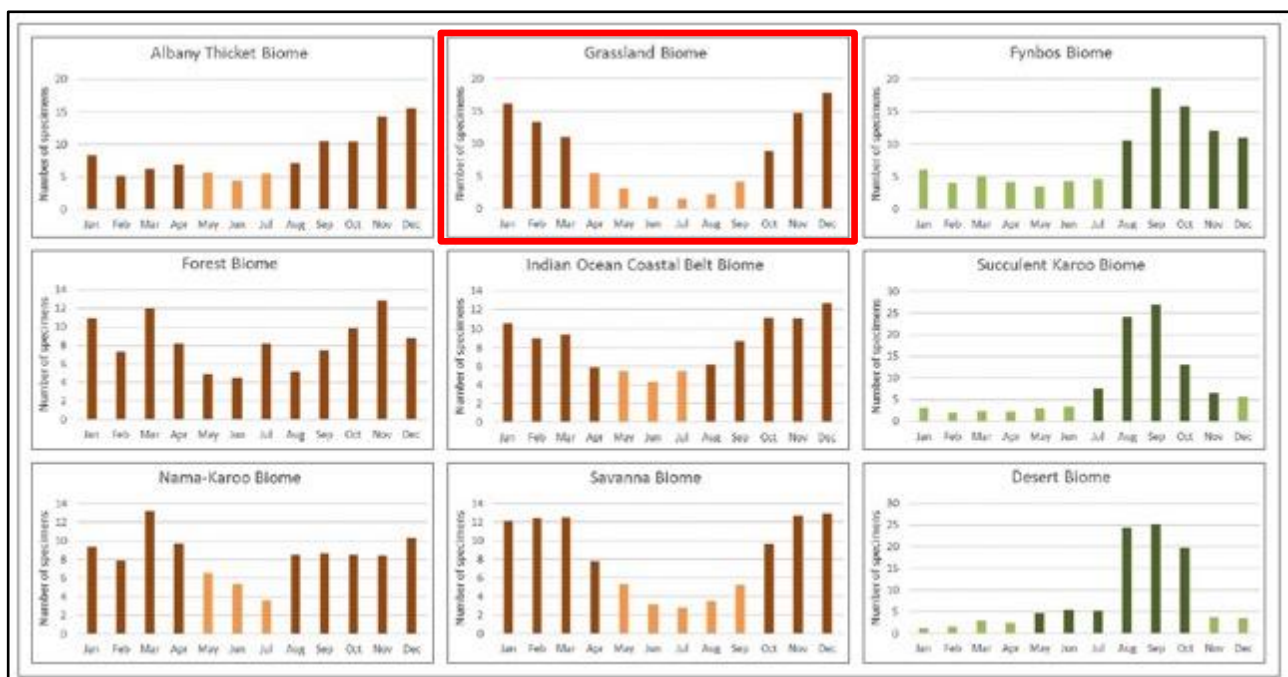


# METHODOLOGY

The detailed methodology followed as well as the sources of data and information used as part of this assessment is described below.

## Survey timing

The study commenced as a desktop-study followed by a site-specific field study on 3–7 February 2020. The site is within the grassland biome with a peak rainfall season in summer, which occurs from October to March (Figure 3). There is, however, a delay between rainfall and vegetation growth, which means the peak growing season is from November to April, with most perennial species characteristic of the vegetation being easily identifiable from January to March. The timing of the field survey was therefore ideal in terms of assessing the vegetation condition and flora composition of the site.



**Figure 3: Recommended survey periods for different biomes (Species Environmental Assessment Guidelines).**

## Field survey approach

During the field survey, all major natural variation on site was assessed and select locations were traversed on foot. A hand-held Garmin GPSMap 64s was used to record a track within which observations were made.

Aerial imagery from Google Earth was used to identify and assess habitats on site. Patterns identified from satellite imagery were verified on the ground. During the field survey, particular attention was paid to ensuring that all habitat variability was covered physically on the ground during the search for plant species. From this ground survey, as well as ad hoc observations on site, a checklist of plant species occurring on site was compiled.

Digital photographs were taken of all plant species that were seen on site. All plant species recorded were uploaded to the iNaturalist website.

## Sources of information

1. Broad vegetation types occurring on site were obtained from Mucina and Rutherford (2006), with updates according to the SANBI BGIS website (<http://bgis.sanbi.org>). The description of each vegetation type includes a list of plant species that may be expected to occur within the particular vegetation type.
2. Plant species that could potentially occur on in the general area was extracted from the NewPosa database of the South African National biodiversity Institute (SANBI) for the quarter degree grids in which the site is located.
3. The IUCN Red List status for plant species, as well as supplementary information on habitats and distribution, was obtained from the SANBI Threatened Species Programme (Red List of South African Plants, <http://redlist.sanbi.org>).
4. 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://newposa.sanbi.org>) for the quarter degree grids 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.
5. Regulations published for the National Forests Act (Act 84 of 1998) (NFA) 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 were obtained from published sources (e.g. van Wyk & van Wyk 1997) and from the SANBI database ([www.newposa.sanbi.org](http://www.newposa.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 50 km), or where it is considered possible that they could occur there, were listed and were considered as being at risk of occurring there.

## Limitations

The purpose of the fieldwork undertaken for this Project to characterize the habitat of the study area, compile species checklists from as diverse a variety of habitats as possible, and to map habitats within the entire collection of farms within which the Project is situated. The proposed project layout was provided during the EIA process, therefore no development footprint areas were assessed for the Project, only the general area in which the project is located. A final walk-through to survey conducted in Spring or Summer, where possible, is therefore recommended to check for potential species of conservation concern within footprints of the development.

# RESULTS

## Broad vegetation patterns

There are two regional vegetation types occurring in the study area, namely Eastern Highveld Grassland and Wakkerstroom Montane Grassland (Figure 4). Terrestrial vegetation patterns reflect these vegetation types, described below. The descriptions are from Mucina & Rutherford (2006), extracted from the SANBI BGIS website (<http://bgis.sanbi.org/vegmap>).

### **Eastern Highveld Grassland**

#### Distribution

Found in Mpumalanga and Gauteng Provinces, on the plains between Belfast in the east and the eastern side of Johannesburg in the west and extending southwards to Bethal, Ermelo and west of Piet Retief. The vegetation type occurs at an altitude of between 1 520–1 780 m.

#### Vegetation & Landscape Features

The vegetation occurs on slightly to moderately undulating plains, including some low hills and pan depressions. The vegetation is short dense grassland dominated by the usual highveld grass composition (*Aristida*, *Digitaria*, *Eragrostis*, *Themeda*, *Tristachya*, etc.) with small, scattered rocky outcrops with wiry, sour grasses and some woody species (*Acacia caffra*, *Celtis africana*, *Diospyros lycioides* subsp. *lycioides*, *Parinari capensis*, *Protea caffra*, *P. welwitschii* and *Searsia magalismontanum*).

#### Geology & Soils

Red to yellow sandy soils of the Ba and Bb land types found on shales and sandstones of the Madzaringwe Formation (Karoo Supergroup). Land types Bb (65%) and Ba (30%).

#### Climate

Strongly seasonal summer rainfall, with very dry winters. MAP 650–900 mm (overall average: 726 mm), MAP relatively uniform across most of this unit, but increases significantly in the extreme southeast. The coefficient of variation in MAP is 25% across most of the unit, but drops to 21% in the east and southeast. Incidence of frost from 13–42 days, but higher at higher elevations.

#### Important Taxa

<b>Low Shrubs</b>	<i>Anthospermum rigidum</i> subsp. <i>pumilum</i> , <i>Stoebe plumosa</i>
<b>Herbs</b>	<i>Berkheya setifera</i> (d), <i>Haplocarpha scaposa</i> (d), <i>Justicia anagalloides</i> (d), <i>Pelargonium luridum</i> (d), <i>Acalypha angustata</i> , <i>Chamaecrista mimosoides</i> , <i>Dicoma anomala</i> , <i>Euryops gilfillanii</i> , <i>E. transvaalensis</i> subsp. <i>setilobus</i> , <i>Helichrysum aureonitens</i> , <i>H. caespititium</i> , <i>H. callicomum</i> , <i>H. oreophilum</i> , <i>H. rugulosum</i> , <i>Ipomoea crassipes</i> , <i>Pentanisia prunelloides</i> subsp. <i>latifolia</i> , <i>Selago densiflora</i> , <i>Senecio coronatus</i> , <i>Vernonia oligocephala</i> , <i>Wahlenbergia undulata</i> .
<b>Geophytic Herbs</b>	<i>Gladiolus crassifolius</i> , <i>Haemanthus humilis</i> subsp. <i>hirsutus</i> , <i>Hypoxis rigidula</i> var. <i>pilosissima</i> , <i>Ledebouria ovatifolia</i> .
<b>Succulent Herbs</b>	<i>Aloe ecklonis</i>
<b>Graminoids</b>	<i>Aristida aequiglumis</i> (d), <i>A. congesta</i> (d), <i>A. junciformis</i> subsp. <i>galpinii</i> (d), <i>Brachiaria serrata</i> (d), <i>Cynodon dactylon</i> (d), <i>Digitaria monodactyla</i> (d), <i>D. tricholaenoides</i> (d), <i>Elionurus muticus</i> (d), <i>Eragrostis chloromelas</i> (d), <i>E. curvula</i> (d), <i>E. plana</i> (d), <i>E. racemosa</i> (d), <i>E. sclerantha</i> (d), <i>Heteropogon contortus</i> (d), <i>Loudetia simplex</i> (d), <i>Microchloa caffra</i> (d), <i>Monocymbium cerasiiforme</i> (d), <i>Setaria sphacelata</i> (d), <i>Sporobolus africanus</i> (d), <i>S. pectinatus</i> (d), <i>Themeda triandra</i> (d), <i>Trachypogon spicatus</i> (d), <i>Tristachya leucothrix</i> (d), <i>T. rehmannii</i> (d), <i>Alloteropsis semialata</i> subsp. <i>eckloniana</i> , <i>Andropogon appendiculatus</i> , <i>A. schirensis</i> , <i>Bewsia biflora</i> , <i>Ctenium concinnum</i> , <i>Diheteropogon amplexans</i> , <i>Eragrostis capensis</i> , <i>E. gummiflua</i> , <i>E. patentissima</i> ,

---

*Harpochloa falx*, *Panicum natalense*, *Rendlia altera*, *Schizachyrium sanguineum*, *Setaria nigrirostris*, *Urelytrum agropyroides*.

---

## Wakkerstroom Montane Grassland

### Distribution

KwaZulu-Natal and Mpumalanga Provinces: Occurring from the Escarpment just north of Sheepmoor (north), to southeast of Utrecht, and then from the vicinity of Volksrust in the west to Mandhlangampisi Mountain near Luneburg in the east. Altitude 1 440–2 200 m.

### Vegetation & Landscape Features

This unit is a less obvious continuation of the Escarpment that links the southern and northern Drakensberg escarpments. It straddles this divide and is comprised of low mountains and undulating plains. The vegetation comprises predominantly short montane grasslands on the plateaus and the relatively flat areas, with short forest and *Leucosidea* thickets occurring along steep, mainly east-facing slopes and drainage areas. *L. sericea* is the dominant woody pioneer species that invades areas as a result of grazing mismanagement.

### Geology & Soils

The mudstones, sandstones and shale of the Madzaringwe and Volksrust Formations (Karoo Supergroup) were intruded by voluminous Jurassic dolerite dykes and sills. Ac land type dominant, while Fa and Ca are of subordinate importance.

### Climate

Rainfall peaks in midsummer. Rainfall 800–1 250 mm per year (MAP 902 mm). This unit experiences an orographic effect which results in a locally higher precipitation than the adjacent areas. Winters very cold and summers mild (MAT 14°C).

### Important Taxa

<b>Small trees</b>	<i>Canthium ciliatum</i> , <i>Protea subvestita</i>
<b>Tall Shrubs</b>	<i>Buddleja salviifolia</i> (d), <i>Leucosidea sericea</i> (d), <i>Buddleja auriculata</i> , <i>Diospyros lycioides</i> subsp. <i>guerkei</i> , <i>Euclea crispa</i> subsp. <i>crispa</i> , <i>Rhus montana</i> , <i>R. rehmanniana</i> , <i>R. transvaalensis</i> .
<b>Low shrubs</b>	<i>Asparagus devenishii</i> (d), <i>Cliffortia linearifolia</i> (d), <i>Helichrysum melanacme</i> (d), <i>H. splendidum</i> (d), <i>Anthospermum rigidum</i> subsp. <i>pumilum</i> , <i>Clutia natalensis</i> , <i>Erica oatesii</i> , <i>Felicia filifolia</i> subsp. <i>filifolia</i> , <i>Gymnosporia heterophylla</i> , <i>Helichrysum hypoleucum</i> , <i>Hermannia geniculata</i> , <i>Inulathera dregeana</i> , <i>Metalsia densa</i> , <i>Printzia pyrifolia</i> , <i>Rhus discolor</i> , <i>Rubus ludwigii</i> subsp. <i>ludwigii</i> .
<b>Graminoids</b>	<i>Andropogon schirensis</i> (d), <i>Ctenium concinnum</i> (d), <i>Cymbopogon caesius</i> (d), <i>Digitaria tricholaenoides</i> (d), <i>Diheteropogon amplexans</i> (d), <i>Eragrostis chloromelas</i> (d), <i>E. plana</i> (d), <i>E. racemosa</i> (d), <i>Harpochloa falx</i> (d), <i>Heteropogon contortus</i> (d), <i>Hyparrhenia hirta</i> (d), <i>Microchloa caffra</i> (d), <i>Themeda triandra</i> (d), <i>Trachypogon spicatus</i> (d), <i>Tristachya leucothrix</i> (d), <i>Alloteropsis semialata</i> subsp. <i>eckloniana</i> , <i>Aristida junciformis</i> subsp. <i>galpinii</i> , <i>Brachiaria serrata</i> , <i>Diheteropogon filifolius</i> , <i>Elionurus muticus</i> , <i>Eragrostis capensis</i> , <i>Eulalia villosa</i> , <i>Festuca scabra</i> , <i>Loudetia simplex</i> , <i>Rendlia altera</i> , <i>Setaria nigrirostris</i> .
<b>Herbs</b>	<i>Berkheya onopordifolia</i> var. <i>glabra</i> (d), <i>Cephalaria natalensis</i> (d), <i>Pelargonium luridum</i> (d), <i>Acalypha depressinerva</i> , <i>A. peduncularis</i> , <i>A. wilmsii</i> , <i>Aster bakerianus</i> , <i>Berkheya setifera</i> , <i>Euryops transvaalensis</i> subsp. <i>setilobus</i> , <i>Galium thunbergianum</i> var. <i>thunbergianum</i> , <i>Geranium ornithopodioides</i> , <i>Helichrysum cephaloideum</i> , <i>H. cooperi</i> , <i>H. monticola</i> , <i>H. nudifolium</i> var. <i>nudifolium</i> , <i>H. oreophilum</i> , <i>H. simillimum</i> , <i>Pentanisia prunelloides</i> subsp. <i>latifolia</i> , <i>Plectranthus laxiflorus</i> , <i>Sebaea leiostyla</i> , <i>S. sedoides</i> var. <i>sedoides</i> , <i>Selago densiflora</i> , <i>Vernonia hirsuta</i> , <i>V. natalensis</i> , <i>Wahlenbergia cuspidata</i> .
<b>Geophytic Herbs</b>	<i>Hypoxis costata</i> (d), <i>Agapanthus inapertus</i> subsp. <i>intermedius</i> , <i>Asclepias aurea</i> , <i>Cheilanthes hirta</i> , <i>Corycium dracomontanum</i> , <i>C. nigrescens</i> , <i>Cyrtanthus tuckii</i> var. <i>transvaalensis</i> , <i>Disa versicolor</i> , <i>Eriospermum cooperi</i> var. <i>cooperi</i> , <i>Eucomis bicolor</i> , <i>Geum capense</i> , <i>Gladiolus ecklonii</i> , <i>G. sericeovillosus</i> subsp. <i>sericeovillosus</i> , <i>Hesperantha coccinea</i> , <i>Hypoxis rigidula</i> var. <i>pilosissima</i> , <i>Moraea brevistyla</i> , <i>Rhodohypoxis baurii</i> var. <i>confecta</i> .
<b>Semiparasitic herb</b>	<i>Striga bilabiata</i> subsp. <i>bilabiata</i> .

Biogeographically Important Taxa (<sup>L</sup>Low Escarpment endemic, <sup>N</sup>Northern sourveld endemic)



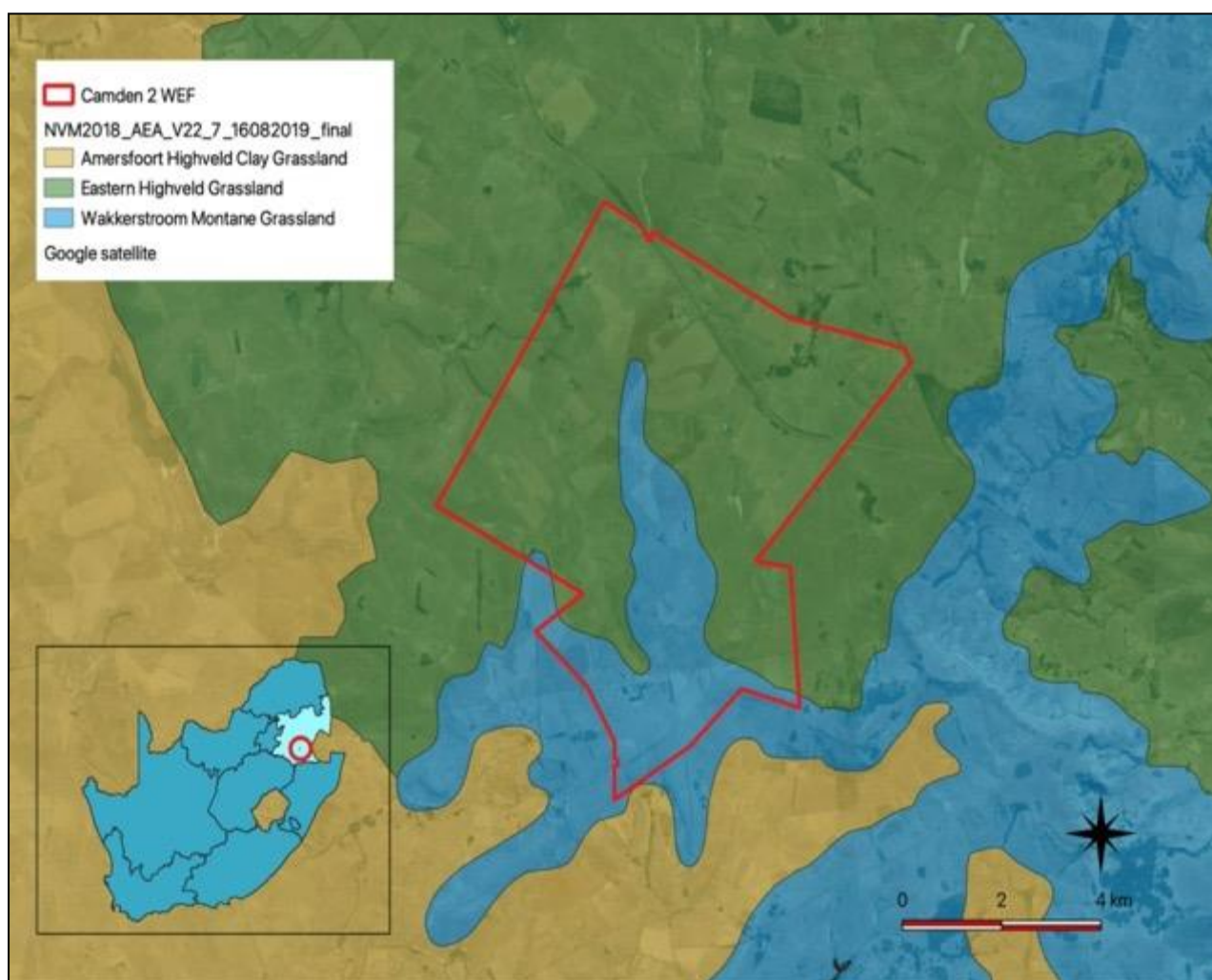
<b>Low shrubs</b>	<i>Bowkeria citrina</i> <sup>L</sup> , <i>Lotononis amajubica</i> <sup>L</sup> , <i>Protea parvula</i> <sup>N</sup> .
<b>Succulent herb</b>	<i>Aloe modesta</i> <sup>N</sup>

#### Endemic Taxa

<b>Herbs</b>	<i>Helichrysum aureum</i> var. <i>argenteum</i> , <i>Selago longicalyx</i>
<b>Geophytic herbs</b>	<i>Kniphofia</i> sp. nov. (' <i>laxiflora</i> Form C'), <i>Nerine platypetala</i> .
<b>Woody climber</b>	<i>Asparagus fractiflexus</i>

#### Remarks

Overgrazing leads to invasion of *Seriphium plumosum*. Parts of this unit were once cultivated and now lie fallow and have been left to re-vegetate with pioneer species. These transformed areas are not picked up by satellite for transformation coverage and the percentage of grasslands still in a natural state may be underestimated.



**Figure 3: Regional vegetation types of the study area.**



## Habitats on site

A map of habitats within the study area is provided in Figure 5. The site is within an area of natural grassland but degraded (from heavily to light). The grassland contains variation due to changes in topography, slope inclination, surface rockiness and the influence of water-flow and water retention in the landscape. A broad classification of the habitat units on site, which also reflects relatively uniform plant species compositional units, is as follows:

Natural habitats:

1. **Natural grassland** (open grassland on undulating plains – the condition is not indicated in the habitat map although there is a gradient from heavily grazed poor condition to moderate condition);
2. **Wetlands** (permanent and seasonal wetlands in drainage valleys, including channels, where they occur);

Transformed and degraded areas:

3. **Old lands** (secondary grasslands on previously cultivated areas);
4. **Exotic trees** (stands of exotic trees);
5. **Degraded areas** (disturbed areas with bare ground, weeds or waste ground).
6. **Current cultivation** (areas currently cultivated and fallow lands);
7. **Transformed** (areas such as roads and buildings where there is no vegetation).

NATURAL VERSUS SECONDARY GRASSLAND	
Natural grassland	Areas of original vegetation in which the soil has not been mechanically disturbed, including areas that are in poor condition due to <b>overgrazing, trampling, invasion</b> by weeds or alien invasive species, <b>inappropriate fire regimes</b> , or any other factor that drives natural change in species composition or vegetation structure. The key factor is that the original plants continue to exist, often resprouting after defoliation from sub-surface stems or other storage organs.
Secondary grassland	Areas of vegetation where the original grassland vegetation has been lost through direct <b>disturbance of the soil</b> that results in physical removal of the original plants, the most common cause of which is ploughing, but could be other mechanical factors. The vegetation that then develops is a result of recolonisation of the area through propagation.

### Grassland

The general study area is characterised by an open grassland on the undulating hills and plains. It is generally a short to moderate height tussock grassland with closed canopy cover. The soil depth varies, as does the amount of surface rock cover, but tends to have shallow soil.

The general floristic character of this vegetation on site is fairly uniform across wide areas, often dominated by the same suite of species, including the grasses, *Alloteropsis semialata*, *Aristida diffusa*, *Aristida junciformis*, *Bewisia biflora*, *Brachiaria serrata*, *Diheteropogon amplexans*, *Elionurus muticus*, *Eragrostis capensis*, *Eragrostis chloromelas*, *Eragrostis plana*, *Eragrostis racemosa*, *Harpochloa falx*, *Heteropogon contortus*, *Microchloa caffra*, *Panicum natalense*, *Setaria sphacelata* var. *torta*, *Themeda triandra*, and *Tristachya leucothrix*, and

the forbs, *Acalypha angustata*, *Anthospermum rigidum* subsp. *rigidum*, *Berkheya setifera*, *Chaetacanthus costatus*, *Commelina africana*, *Crabbea acaulis*, *Cucumis hirsutus*, *Cucumis zeyheri*, *Cyanotis speciosa*, *Gerbera viridifolia*, *Haplocarpha scaposa*, *Helichrysum rugulosum*, *Hemizygia pretoriae*, *Hermannia transvaalensis*, *Hibiscus aethiopicus*, *Hypoxis obtusa*, *Hypoxis rigidula*, *Indigofera comosa*, *Ipomoea ommaneyi*, *Justicia anagalloides*, *Kohautia amatymbica*, *Ledebouria ovatifolia*, *Monsonia attenuata*, *Nidorella hottentotta*, *Pentanisia angustifolia*, *Pollichia campestris*, *Scabiosa columbaria*, *Selago densiflora*, *Seriphium plumosum*, *Vernonia galpinii*, *Vernonia oligocephala*, and *Zornia milneana*. Overall diversity in this unit was high and included a full list of over 100 species. Local species richness was also high at 56 species per 400m<sup>2</sup> sampling area. This rivals the local richness of some of the most species-rich grasslands anywhere in the country.

## **Wetlands**

Wetlands were mapped from Google Earth imagery dated 28/03/2019, a date which shows the wetness signal very well as darker green areas. This also corresponds well to black and white historical aerial photographs from 1955, where wetlands appear as darker areas.

Valley bottom wetlands in this general area around Ermelo, such as this one, are generally dominated by a variety of grasses, sedges and herbaceous plants, including the graminoids, *Kyllinga erecta*, *Leersia hexandra*, *Agrostis lachnantha*, *Andropogon appendiculatus*, *Helictotrichon turgidulum*, *Scirpoides burkei*, *Cyperus teneristolon*, *Cyperus macranthus*, *Typha capensis*, *Agrostis erianthe*, *Hemarthria altissima*, *Panicum schinzii*, *Cyperus rigidifolius* and *Arundinella nepalensis*, the herbs, *Centella asiatica*, *Senecio polyodon*, *Senecio erubescens*, *Haplocarpha scaposa*, *Pelargonium luridum*, *Commelina africana*, *Lobelia flaccida*, *Monopsis decipiens*, and *Helichrysum aureonitens*. The species composition depends entirely on the hydrological characteristics of the site, with a greater number of obligate wetland species occurring in more permanently damp areas, whereas dryer areas more closely resembling terrestrial grassland in species composition.

## **Current cultivation**

These are areas that, according to recent satellite imagery, are currently being cultivated, or were recently cultivated (within the last five years). If not under crops, they would be a ploughed land, or a fallow land with either weeds or a cover crop. From an ecological or biodiversity perspective, these areas have no natural habitat and have no plant or vegetation biodiversity value. The soil profile has been completely disturbed, removing all original vegetation, including geophytic and resprouting plant species. In the Grassland Biome of South Africa, a large proportion of the indigenous biodiversity consists of herbaceous and low shrubby species that re-sprout seasonally, after fire, or after defoliation from grazing animals, and can persist under these conditions. In cultivated areas, it is possible through natural succession, or through active rehabilitation, to restore a perennial cover of grasses, but the original biodiversity is permanently lost. They also have little value for animal biodiversity, except for species that forage in cultivated areas.

## **Old lands**

These are areas that were previously ploughed for cultivation but have been left for an extended period without ploughing. Through natural succession processes, they generally develop a perennial cover of grasses, but these secondary grasslands are species poor and the original diversity of resprouting species is usually entirely absent. Non-grass species diversity usually consists of re-seeding and weedy species, and sometimes animal- and/or bird-dispersed woody species.

On aerial photographs and satellite images with adequate resolution, these areas are often recognisable by the presence of residual plough lines and other structural features often present in cultivated fields.

### ***Exotic trees***

There are planted windrows on the roadsides in various parts of the site, as well as within homestead complex areas. These are mostly deliberately planted some decades ago and are not alien invasive species. There are, however, various places on site where alien invasive species have become established in previously disturbed areas. In both cases, the underlying natural grassland is lost.

### ***Degraded areas***

Any areas where the original vegetation is lost due to continuous degradation, such as trampling, severe overgrazing, or some other factor, it is mapped as degraded. These areas are unlikely to restore to natural grassland, even with removal of the drivers of the degradation.

### ***Transformed areas***

Areas where natural habitat no longer exists due to development of infrastructure, such as roads, buildings, and other hard surfaces. Current cultivation is also transformed, but has not been replaced by built infrastructure, therefore the soil surface can be colonized by plants, if cultivation is stopped.

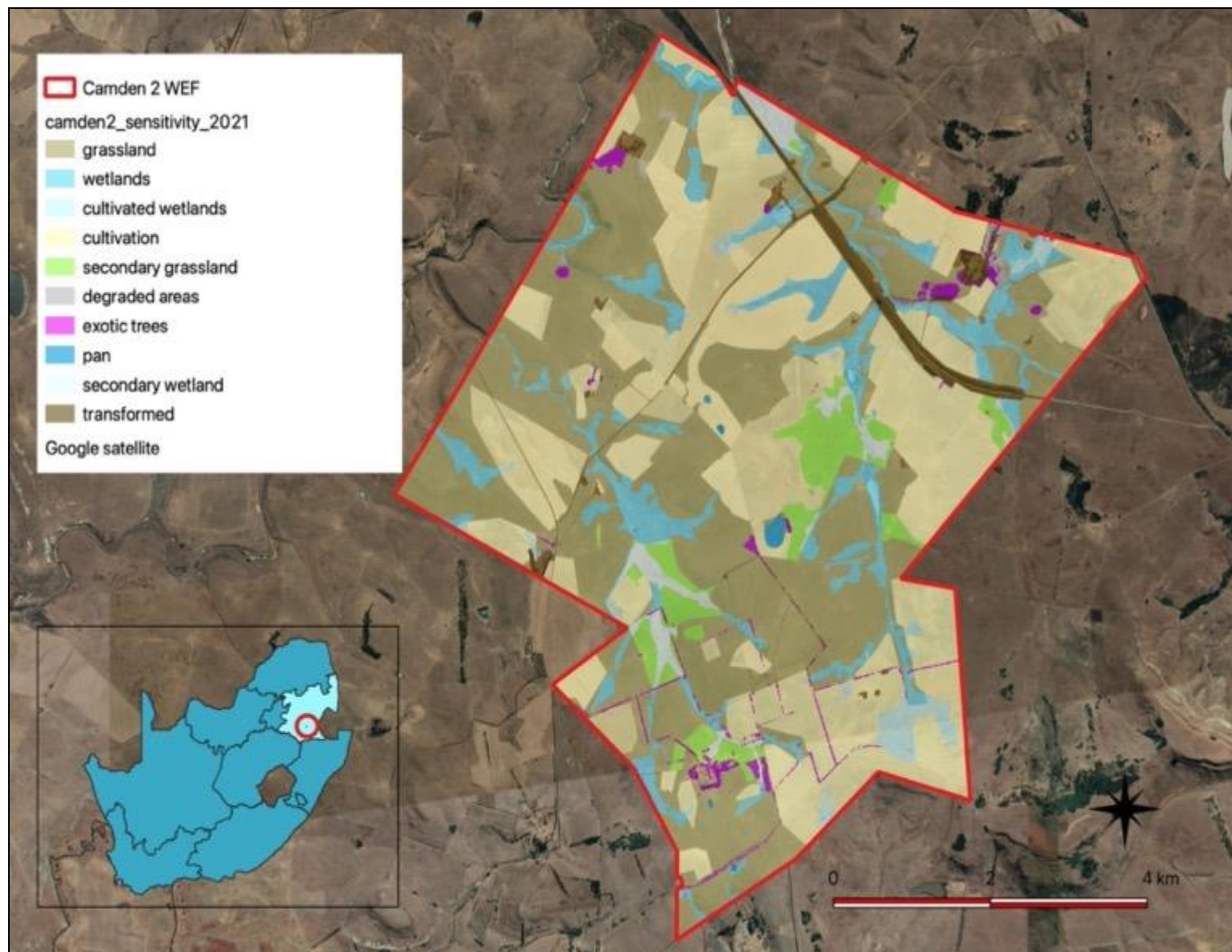


Figure 5: Main habitats of the study area.

## Plant species flagged for the study area

According to the DFFE online environmental screening tool, four plant species have been flagged as of concern for the area the current project is in. A description of each species is provided.

### **Sensitive species 1252**

Vulnerable A2cd

A medicinally harvested species not endemic to South Africa, found in Western Cape, Eastern Cape, KwaZulu-Natal, Free State, Gauteng, Mpumalanga, Limpopo Province, Swaziland, Zimbabwe and Zambia. It is found in wooded and relatively mesic places, such as the moister bushveld areas, coastal bush and wooded mountain kloofs. Although the site is within the overall distribution range of this species, there are no suitable habitats on site. It is therefore unlikely to occur there. There is a LOW probability of it occurring on site.

### ***Khadia carolinensis***

Vulnerable

Occurs at Carolina and Belfast in Eastern Highveld Grassland, Lydenburg Montane Grassland, and Rand Highveld Grassland. It is found in well-drained, sandy loam soils among rocky outcrops, or at the edges of sandstone sheets, at around 1700 m elevation. It has been recently recorded just to the north of the site in grasslands close to the Vaal River. Based on the known distribution and habitat requirements, as well as known nearby populations, there is a HIGH chance of it occurring in the general area where the project is located.

### **Sensitive species 1201**

Occurs on dolerite outcrops in grasslands at about 2000m altitude, from Dullstroom in the north to Vryheid in the south. This geophyte is fairly restricted and threatened by alien invasive plants, and is therefore listed as Vulnerable on the national Red List. This species is conspicuous when flowering, with attractive pale white flowers in summer. The closest locality at which this species has been observed is Hartebeespruit due south of Camden. It therefore has a MODERATE chance of occurring on the site.

### ***Aspidoglossum xanthosphaerum***

Vulnerable

Occurs in Mpumalanga, around Groenvlei and Ermelo. Closest known record is from Breyten and just to the west of Ermelo. It is found in montane grassland, marshy sites, at around 1800 m elevation. Based on the known distribution and habitat requirements, as well as known nearby populations, there is a HIGH chance of it occurring in the general area where the project is located.

### ***Khadia alticola***

A species listed as Rare, occurring at Steenkampsberg, Utrecht and Wakkerstroom, where it is found in montane grassland in shallow, sandy, humus-rich soil pockets and crevices between rock plates above 2000 m. It is a high altitude habitat specialist that is not threatened due to the inaccessibility of its habitat. The site is within the geographical range of the species, with observations far to the north as well as to the south of the site - most observations are in the mountains near to Lydenburg. There is therefore a possibility of it occurring on site, although the habitat description suggests that suitable habitat probably does not occur on site. It is therefore assessed here that there is, at most, a MODERATE probability of it occurring on site.

***Lotononis amajubica***

A species listed as Rare, occurring in high mountain peaks of southern Mpumalanga, north-western KwaZulu-Natal and eastern Free State, where it is found in well-drained, high altitude grassland, at altitudes of 1600-1800 m. Known observations clearly show that it occurs in the rugged escarpment zone typical of the area around Wakkerstroom. There is a LOW probability of it occurring on site.

***Sensitive species 41***

A common and widespread geophyte that is very similar to *Gladiolus crassifolius*, also a widespread and common species with a similar distribution. The main distribution area is Witbank to Lydenburg, and southwards to Piet Retief and Wakkerstroom. It occurs in wetlands or marshes in high altitude grassland that remain wet throughout the year or dry out for only a short period. This species is listed on the South African Red List with a national assessment of Vulnerable, but is currently not recognized by the IUCN as it is regarded as a synonym of *G. crassifolius*. Whereas this species is confined more to wetland habitats, *G. crassifolius* has larger leaves, longer spikes and smaller flowers, and is found in drier, more stony habitats. It flowers from October to January and has a high probability of occurring in wetland areas on the study site. Without flowers, the plant can be recognized as a *Gladiolus*. The closest historical record is approximately 30km from the study site. This species has a MODERATE chance of occurring on the site.

***Sensitive species 691***

A widespread geophyte distributed in Free State, North West, Gauteng, and in Mpumalanga from Belfast and Ermelo to Wolmaransstad. It is found in wetlands in undulating grasslands. The species is currently listed as Vulnerable. It flowers from January to March but its peak flowering month is February. It could feasibly be found in wet areas on the site but is quite conspicuous in February when it flowers. The closest historical record is approximately 40km from the site. It has a MODERATE chance of occurring on the site.

***Sensitive species 998***

Endangered A2bd

A species that is widespread and extremely common across the eastern highveld of Mpumalanga, the eastern Free State, and north-western KwaZulu-Natal. It is harvested for the traditional medicine trade. It occurs along the north and north-eastern borders of Lesotho and is also found in Eswatini, on the Eastern Highlands of Zimbabwe and the Chimanimani Mountains of Mozambique. It is found on forest margins, west and south facing mountain slopes and near drainage lines or islands within wetlands, as well as open grassland or on forest margins, often amongst rocks and/or along streams. All known distribution records show that it does not occur within the grids in which the site is found, or any surrounding grids, and that it is probably restricted to the escarpment zone in the area closest to the site. Therefore, although potentially suitable habitat may occur on site (open grassland), there is a LOW probability of it occurring on site.

***Sensitive species 1219***

Vulnerable B1ab(iii)+2ab(iii)

This species occurs in scattered, isolated subpopulations across the Mpumalanga Highveld, from Dullstroom to Graskop, and southwards to Barberton and Wakkerstroom. It occurs in seasonally moist, high altitude montane grasslands, 1800-2300 m. There are no known records of it occurring in or around the study area. Much of this species habitat along the Mpumalanga escarpment edge was lost to commercial timber plantations in the past, and

two remaining subpopulations in this area occur on isolated fragments among plantations. It is relatively common in the Wakkerstroom and Dullstroom areas. There is a LOW probability of it occurring on site.

### ***Pachycarpus suaveolens***

Vulnerable

Occurs in Gauteng and Mpumalanga to Eswatini, where it is found in Lydenburg Montane Grassland, Eastern Highveld Grassland, and Soweto Highveld Grassland in short or annually burnt grasslands, at elevations of 1400-2000 m. Based on the known distribution and habitat requirements, as well as known nearby populations, there is a HIGH chance of it occurring in the general area where the project is located.

### **Sensitive species 321**

Rare

A high altitude habitat specialist, known from the Drakensberg Mountain Range from Mpumalanga through Lesotho and KwaZulu-Natal to the Eastern Cape. It is found in montane and subalpine grassland at altitudes of 1600 - 3000 m, on grassy and sometimes stony or moist slopes. There are no known records of it occurring in or around the study area. There is a LOW probability of it occurring on site.

### **Sensitive species 851**

A small succulent perennial herb with white flowers, growing in marshy areas or shallow vleis. This species is listed as Vulnerable but the confidence in this assessment is low (according to the Red List). Its distribution is uncertain because of its taxonomic confusion with the very similar *Crassula inanis*, but it appears to be restricted to the area between Ermelo and Maseru. The closest known record to the site of the Project is in the Bethal area. It has a MODERATE chance of occurring on the site.

### ***Zaluzianskya distans***

This is a widespread, but very rare species that is listed as Rare. It occurs from the Mpumalanga Drakensberg Escarpment near Lydenburg southwards to the KwaZulu-Natal Drakensberg foothills near Himeville, where it is found in damp, partially shaded places in the shelter of rocks or montane scrub and in scrub-filled watercourses. Known observations clearly show that it occurs in the rugged escarpment zone typical of the area around Wakkerstroom. There is a LOW probability of it occurring on site.

### **Additional listed plant species for the study area**

A database search identified a number of additional plant species of conservation concern that could also occur on site that are not flagged in the Screening Tool output. These include the following:

Taxon	Red List status	Habitat and distribution	Flowering Time	Probability of occurrence
Alepidea longeciliata APIACEAE	Endangered	Between Breyten, Lothair, Middelburg and Stoffberg. Recorded from 2 neighbouring grids. Eastern Highveld Grassland. Grassland, Karoo Sandstone, above 1600 m. Possibly associated with edges of pans.	Summer	<b>MODERATE</b> (within known overall distribution)



Bowiea volubilis subsp. volubilis HYACINTHACEAE	Vulnerable (national)	Eastern Cape to Limpopo Province. Widespread elsewhere in southern and eastern Africa. Low and medium altitudes, usually along mountain ranges and in thickly vegetated river valleys, often under bush clumps and in boulder scree, sometimes found scrambling at the margins of karroid, succulent bush in the Eastern Cape. Occurs in bushy kloofs at the coast and inland in KwaZulu-Natal. In Gauteng, Mpumalanga and North West Province it is often found in open woodland or on steep rocky hills usually in well-shaded situations. Tolerates wet and dry conditions, growing predominantly in summer rainfall areas with an annual rainfall of 200-800 mm.		LOW (site within gap in distribution, habitat not suitable)
Brachystelma gerrardii APOCYNACEAE	Endangered	KwaZulu-Natal, Waterberg, Wolkberg and Eswatini. Open grassland, 400-1800 m. Site is within overall distribution range, but plant absent from Mpumalanga highveld.		LOW
Eucomis pallidiflora subsp. polevansii HYACINTHACEAE	Near Threatened	Pilgrim's Rest and Lydenburg to Eswatini to southern Mpumalanga. Wetlands in grassland, often in standing water up to 300 mm deep. Recorded at Ermelo in similar habitat as that found on site.		<b>HIGH</b>
Gladiolus robertsoniae IRIDACEAE	Near Threatened	South-eastern Gauteng, northern Free State and south-western Mpumalanga. Moist highveld grasslands, found in wet, rocky sites, mostly dolerite outcrops, wedged in rock crevices.		<b>HIGH</b>
Habenaria barbertonii ORCHIDACEAE	Near Threatened	Gauteng and Mpumalanga. Rocky hillsides, in bushveld in association with acacias, 1000-1500 m.	February to March	<b>MODERATE</b> (habitat may not be suitable)
Kniphofia typhoides ASPHODELACEAE	Near Threatened	Gauteng, Limpopo, Mpumalanga, North West, Parys to Lydenburg to		<b>MODERATE</b>



		Paulpietersburg to Newcastle. Low lying wetlands and seasonally wet areas in climax Themeda triandra grasslands on heavy black clay soils, tends to disappear from degraded grasslands.		(habitat may not be suitable)
Merwillia plumbea HYACINTHACEAE	Near Threatened	Widespread in eastern half of South Africa. Also in Eswatini and Lesotho. Montane mistbelt and Ngongoni grassland, rocky areas on steep, well drained slopes. 300-2500 m.		<b>HIGH</b>
Miraglossum davyi APOCYNACEAE	Vulnerable	Dullstroom, Middelburg and Standerton. Grassland (Lydenburg Montane Grassland, Soweto Highveld Grassland, Eastern Highveld Grassland).		<b>HIGH</b>
Riocreuxia aberrans APOCYNACEAE	Near Threatened	Dullstroom to Ermelo. Grassland. Wedged in cracks among rocks on exposed quartzite ridges.		LOW (habitat not suitable)

## Protected species recorded in the study area

None of the tree species protected under the National Forests Act (Appendix 1) have been previously recorded in the area in which the site is located. A full list of plants that could occur on site, as well as those actually recorded, is given in Appendix 2.

There are a number of species recorded on site that are protected under the Mpumalanga Nature Conservation Act No. 10 of 1998 (Appendix 3). It is a legal requirement to obtain a permit from the provincial authorities for the destruction of any of these species. A comprehensive walk-through survey of the final footprint is required to compile a complete list of these protected species.

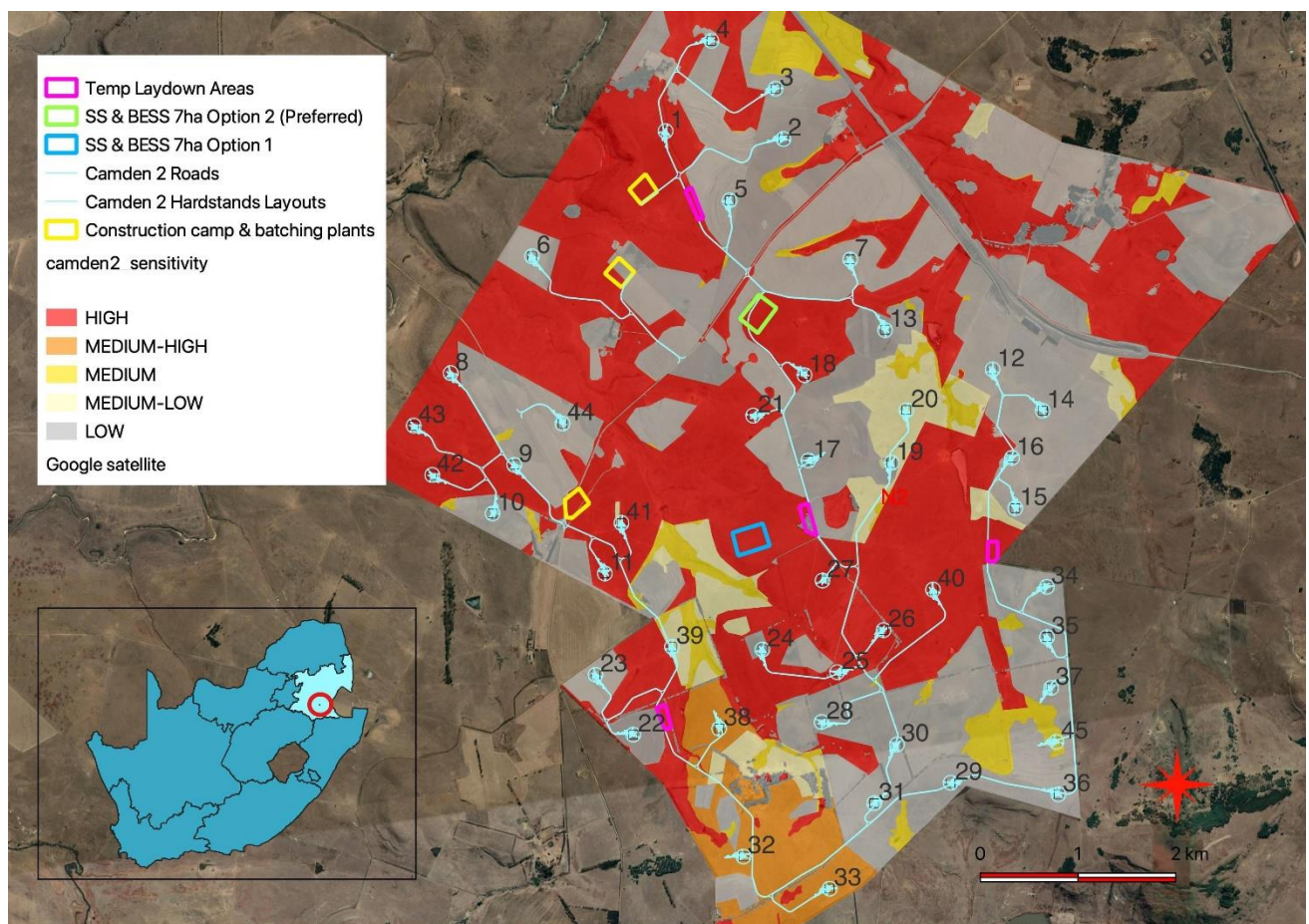
# POSSIBLE IMPACTS

## Anticipated impacts

For all infrastructure components there is the possibility that individuals or populations of plant species of conservation concern may be lost due to construction impacts. Based on known information, and data collected on site, the probability of encountering species of conservation concern at any particular location is considered to be low. Due to the high degree of transformation on site, there is limited amount of habitat in which rare species are likely to be found. Approximately half of the proposed road network, which is the infrastructure component of wind projects with the highest impact on natural habitats, is within transformed areas (see Figure 6).

The best mitigation to address uncertainty issues related to SCC is to do a walk-through survey of all final infrastructure positions to check for SCC, and to collect the necessary data for any flora permits that may be required.

Based on the field data and desktop assessment of SCC, the specific habitats or locations where the risk is considered to be higher than anywhere else is within the wetlands and adjacent grasslands (Figure 6). Any areas with permanent moisture are potential habitat for one SCC.



**Figure 6: Proposed infrastructure in relation to habitat sensitivity on site.**

## Proposed infrastructure in relation to sensitivities

Infrastructure locations relative to mapped Plant Theme sensitivities are shown in Figure 6.

## Construction Phase Impacts

The only impact is potential loss of individuals of SCC.

# ASSESSMENT OF IMPACTS

A detailed assessment, as per the requirements the protocol for the specialist assessment and minimum report content requirements of environmental impacts on terrestrial plant species for activities requiring environmental authorisation, (20 March 2020), of the significance of all impacts during all phases of the project (Construction, Operation, Decommissioning and Cumulative) is provided below. This also includes all proposed mitigation measures and provides assessment before and after the implementation of proposed mitigation measures.

## Construction Phase Impacts

Loss of individuals of Species of Conservation Concern due to clearing for construction

Loss of individuals of Species of Conservation Concern due to clearing for construction		
Impact 1		
Issue	Clearing of natural habitat for construction	
Description of Impact		
The impact will occur due to clearing of indigenous vegetation for the purposes of construction of infrastructure.		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	Construction	
Criteria	Without Mitigation	With Mitigation
Extent	2	2
Duration	5	5
Reversibility	5	5
Magnitude (severity of impact)	2	2
Probability	3	1
Significance	42 (MODERATE)	14 (VERY LOW)
Mitigation actions		
The following measures are recommended:	1. Prior to construction commencing, undertake a detailed walk-through survey of footprint areas that are within habitats where SCC are likely to occur. 2. Where significant populations of SCC are found, collect the data for any flora permits or micro-siting of infrastructure that may be required. 3. Prior to construction commencing, compile a Plant Rescue Plan, including monitoring specifications (timeframe, frequency etc). 4. Undertake monitoring (as per the Plant Rescue Plan specifications) to evaluate whether further measures would be required to manage impacts.	
Monitoring		

<b>The following monitoring is recommended:</b>	As per management plans.
-------------------------------------------------	--------------------------

## Cumulative Impacts

Cumulative impacts on SCC from construction clearing due to a number of projects

Cumulative impacts on SCC from construction clearing due to a number of projects		
Impact 2		
Issue	Loss of individuals of Species of Conservation Concern	
Description of Impact		
Construction activities will require clearing of natural habitat, to be replaced by the infrastructure. This will result in possible loss of populations of SCC.		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	Construction	
Criteria	Overall impact of the proposed project considered in isolation	Cumulative impact of the project and other projects in the area
Extent	2	3
Duration	5	5
Reversibility	5	5
Magnitude (severity of impact)	2	3
Probability	1	3
Significance	14 (VERY LOW)	48 (MEDIUM)

## Summary of mitigation measures

The following mitigation measures are recommended to address known potential impacts:

1. It is a legal requirement to obtain permits for specimens or protected species that will be lost due to construction of the project.
2. A detailed pre-construction walk-through survey will be required during a favourable season where possible, to locate any individuals of protected plants, as well as for any populations of threatened plant species. This survey must cover the footprint of all approved infrastructure, including internal service roads and footprints of tower structures (final infrastructure layout). The best season is early to late Summer if possible, taking administrative processes into account, but will be influenced by recent rainfall and vegetation growth.
3. It is possible that some plants lost to the development can be rescued and planted in appropriate places in rehabilitation areas, but the description and appropriateness of such measures must be included in a Plant Rescue Plan. Any such measures will reduce the irreplaceable loss of resources as well as the cumulative effect. Note that Search and Rescue is only appropriate for some species and that a high mortality rate can be expected from individuals of species that are not appropriate to transplant.
4. Prior to construction commencing, a Plant Rescue Plan must be compiled to be approved by the appropriate authorities as part of the EMPr approval.
5. For any plants that are transplanted, annual monitoring should take place to assess survival. This should be undertaken as per the frequency specified in the management plan and be undertaken by a qualified botanist. The monitoring programme must be designed prior to translocation of plants and should include control sites (areas not disturbed by the project) to evaluate mortality relative to wild populations.
6. No collecting or poaching of any plant species.

## Summary of monitoring recommendations

Specific monitoring recommendations should be provided in the Plant Rescue Plan, the Alien Invasive Management Plan, and the Rehabilitation Plan. The following are broad recommendations:

### ***Rescued plants***

1. The location of all transplanted rescued plants must be recorded, along with the identity of the plant.
2. The health / vigour of each transplanted individual should be monitored as per the frequency and duration specified in the management plan.
3. As a scientific control, an equal number of non-transplanted individuals of the same species, within similar habitats, should be monitored in the same way as the transplanted specimens. This will provide comparative data on the survival of wild populations relative to transplanted plants.

### ***Threatened species***

1. If populations of threatened plant species are found to occur on site, annual monitoring of population health should take place. This should be appropriate to the species concerned.

# CONCLUSIONS

There are fourteen plant species of conservation concern flagged by the screening tool of which only three have a high probability of occurring on site, as well as additional species from historical records from SANBI databases, but none were seen during general field surveys. A targeted walk-through survey of footprint of construction areas is required prior to the commencement of construction, to determine whether or not any occur in the footprint of the development. This survey can take place at the same time as the required walk-through surveys for permitting purposes, or it can be undertaken as a separate targeted survey. It is recommended that this is undertaken in optimum growing season where possible.

## Required pre-construction survey

For permitting purposes, the following flora survey is required prior to construction activities taking place:

Detailed floristic walk-through survey of all footprint areas in order to document composition, especially of protected species. It is suggested this be undertaken after an appropriate time-period after rainfall, where possible, to allow emergence of any species of potential concern. The survey must also cover all footprint areas, including final road alignments. Renewable energy projects similar to the one assessed here tend to have high fluidity in terms of layout and technology, due to the current rapid evolution of the technology, which allows more efficient deployment of infrastructure. However, this means that “final” layouts regularly change. The walk-through survey:

1. MUST ASSESS THE FOOTPRINT THAT WILL BE CONSTRUCTED – if this changes then the new footprint areas must be subject to a walk-through survey in full.
2. MUST BE UNDERTAKEN IN THE CORRECT SEASON, if possible, taking administrative processes into account.
3. MUST BE ADEQUATELY RESOURCED TO ENSURE IT IS DONE PROPERLY.
4. MUST BE UNDERTAKEN BY A COMPETENT BOTANIST WITH KNOWLEDGE OF THE AREA.



## REFERENCES

- IUCN (2001). *IUCN Red Data List categories and criteria: Version 3.1*. IUCN Species Survival Commission: Gland, Switzerland.
- MUCINA, L. AND RUTHERFORD, M.C. (editors) 2006. Vegetation map of South Africa, Lesotho and Swaziland: an illustrated guide. *Strelitzia* 19, South African National Biodiversity Institute, Pretoria.
- VAN WYK, A.E. AND SMITH, G.F. (Eds) 2001. Regions of Floristic Endemism in Southern Africa: A review with emphasis on succulents, pp. 1-199. Umdaus Press, Pretoria.

# APPENDICES

## Appendix 1: List of protected tree species (National Forests Act, 1998).

In terms of section 15(1) of the National Forests Act, 1998, no person may cut, disturb, damage or destroy any protected tree; or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree or any product derived from a protected tree, except under a licence or exemption granted by the Minister of Agriculture, Forestry and Fisheries. The list of Protected Tree Species under the National Forest Act, 1998 (Act No. 84 of 1998) is attached here as Appendix 1. The most recent version of this list was published in the Government Gazette No. 41887 on 7 September 2018, designated as GN No. 536 of 2018, and contains 47 species distributed across South Africa.

<b>Botanical name</b>	<b>English common names</b>	<b>Other common names Afrikaans (A), Sepedi (P), Sesotho (S), Setswana (T), Tshivenda (V), isiXhosa (X), isiZulu (Z), Xitsonga (XT)</b>	<b>National tree number</b>
<i>Acacia erioloba</i>	Camel thorn	Kameeldoring (A)/Mogohlo (NS)/Mogoŋlho (T)/	168
<i>Acacia haematoxylon</i>	Grey camel thorn	Vaalkameeldoring (A)/Mokholo (T))	169
<i>Adansonia digitata</i>	Baobab	Kremetart (A)/Seboi (NS)/Mowana (T)/Ximuwu (XT)	467
<i>Azelia quanzensis</i>	Pod mahogany	Peulmahonie (A)/Mutokota (V)/Inkehli (Z)	207
<i>Balanites subsp. maughamii</i>	Torchwood	Groendoring (A)/Ugobandlovu (Z)	251
<i>Barringtonia racemosa</i>	Powder-puff tree	Poeierkwasboom (A)/lboqo (Z)	524
<i>Boscia albitrunca</i>	Shepherd's tree	Witgat (A)/Mohlōpi (NS)/Motlhoŋpi (T)/Muvhombwe (V)/Umgqomogqomo (X)/Umvithi (Z)	122
<i>Brachystegia spiciformis</i>	Msasa	Msasa (A)	198.1
<i>Breonadia salicina</i>	Matumi	Mingerhout (A)/Mohlome (NS)/Mutu-lume (V)/Umfomfo (Z)	684
<i>Bruguiera gymnorhiza</i>	Black mangrove	Swartwortelboom (A)/isiKhangati (X)/IsiHlobane (Z)	527
<i>Cassipourea swaziensis</i>	Swazi onionwood	Swazi-uehout (A)	531.1
<i>Catha edulis</i>	Bushman's tea	Boesmanstee (A)/Mohlatse (NS)/lgqwaka (X)/Umhlwazi (Z)	404

<i>Ceriops tagal</i>	Indian mangrove	Indiese wortelboom (A)/isinkaha (Z)	525
<i>Cleistanthus schlechteri</i> var. <i>schlechteri</i>	False tamboti	Bastertambotie (A)/Umzithi (Z)	320
<i>Colubrina nicholsonii</i>	Pondo weeping thorn	Pondo-treurdoring (A)	453.8
<i>Combretum imberbe</i>	Leadwood	Hardekool (A)/Mohwelere-tšhipi (NS)/Motswiri (T)/Impondondlovu (Z)	539
<i>Curtisia dentata</i>	Assegai	Assegai (A)/Umgxina (X)/Umagunda (Z)	570
<i>Elaeodendron transvaalensis</i>	Bushveld saffron	Bosveld-saffraan (A)/Monomane (T)/Ingwavuma (Z)	416
<i>Erythrophysa transvaalensis</i>	Bushveld red balloon	Bosveld-rooiklapperbos (A)/Mofalatsane (T)	436.2
<i>Euclea pseudebenus</i>	Ebony guarri	Ebbeboom-ghwarrie (A)	598
<i>Ficus trichopoda</i>	Swamp fig	Moerasvy (A)/Umvubu (Z)	54
<i>Leucadendron argenteum</i>	Silver tree	Silwerboom (A)	77
<i>Lumnitzera racemosa</i> var. <i>racemosa</i>	Tonga mangrove	Tonga-wortelboom (A)/isiKhaha-esibomvu (Z)	552
<i>Lydenburgia abbottii</i>	Pondo bushman's tea	Pondo-boesmanstee (A)	407
<i>Lydenburgia cassinoides</i>	Sekhukhuni bushman's tea	Sekhukhuni-boesmanstee (A)	406
<i>Mimusops caffra</i>	Coastal red milkwood	Kusrooimelkhout (A)/Umthunzi (X)/Umkhakhayi (Z)	583
<i>Newtonia hildebrandtii</i> var. <i>hildebrandtii</i>	Lebombo wattle	Lebombo-wattel (A)/Umfomothi (Z)	191
<i>Ocotea bullata</i>	Stinkwood	Stinkhout (A)/Umhlungulu (X)/Umnukane (Z)	118
<i>Ozoroa namaquensis</i>	Gariep resin tree	Gariep-harpuisboom (A)	373.2
<i>Philenoptera violacea</i>	Apple-leaf	Appelblaar (A)/Mphata (NS)/Mohata (T)/isiHomohomo (Z)	238
<i>Pittosporum viridiflorum</i>	Cheesewood	Kasuur (A)/Kgalagangwe (NS)/Umkhwenkwe (X)/Umfusamvu (Z)	139
<i>Podocarpus elongatus</i>	Breede River yellowwood	Breeërviergeelhout (A)	15
<i>Podocarpus falcatus</i> ( <i>Afrocarpus falcatus</i> )	Outeniqua yellowwood	Outniekwageelhout (A)/Mogōbagōba (NS)/Umkhoba (X)/Umsonti (Z)	16
<i>Podocarpus henkelii</i>	Henkel's yellowwood	Henkel se geelhout (A)/Umsonti (X)/Umsonti (Z)	17
<i>Podocarpus latifolius</i>	Real yellowwood	Regte-geelhout (A)/Mogōbagōba (NS)/Umcheya (X)/Umkhoba (Z)	18

<i>Protea comptonii</i>	Saddleback sugarbush	Barberton-suikerbos (A)	88
<i>Protea curvata</i>	Serpentine sugarbush	Serpentynsuikerbos (A)	88.1
<i>Prunus africana</i>	Red stinkwood	Rooistinkhout (A)/Umkhakhase (X)/Umdumezulu (Z)	147
<i>Pterocarpus angolensis</i>	Wild teak	Kiaat (A)/Morotō (NS)/Mokwa (T)/Mutondo (V)/Umvangazi (Z)	236
<i>Rhizophora mucronata</i>	Red mangrove	Rooiwortelboom (A)/isiKhangathi (X)/Umhlume (Z)	526
<i>Sclerocarya birrea</i> subsp. <i>caffra</i>	Marula	Maroela (A)/Morula (NS)/Morula (T)/Umganu (Z) /Nkanyi (XT)	360
<i>Securidaca longepedunculata</i>	Violet tree	Krinkhout (A)/Mmaba (T)	303
<i>Sideroxylon inerme</i> subsp. <i>inerme</i>	White milkwood	Witmelkhout (A)/Ximafana (X)/Umakhwelafingqane (Z)	579
<i>Tephrosia pondoensis</i>	Pondo poison pea	Pondo-gifertjie (A)	226.1
<i>Warburgia salutaris</i>	Pepper-bark tree	Peperbasboom (A)/Molaka (NS)/Mulanga (V)/isiBaha (Z)	488
<i>Widdringtonia cedarbergensis</i>	Clanwilliam cedar	Clanwilliamseder (A)	19
<i>Widdringtonia schwarzii</i>	Willowmore cedar	Baviaanskloofseder (A)	21
<i>Berchemia zeyheri</i> (RHAMNACEAE) LC	Red ivory Pink ivory	Rooi-ivoor (A) / Rooihout (A) / Monee (S) / umNeyi (SW) / umNini (Z, X) / Xiniyani (TS) / Moye (T) / Munia-niane (V)	450
<i>Diospyros mespiliformis</i> (EBENACEAE) LC	Jackal berry	Jakkalsbessie (A) / Musuma (V) / Muntoma (TS) / Mgula (TS)	606
<i>Schinziophyton rautanenii</i>	Manketti / Mongongo	Mankettiboom (A) / Monghongho (T) / Makongwa (T)	337
<i>Umtiza listeriana</i>	Umtiza	Umtiza (X) / Omtisa (A)	205

## Appendix 2: Plant species recorded on site and nearby.

This list was compiled by extracting a list of species that have been recorded within a rectangular area that includes the study area as well as similar habitats in surrounding areas, as obtained from SANBI ([www.newposa.sanbi.org](http://www.newposa.sanbi.org)) accessed on 12 September 2021. It is probable that it includes some species that occur in habitats that do not occur on site. The list was supplemented from field observations, as well as observations from the online iNaturalist tool and database (<https://www.inaturalist.org>), which are photographic observations verified by an online community.

The list is arranged by family in alphabetical order. Species listed in **green** are those that were found on site.

### **Acanthaceae**

*Blepharis innocua*  
*Blepharis stainbankiae*  
*Blepharis subvolubilis*  
*Crabbea acaulis*  
*Dyschoriste burchellii*  
*Justicia anagalloides*  
*Ruellia cordata*  
*Thunbergia atriplicifolia*  
*Thunbergia pondoensis*

### **Achariaceae**

*Ceratiosicyos laevis*  
*Kiggelaria africana*

### **Agapanthaceae**

*Agapanthus inapertus*. subsp. *intermedius*

### **Agavaceae**

*Chlorophytum comosum*  
*Chlorophytum cooperi*  
*Chlorophytum fasciculatum*  
*Chlorophytum galpinii*

### **Aizoaceae**

*Delosperma sutherlandii*  
*Khadia carolinensis*  
*Mossia intervallaris*  
*Ruschia* sp.

### **Alliaceae**

*Tulbaghia acutiloba*  
*Tulbaghia cernua*  
*Tulbaghia leucantha*

*Tulbaghia ludwigiana*

### **Amaranthaceae**

*Amaranthus hybridus* subsp. *cruentus*; Naturalised

*Amaranthus hybridus* subsp. *hybridus* var. *hybridus*; Naturalised

*Amaranthus thunbergii*

*Chenopodium album*; Naturalised

*Cyathula cylindrica* var. *cylindrica*

*Cyathula uncinulata*

*Gomphrena celosioides*; Naturalised

*Guilleminea densa*; Naturalised; Invasive

### **Amaryllidaceae**

*Boophone disticha*

*Brunsvigia natalensis*

*Brunsvigia radulosa*

*Crinum bulbispermum*

*Cyrtanthus breviflorus*

*Cyrtanthus stenanthus* var. *major*

*Cyrtanthus tuckii* var. *transvaalensis*

*Cyrtanthus tuckii* var. *tuckii*

*Haemanthus humilis* subsp. *hirsutus*

*Haemanthus montanus*

*Nerine angustifolia*

*Nerine gracilis*

*Nerine krigei*

*Nerine rehmannii*

*Scadoxus puniceus*

### **Anacardiaceae**

*Ozoroa engleri*

*Searsia dentata*

*Searsia discolor*

*Searsia magalismontana* subsp. *magalismontana*

*Searsia rigida* var. *rigida*

*Searsia tumulicola* var. *tumulicola*

### **Apiaceae**

*Afrosciadium magalismontanum*

*Alepidea peduncularis*

*Centella asiatica*

*Heteromorpha arborescens* var. *abyssinica*

### **Apocynaceae**

*Anisotoma pedunculata*

*Asclepias albens*

*Asclepias aurea*

*Asclepias brevicuspis*

*Asclepias crassinervis*

*Asclepias cucullata* subsp. *cucullata*

*Asclepias cultriformis*

*Asclepias eminens*  
*Asclepias fulva*  
*Asclepias gibba* var. *gibba*  
*Asclepias gibba* var. *media*  
*Asclepias macropus*  
*Asclepias multicaulis*  
*Asclepias stellifera*  
*Aspidoglossum araneiferum*  
*Aspidoglossum biflorum*  
*Aspidoglossum glanduliferum*  
*Aspidoglossum lamellatum*  
*Aspidoglossum ovalifolium*  
*Aspidoglossum xanthosphaerum*  
*Brachystelma foetidum*  
*Brachystelma pygmaeum* subsp. *pygmaeum*  
*Cordylogyne globosa*  
*Gomphocarpus fruticosus*  
*Gomphocarpus rivularis*  
*Miraglossum pulchellum*  
*Pachycarpus campanulatus* var. *sutherlandii*  
*Pachycarpus grandiflorus* subsp. *grandiflorus*  
*Pachycarpus macrochilus*  
*Pachycarpus plicatus*  
*Pachycarpus scaber*  
*Pachycarpus suaveolens*  
*Parapodium costatum*  
*Raphionacme hirsuta*  
*Riocreuxia picta*  
*Riocreuxia polyantha*  
*Schizoglossum atropurpureum atropurpureum*  
*Schizoglossum nitidum*. Indigenous  
*Schizoglossum peglerae*  
*Sisyranthus huttoniae*  
*Sisyranthus imberbis*  
*Stenostelma periglossoides*  
*Woodia* sp.  
*Xysmalobium asperum*  
*Xysmalobium parviflorum*  
*Xysmalobium stockenstromense*  
*Xysmalobium undulatum* var. *undulatum*

### **Aponogetonaceae**

*Aponogeton junceus*

### **Araceae**

*Zantedeschia albomaculata* subsp. *macrocarpa*  
*Zantedeschia rehmannii*

### **Asparagaceae**

*Asparagus bechuanicus*  
*Asparagus cooperi*

*Asparagus devenishii*  
*Asparagus fractiflexus*  
*Asparagus laricinus*  
*Asparagus ramosissimus*  
*Asparagus virgatus*

### **Asphodelaceae**

*Aloe bergeriana*  
*Aloe boylei*  
*Aloe davyana*  
*Aloe ecklonis*  
*Aloe graciliflora*  
*Aloe hlangapies*  
*Aloe jeppae*  
*Aloe maculata* subsp. *maculata*  
*Bulbine abyssinica*  
*Bulbine capitata*  
*Kniphofia albescens*  
*Kniphofia porphyrantha*  
*Kniphofia typhoides*  
*Trachyandra asperata* var. *carolinensis*  
*Trachyandra asperata* var. *macowanii*  
*Trachyandra asperata* var. *nataglencoensis*  
*Trachyandra asperata* var. *swaziensis*  
*Trachyandra gerrardii*  
*Trachyandra saltii* var. *saltii*

### **Aspleniaceae**

*Asplenium aethiopicum*  
*Asplenium capense*

### **Asteraceae**

*Adenanthellum osmitoides*  
*Afroaster hispidus*  
*Afroaster serrulatus*  
*Artemisia afra*  
*Athrixia elata*  
*Berkheya echinacea* subsp. *echinacea*  
*Berkheya insignis*  
*Berkheya pinnatifida* subsp. *ingrata*  
*Berkheya radula*  
*Berkheya setifera*  
*Berkheya speciosa* subsp. *lanceolata*  
*Berkheya zeyheri* subsp. *zeyheri*  
*Bidens pilosa*; Naturalised  
*Callilepis salicifolia*  
*Campuloclinium macrocephalum*; Naturalised; Invasive  
*Cineraria lyratiformis*  
*Cirsium vulgare*; Naturalised; Invasive, NEMBA Category 1b  
*Conyza gouanii*  
*Conyza pinnata*



*Conyza podocephala*  
*Cosmos bipinnatus*; Naturalised  
*Cotula anthemoides*  
*Denekia capensis*  
*Dichrocephala integrifolia* subsp. *integrifolia*  
*Dicoma anomala*  
*Didelta carnosae* var. *carnosae*  
*Dimorphotheca caulescens*  
*Dimorphotheca jucunda* E  
*Dimorphotheca spectabilis*  
*Dimorphotheca zeyheri*  
*Erigeron bonariensis*; Naturalised; Invasive  
*Erigeron canadensis*; Naturalised; Invasive  
*Euryops gilfillanii*  
*Euryops laxus* (  
*Euryops transvaalensis* subsp. *setilobus*  
*Felicia filifolia* subsp. *filifolia*  
*Felicia muricata* subsp. *muricata*  
*Felicia muricata* subsp. *strictifolia*  
*Gamochaeta antillana*; Naturalised; Invasive  
*Gamochaeta pensylvanica*; Naturalised  
*Gazania krebsiana*. subsp. *serrulata*  
*Geigeria aspera* var. *aspera*  
*Geigeria burkei* subsp. *burkei* var. *burkei*  
*Geigeria burkei* subsp. *burkei* var. *intermedia*  
*Geigeria burkei* subsp. *valida*  
*Geigeria filifolia*  
*Gerbera ambigua*  
*Gerbera natalensis*  
*Gerbera piloselloides*  
*Gerbera viridifolia*  
*Gnaphalium filagopsis*  
*Haplocarpha scaposa*  
*Helichrysum adenocarpum* subsp. *adenocarpum*  
*Helichrysum albilanatum*  
*Helichrysum aureonitens*  
*Helichrysum aureum* var. *monocephalum*  
*Helichrysum caespititium*  
*Helichrysum callicomum*  
*Helichrysum cephaloideum*  
*Helichrysum griseum*  
*Helichrysum miconiifolium*  
*Helichrysum molestum*  
*Helichrysum mundtii*  
*Helichrysum nudifolium* var. *nudifolium*  
*Helichrysum nudifolium* var. *pilosellum*  
*Helichrysum opacum*  
*Helichrysum oreophilum*  
*Helichrysum rugulosum*  
*Helichrysum splendidum*  
*Helichrysum subglomeratum*

*Hilliardiella aristata*  
*Hilliardiella elaeagnoides*  
*Hilliardiella hirsuta*  
*Hilliardiella nudicaulis*  
*Hypochaeris radicata*; Naturalised  
*Lactuca inermis*  
*Lasiospermum pedunculare*  
*Lopholaena segmentata*  
*Macleodium zeyheri* subsp. *zeyheri*  
*Nidorella anomala*  
*Nidorella auriculata*  
*Nidorella resedifolia* subsp. *resedifolia*  
*Osteospermum moniliferum* subsp. *canescens*  
*Osteospermum scariosum* var. *scariosum*  
*Othonna natalensis*  
*Parapolydora fastigiata*  
*Polydora angustifolia*  
*Pseudognaphalium luteoalbum* cryptogenic  
*Pseudognaphalium oligandrum*  
*Pseudopegolettia tenella*  
*Pulicaria scabra*  
*Schistostephium crataegifolium*  
*Schkuhria pinnata*; Naturalised  
*Senecio affinis*  
*Senecio albanensis* var. *albanensis*  
*Senecio bupleuroides*  
*Senecio coronatus*  
*Senecio erubescens* var. *erubescens*  
*Senecio harveianus*  
*Senecio hieracioides*  
*Senecio isatideus*  
*Senecio laevigatus* var. *integrifolius*  
*Senecio laevigatus* var. *laevigatus*  
*Senecio latifolius*  
*Senecio madagascariensis*  
*Senecio othonniflorus*  
*Senecio oxyriifolius* subsp. *oxyriifolius*  
*Senecio pentactinus*  
*Senecio polyodon*  
*Senecio rhomboideus*  
*Senecio scitus*  
*Senecio speciosus*  
*Senecio subcoriaceus*  
*Senecio venosus*  
*Seriphium plumosum*  
*Sonchus asper* subsp. *asper*; Naturalised; Invasive  
*Sonchus nanus*  
*Sonchus oleraceus*; Naturalised; Invasive  
*Tagetes minuta*; Naturalised; Invasive  
*Tolpis capensis*  
*Ursinia montana* subsp. *montana*

*Ursinia nana* subsp. *leptophylla*  
*Ursinia nana* subsp. *nana*  
*Ursinia paleacea*  
*Ursinia tenuiloba*

#### **Bartramiaceae**

*Philonotis falcata*  
*Philonotis hastata*

#### **Begoniaceae**

*Begonia sutherlandii* subsp. *sutherlandii*

#### **Blechnaceae**

*Blechnum attenuatum*  
*Blechnum australe* subsp. *australe*

#### **Boraginaceae**

*Cynoglossum austroafricanum*  
*Cynoglossum hispidum*  
*Cynoglossum lanceolatum*  
*Lithospermum cinereum*  
*Myosotis graminifolia*  
*Myosotis sylvatica*; Naturalised

#### **Brassicaceae**

*Erucastrum austroafricanum*  
*Heliophila carnososa*  
*Lepidium schinzii*  
*Lepidium transvaalense*  
*Nasturtium officinale*; Naturalised; Invasive  
*Rorippa fluviatilis* var. *fluviatilis*  
*Rorippa nudiuscula*  
*Sisymbrium turczaninowii*  
*Turritis glabra*; Naturalised

#### **Bruchiaceae**

*Cladophascum gymnomitrioides*

#### **Bryaceae**

*Anomobryum julaceum*  
*Bryum apiculatum*  
*Bryum argenteum*  
*Bryum cellulare*  
*Bryum dichotomum*

#### **Cactaceae**

*Opuntia ficus-indica*; Naturalised; Invasive, NEMBA Category 1b

#### **Campanulaceae**

*Wahlenbergia undulata*  
*Wahlenbergia virgata*

**Caryophyllaceae**

*Cerastium arabidis*

*Cerastium capense*

*Dianthus transvaalensis*

*Dianthus* sp.

*Herniaria erckertii* subsp. *erckertii*

*Pollichia campestris*

*Silene burchellii* subsp. *modesta*

*Silene burchellii* subsp. *pilosellifolia*

*Silene undulata*

*Spergularia media*; Naturalised

**Celastraceae**

*Gymnosporia buxifolia*

*Maytenus undata*

**Cleomaceae**

*Cleome monophylla*

**Colchicaceae**

*Colchicum longipes*

*Colchicum striatum*

*Gloriosa modesta*

**Commelinaceae**

*Commelina africana* var. *africana*

*Commelina africana* var. *krebsiana*

*Commelina africana* var. *lancispatha*

*Commelina benghalensis*

*Commelina subulata*

*Cyanotis speciosa*

**Convolvulaceae**

*Convolvulus arvensis*; Naturalised; Invasive

*Convolvulus natalensis*

*Convolvulus sagittatus*

*Convolvulus thunbergii*

*Falkia oblonga*

*Ipomoea bathycolpos*

*Ipomoea crassipes* var. *crassipes*

*Ipomoea oblongata*

*Ipomoea ommanneyi*

*Ipomoea simplex*

*Merremia verecunda*

*Xenostegia tridentata* subsp. *angustifolia*

**Crassulaceae**

*Crassula alba* var. *alba*

*Crassula barbata* subsp. *barbata*

*Crassula capitella* subsp. *nodulosa*

*Crassula compacta*  
*Crassula lanceolata* subsp. *transvaalensis*  
*Crassula natans* var. *minus*  
*Crassula natans* var. *natans*  
*Crassula setulosa* var. *setulosa* forma *setulosa*  
*Crassula tuberella*  
*Crassula vaginata* subsp. *vaginata*

### **Cucurbitaceae**

*Coccinia adoensis*  
*Cucumis anguria* var. *longaculeatus*  
*Cucumis hirsutus*  
*Cucumis myriocarpus* subsp. *myriocarpus*  
*Cucumis zeyheri*

### **Cyperaceae**

*Ascolepis capensis*  
*Bulbostylis densa* subsp. *afromontana*  
*Bulbostylis humilis*  
*Bulbostylis oritrephes*  
*Bulbostylis schoenoides*  
*Bulbostylis scleropus*  
*Carex ludwigii*  
*Carex rhodesiaca*  
*Cyperus congestus*  
*Cyperus denudatus*  
*Cyperus difformis*  
*Cyperus esculentus* var. *esculentus*  
*Cyperus fastigiatus*  
*Cyperus laevigatus*  
*Cyperus longus* var. *longus*  
*Cyperus longus* var. *tenuiflorus*  
*Cyperus margaritaceus* var. *margaritaceus*  
*Cyperus marginatus*  
*Cyperus obtusiflorus* var. *flavissimus*  
*Cyperus parvinus*  
*Cyperus rigidifolius*  
*Cyperus rupestris* var. *rupestris*  
*Cyperus schlechteri*  
*Cyperus sphaerospermus*  
*Cyperus squarrosus*  
*Cyperus uitenhagensis*  
*Cyperus teneristolon*  
*Cyperus usitatus*  
*Dracoscirpoides surculosa*  
*Eleocharis dregeana*  
*Eleocharis limosa*  
*Fimbristylis complanata*  
*Fuirena coerulescens*  
*Isolepis cernua* var. *cernua*  
*Isolepis costata*

*Isolepis fluitans* var. *fluitans*  
*Isolepis sepulcralis*  
*Isolepis setacea*  
*Kyllinga alata*  
*Kyllinga erecta* var. *erecta*  
*Kyllinga pulchella*  
*Lipocarpha nana*  
*Lipocarpha rehmannii*  
*Pycnus betschuanus*  
*Pycnus chrysanthus*  
*Pycnus cooperi*  
*Pycnus macranthus*  
*Pycnus nitidus*  
*Pycnus pumilus*  
*Pycnus rehmannianus*  
*Rhynchospora brownii*  
*Schoenoplectus corymbosus*  
*Schoenoplectus decipiens*  
*Schoenoplectus muriculatus*  
*Schoenoplectus tabernaemontani*; Naturalised  
*Schoenoxiphium* sp.  
*Scirpoides burkei*

#### **Dioscoreaceae**

*Dioscorea dregeana*

#### **Dipsacaceae**

*Scabiosa columbaria*

#### **Droseraceae**

*Drosera burkeana*

#### **Dryopteridaceae**

*Dryopteris athamantica*

#### **Ebenaceae**

*Diospyros austro-africana* var. *microphylla*

*Diospyros lycioides* subsp. *guerkei*

*Euclea* sp.

#### **Ericaceae**

*Erica alopecurus* var. *alopecurus*

*Erica cerinthoides* var. *cerinthoides*

*Erica drakensbergensis*

*Erica oatesii*

#### **Eriocaulaceae**

*Eriocaulon abyssinicum*

*Eriocaulon sonderianum*

#### **Euphorbiaceae**

### *Acalypha angustata*

*Acalypha caperonioides* var. *caperonioides*

*Acalypha wilmsii*

*Euphorbia gueinzii*

*Euphorbia inaequilatera*

*Euphorbia natalensis*

*Euphorbia striata*

### **Exormothecaceae** (Liverworts)

*Exormotheca holstii*

### **Fabaceae**

*Acacia dealbata*; Naturalised; Invasive

*Aeschynomene rehmannii* var. *leptobotrya*

*Aeschynomene rehmannii* var. *rehmannii*

*Alysicarpus zeyheri*

*Argyrolobium harveyanum*

*Argyrolobium humile*

*Argyrolobium lotoides*

*Argyrolobium pauciflorum*

*Argyrolobium rupestre* subsp. *rupestre*

*Argyrolobium speciosum*

*Argyrolobium transvaalense*

*Argyrolobium tuberosum*

*Aspalathus callosa* Indigenous

*Chamaecrista capensis* var. *capensis*

*Chamaecrista capensis* var. *flavescens*

*Chamaecrista comosa*

*Crotalaria distans* subsp. *distans*

*Crotalaria eremicola* subsp. *eremicola*

*Crotalaria globifera*

*Crotalaria magaliesbergensis*

*Crotalaria sphaerocarpa* subsp. *sphaerocarpa*

*Dichilus strictus*

*Dolichos angustifolius*

*Dolichos falciformis*

*Elephantorrhiza elephantina*

*Elephantorrhiza praetermissa*

*Eriosema cordatum*

*Eriosema kraussianum*

*Eriosema salignum*

*Eriosema simulans*

*Erythrina zeyheri*

*Indigastrium fastigiatum*

*Indigofera buchananii*

*Indigofera comosa*

*Indigofera dimidiata*

*Indigofera dregeana*

*Indigofera evansiana*

*Indigofera frondosa*

*Indigofera hedyantha*

*Indigofera hilaris* var. *hilaris*  
*Indigofera longibarbata*  
*Indigofera melanadenia*  
*Indigofera placida*  
*Indigofera rostrata*  
*Indigofera sanguinea*  
*Indigofera tristoides*  
*Lablab purpureus* subsp. *uncinatus*  
*Leobordea adpressa* subsp. *adpressa*  
*Leobordea eriantha*  
*Leobordea foliosa*  
*Lespedeza cuneata*; Naturalised  
*Lessertia frutescens* subsp. *microphylla*  
*Listia heterophylla*  
*Lotus discolor* subsp. *discolor*  
*Medicago laciniata* var. *laciniata*; Naturalised  
*Melolobium alpinum*  
*Melolobium calycinum*  
*Melolobium microphyllum*  
*Melolobium obcordatum*  
*Melolobium wilmsii*  
*Mucuna coriacea*  
*Pearsonia cajanifolia* subsp. *cryptantha*  
*Pearsonia sessilifolia* subsp. *filifolia*  
*Pearsonia sessilifolia* subsp. *sessilifolia*  
*Rhynchosia adenodes*  
*Rhynchosia nervosa* var. *nervosa*  
*Rhynchosia pauciflora*  
*Rhynchosia pedunculata*  
*Rhynchosia reptabunda*  
*Rhynchosia totta* var. *totta*  
*Tephrosia capensis* var. *acutifolia*  
*Tephrosia capensis* var. *capensis*  
*Tephrosia natalensis* subsp. *natalensis*  
*Tephrosia semiglabra*  
*Trifolium africanum* var. *africanum*  
*Trifolium africanum* var. *lydenburgense*  
*Vigna luteola* var. *luteola*  
*Vigna oblongifolia* var. *oblongifolia*  
*Vigna unguiculata* subsp. *unguiculata* var. *unguiculata*  
*Zornia capensis* subsp. *capensis*  
*Zornia linearis*  
*Zornia milneana*

## **Fagaceae**

*Quercus robur*; Naturalised

## **Gentianaceae**

*Chironia krebsii*  
*Chironia palustris* subsp. *transvaalensis*  
*Chironia purpurascens* subsp. *humilis*



*Exochaenium grande*  
*Sebaea leiostyla*  
*Sebaea repens*  
*Sebaea sedoides* var. *sedoides*

### **Geraniaceae**

*Geranium multisectum*  
*Geranium robustum*  
*Geranium wakkerstroomianum*  
*Monsonia angustifolia*  
*Monsonia attenuata*  
*Monsonia brevirostrata*  
*Pelargonium alchemilloides*  
*Pelargonium luridum*  
*Pelargonium minimum*  
*Pelargonium pseudofumarioides*  
*Pelargonium sidoides*

### **Gesneriaceae**

*Streptocarpus dunnii*  
*Streptocarpus galpinii*  
*Streptocarpus penttherianus*

### **Haloragaceae**

*Laurembergia repens* subsp. *brachypoda*

### **Hyacinthaceae**

*Albuca baurii*  
*Albuca setosa*  
*Albuca shawii*  
*Albuca virens* subsp. *virens*  
*Dipcadi brevifolium*  
*Dipcadi marlothii*  
*Dipcadi viride*  
*Drimia calcarata*  
*Drimia depressa*  
*Drimia elata*  
*Drimia multisetosa*  
*Drimia pauciflora*  
*Drimia sphaerocephala*  
*Eucomis autumnalis* subsp. *clavata*  
*Eucomis montana*  
*Eucomis pallidiflora* subsp. *pallidiflora*  
*Ledebouria cooperi*  
*Ledebouria humifusa*  
*Ledebouria leptophylla*  
*Ledebouria marginata*  
*Ledebouria ovatifolia*  
*Ledebouria revoluta*  
*Merwillia plumbea*  
*Ornithogalum candicans*

*Ornithogalum capillare*  
*Ornithogalum esterhuyseniae*  
*Ornithogalum flexuosum*  
*Ornithogalum juncifolium* var. *juncifolium*  
*Schizocarpus nervosus*

### **Hydrocharitaceae**

*Lagarosiphon muscoides*

### **Hypericaceae**

*Hypericum aethiopicum* subsp. *sonderi*  
*Hypericum lalandii*

### **Hypoxidaceae**

*Empodium elongatum*  
*Hypoxis acuminata*  
*Hypoxis argentea* var. *argentea*  
*Hypoxis filiformis*  
*Hypoxis hemerocallidea*  
*Hypoxis iridifolia*  
*Hypoxis multiceps*  
*Hypoxis obtusa*  
*Hypoxis rigidula* var. *rigidula*

### **Iridaceae**

*Aristea torulosa*  
*Babiana bainesii*  
*Crocasmia paniculata*  
*Dierama insigne*  
*Dierama mossii*  
*Dierama tyrium*  
*Gladiolus crassifolius*  
*Gladiolus dalenii* subsp. *dalenii*  
*Gladiolus ecklonii*  
*Gladiolus elliotii*  
*Gladiolus longicollis* subsp. *platypetalus*  
*Gladiolus paludosus*  
*Gladiolus papilio*  
*Gladiolus robertsoniae*  
*Gladiolus sericeovillosus* subsp. *calvatus*  
*Gladiolus sericeovillosus* subsp. *sericeovillosus*  
*Gladiolus vinosomaculatus*  
*Gladiolus woodii*  
*Hesperantha coccinea*  
*Hesperantha longicollis*  
*Hesperantha rupestris*  
*Moraea elliotii*  
*Moraea filicaulis*  
*Moraea pallida*  
*Moraea pubiflora*  
*Watsonia bella*

*Watsonia pulchra*

### **Juncaceae**

*Juncus dregeanus* subsp. *dregeanus*

*Juncus exsertus*

*Juncus oxycarpus*

*Juncus punctorius*

### **Lamiaceae**

*Acrotome hispida*

*Acrotome inflata*

*Aeollanthus buchnerianus*

*Ajuga ophrydis*

*Leonotis ocymifolia* var. *raineriana*

*Mentha aquatica*

*Ocimum obovatum* subsp. *obovatum* var. *obovatum*

*Platostoma rotundifolium*

*Pycnostachys reticulata*

*Rothea hirsuta*

*Salvia aurita* var. *galpinii*

*Salvia repens* var. *repens*

*Salvia runcinata*

*Stachys hyssopoides*

*Stachys kuntzei*

*Stachys natalensis* var. *natalensis*

*Stachys nigricans*

*Syncolostemon albiflorus*

*Syncolostemon concinnus*

*Syncolostemon pretoriae*

*Teucrium trifidum*

### **Lentibulariaceae**

*Utricularia prehensilis*

### **Limeaceae**

*Limeum sulcatum* var. *sulcatum*

### **Linaceae**

*Linum thunbergii*

### **Linderniaceae**

*Linderniella nana*

### **Lobeliaceae**

*Cyphia elata*

*Lobelia erinus*

*Lobelia flaccida* subsp. *flaccida*

*Lobelia sonderiana*

*Monopsis decipiens*

### **Lythraceae**

*Nesaea sagittifolia* var. *sagittifolia*  
*Nesaea schinzii*

### **Malvaceae**

*Grewia flava*  
*Grewia occidentalis* var. *occidentalis*  
*Hermannia cordata*  
*Hermannia cristata*  
*Hermannia depressa*  
*Hermannia transvaalensis*  
*Hibiscus aethiopicus* var. *ovatus*  
*Hibiscus microcarpus*  
*Hibiscus trionum*; Naturalised  
*Malva parviflora* var. *parviflora*; Naturalised  
*Pavonia columella*  
*Sida chrysantha*  
*Sida rhombifolia* subsp. *rhombifolia*

### **Melianthaceae**

*Melianthus dregeanus* subsp. *insignis*

### **Menispermaceae**

*Stephania abyssinica* var. *tomentella*

### **Menyanthaceae**

*Nymphoides thunbergiana*

### **Molluginaceae**

*Psammotropha myriantha*

### **Myrsinaceae**

*Rapanea melanophloeos*

### **Myrtaceae**

*Eucalyptus camaldulensis*; Naturalised; Invasive, NEMBA Category 1b in riparian areas

### **Ochnaceae**

*Ochna natalitia*

### **Onagraceae**

*Epilobium capense*  
*Ludwigia palustris*; Naturalised  
*Oenothera stricta* subsp. *stricta*; Naturalised; Invasive  
*Oenothera tetraptera*; Naturalised; Invasive

### **Orchidaceae**

*Brachycorythis ovata* subsp. *ovata*  
*Brachycorythis pubescens*  
*Brownleea parviflora*  
*Disa aconitoides* subsp. *aconitoides*  
*Disa cooperi*

*Disa nervosa*  
*Disa patula* var. *transvaalensis*  
*Disa stachyoides*  
*Disa versicolor*  
*Disperis cooperi*  
*Disperis fanniniae*  
*Eulophia cooperi*  
*Eulophia hians* var. *hians*  
*Eulophia hians* var. *inaequalis*  
*Eulophia hians* var. *nutans*  
*Eulophia ovalis* var. *bainesii*  
*Eulophia ovalis* var. *ovalis*  
*Eulophia parvilabris*  
*Habenaria barbertoni*  
*Habenaria clavata*  
*Habenaria dives*  
*Habenaria epipactidea*  
*Habenaria falcicornis* subsp. *caffra*  
*Habenaria lithophila*  
*Neobolusia tysonii*  
*Orthochilus foliosus*  
*Orthochilus leontoglossus*  
*Orthochilus vinosus*  
*Orthochilus welwitschii*  
*Pterygodium nigrescens*  
*Satyrium hallackii* subsp. *ocellatum*  
*Satyrium longicauda* var. *longicauda*  
*Satyrium neglectum* subsp. *neglectum* var. *neglectum*  
*Satyrium parviflorum*  
*Satyrium trinerve*  
*Schizochilus zeyheri*

### **Orobanchaceae**

*Alectra capensis*  
*Buchnera reducta*  
*Cycnium adonense*  
*Cycnium tubulosum* subsp. *tubulosum*  
*Harveya speciosa*  
*Melasma scabrum* var. *scabrum*  
*Sopubia cana* var. *cana*  
*Sopubia simplex*  
*Striga asiatica*  
*Striga bilabiata* subsp. *bilabiata*  
*Striga elegans*  
*Striga gesnerioides*

### **Orthotrichaceae**

*Orthotrichum diaphanum*

### **Oxalidaceae**

*Oxalis convexula*

*Oxalis corniculata*; Naturalised; Invasive  
*Oxalis obliquifolia*  
*Oxalis smithiana*

### **Papaveraceae**

*Argemone ochroleuca*; Naturalised; Invasive, NEMBA Category 1b  
*Papaver aculeatum*

### **Peraceae**

*Clusia hirsuta* var. *hirsuta*  
*Clusia monticola* var. *monticola*  
*Clusia natalensis*  
*Clusia virgata*

### **Phrymaceae**

*Mimulus gracilis*

### **Phyllanthaceae**

*Phyllanthus glaucophyllus*

### **Phytolaccaceae**

*Phytolacca octandra*; Naturalized; Invasive

### **Plantaginaceae**

*Linaria vulgaris*; Naturalised; Invasive  
*Plantago lanceolata*  
*Veronica anagallis-aquatica*

### **Poaceae**

*Agrostis continuata*  
*Agrostis eriantha* var. *eriantha*  
*Agrostis gigantea*; Naturalised  
*Agrostis lachnantha* var. *lachnantha*  
*Alloteropsis semialata* subsp. *eckloniana*  
*Alloteropsis semialata* subsp. *semialata*  
*Andropogon appendiculatus*  
*Andropogon eucomus*  
*Andropogon lacunosus*  
*Andropogon schirensis*  
*Anthoxanthum odoratum* var. *odoratum*; Naturalised  
*Aristida adscensionis*  
*Aristida bipartita*  
*Aristida canescens* subsp. *canescens*  
*Aristida congesta* subsp. *barbicollis*  
*Aristida congesta* subsp. *congesta*  
*Aristida diffusa* subsp. *burkei*  
*Aristida junciformis* subsp. *junciformis*  
*Aristida recta*  
*Aristida scabrivalvis* subsp. *scabrivalvis*  
*Aristida vestita*  
*Arundinella nepalensis*

*Avena sativa*; Naturalised; Invasive  
*Bothriochloa insculpta*  
*Brachiaria eruciformis*  
*Brachiaria humidicola*  
*Brachiaria serrata*  
*Briza minor*; Naturalised; Invasive  
*Bromus catharticus*; Naturalised; Invasive  
*Bromus leptoclados*  
*Calamagrostis epigejos* var. *capensis*  
*Catalepis gracilis*  
*Chloris virgata*  
*Ctenium concinnum*  
*Cymbopogon caesius*  
*Cymbopogon dieterlenii*  
*Cymbopogon pospischilii*  
*Cynodon dactylon*  
*Cynodon hirsutus*  
*Cynodon transvaalensis*  
*Dactylis glomerata*; Naturalised; Invasive  
*Digitaria ciliaris*; Naturalised  
*Digitaria diagonalis* var. *diagonalis*  
*Digitaria diversinervis*  
*Digitaria eriantha*  
*Digitaria flaccida*  
*Digitaria sanguinalis*; Naturalised  
*Digitaria ternata*  
*Digitaria tricholaenoides*  
*Diheteropogon amplexans* var. *amplexans*  
*Echinochloa crus-galli*  
*Ehrharta erecta* var. *natalensis*  
*Eleusine coracana* subsp. *africana*  
*Elionurus muticus*  
*Enneapogon scoparius*  
*Eragrostis caesia*  
*Eragrostis capensis*  
*Eragrostis chloromelas*  
*Eragrostis cilianensis*  
*Eragrostis curvula*  
*Eragrostis gummiflua*  
*Eragrostis lappula*  
*Eragrostis lehmanniana* var. *chaunantha*  
*Eragrostis lehmanniana* var. *lehmanniana*  
*Eragrostis mexicana* subsp. *virescens*; Naturalised  
*Eragrostis obtusa*  
*Eragrostis patentissima*  
*Eragrostis plana*  
*Eragrostis planiculmis*  
*Eragrostis racemosa*  
*Eragrostis remotiflora*  
*Eragrostis sclerantha* subsp. *sclerantha*  
*Eragrostis tef*; Naturalised

*Eriochrysis brachypogon*  
*Festuca caprina*  
*Festuca scabra*  
*Fingerhuthia africana*  
*Fingerhuthia sesleriiformis*  
*Harpochloa falx*  
*Helictotrichon turgidulum*  
*Hemarthria altissima*  
*Heteropogon contortus*  
*Holcus lanatus*; Naturalised; Invasive  
*Hyparrhenia anamesa*  
*Hyparrhenia dregeana*  
*Hyparrhenia hirta*  
*Imperata cylindrica*  
*Koeleria capensis*  
*Leersia hexandra*  
*Lolium multiflorum*; Naturalised; Invasive  
*Lolium temulentum*; Naturalised; Invasive  
*Lophacme digitata*  
*Loudetia densispica*  
*Loudetia simplex*  
*Melinis nerviglumis*  
*Microchloa caffra*  
*Monocymbium cerasiiforme*  
*Panicum ecklonii*  
*Panicum natalense*  
*Panicum schinzii*  
*Paspalum dilatatum*; Naturalised; Invasive  
*Paspalum distichum*; Naturalised; Invasive  
*Paspalum urvillei*; Naturalised; Invasive  
*Pennisetum clandestinum*; Naturalized; Invasive  
*Pennisetum macrourum*  
*Pennisetum sphacelatum*  
*Pennisetum thunbergii*  
*Pennisetum unisetum*  
*Perotis* sp.  
*Phalaris arundinacea*; Naturalised  
*Phalaris canariensis*; Naturalised  
*Phalaris minor*; Naturalised  
*Poa annua*; Naturalised  
*Poa binata*  
*Pogonarthria squarrosa*  
*Rendlia altera*  
*Sacciolepis chevalieri*  
*Sacciolepis typhura*  
*Schizachyrium sanguineum*  
*Setaria incrassata*  
*Setaria nigrirostris*  
*Setaria pumila*  
*Setaria sphacelata* var. *sphacelata*  
*Setaria sphacelata* var. *torta*



*Sorghum bicolor* subsp. *arundinaceum*  
*Sporobolus albicans*  
*Sporobolus centrifugus*  
*Sporobolus discosporus*  
*Sporobolus fimbriatus*  
*Stiburus alopecuroides*  
*Stiburus conrathii*  
*Themeda triandra*  
*Trachypogon spicatus*  
*Tragus berteronianus*  
*Tragus racemosus*  
*Triraphis andropogonoides*  
*Tristachya leucothrix*  
*Tristachya rehmannii*  
*Urochloa panicoides*

### **Polygalaceae**

*Polygala africana*  
*Polygala albida* subsp. *albida*  
*Polygala gerrardii*  
*Polygala gracilentia*  
*Polygala hottentotta*  
*Polygala krumanina*  
*Polygala ohlendoriana*  
*Polygala transvaalensis*  
*Polygala transvaalensis* subsp. *transvaalensis*  
*Polygala uncinata*  
*Polygala virgata* var. *decora*

### **Polygonaceae**

*Oxygonum dregeanum* subsp. *canescens* var. *canescens*  
*Oxygonum dregeanum* subsp. *swazicum*  
*Persicaria amphibia*; Naturalised  
*Persicaria decipiens*  
*Persicaria hystricula*  
*Persicaria lapathifolia*; Naturalised; Invasive  
*Persicaria madagascariensis*  
*Rumex acetosella* subsp. *angiocarpus*; Naturalised; Invasive, NEMBA Category 1b  
*Rumex crispus*; Naturalised; Invasive  
*Rumex lanceolatus*  
*Rumex sagittatus*  
*Rumex woodii*

### **Pontederiaceae**

*Pontederia cordata*; Naturalised

### **Portulacaceae**

*Portulaca oleracea*; Naturalised

### **Pottiaceae**

*Didymodon tophaceus*

*Trichostomum brachydontium*

### **Proteaceae**

*Protea roupelliae* subsp. *roupelliae*

### **Pteridaceae**

*Cheilanthes eckloniana*

*Cheilanthes hirta* var. *brevipilosa*

*Cheilanthes hirta* var. *hirta*

*Cheilanthes hirta* var. *nemorosa*

*Cheilanthes multifida* subsp. *lacerata*

*Cheilanthes quadripinnata*

*Cheilanthes viridis* var. *viridis*

*Pellaea calomelanos* var. *calomelanos*

*Pityrogramma argentea*

### **Ranunculaceae**

*Clematis brachiata*

*Peltocalathos baurii*

*Ranunculus dregei*

*Ranunculus multifidus*

*Ranunculus trichophyllus*

### **Rhamnaceae**

*Ziziphus zeyheriana*

### **Rosaceae**

*Agrimonia procera*; Naturalised; Invasive

*Alchemilla capensis*

*Alchemilla woodii*

*Rubus ludwigii* subsp. *ludwigii*

*Sanguisorba minor* subsp. *muricata*; Naturalised

### **Rubiaceae**

*Anthospermum herbaceum*

*Anthospermum rigidum* subsp. *rigidum*

*Canthium inerme*

*Cephalanthus natalensis*

*Galium capense* subsp. *capense*

*Galium capense* subsp. *garipense* var. *garipense*

*Kohautia amatymbica*

*Kohautia caespitosa* subsp. *brachyloba*

*Pachystigma pygmaeum*

*Pachystigma thamnus*

*Pentanisia angustifolia*

*Pentanisia prunelloides* subsp. *prunelloides*

*Pentanisia prunelloides* subsp. *latifolia*

*Richardia brasiliensis*; Naturalised

*Spermacoce natalensis*

### **Ruscaceae**

*Eriospermum cooperi* var. *cooperi*  
*Eriospermum corymbosum*  
*Eriospermum flagelliforme*  
*Eriospermum porphyrium*  
*Eriospermum porphyrovalve*

### **Rutaceae**

*Ruta graveolens*; Naturalised

### **Salicaceae**

*Salix babylonica* var. *babylonica*; Naturalised

### **Santalaceae**

*Thesium asterias*  
*Thesium costatum* var. *costatum*  
*Thesium costatum* var. *juniperinum*  
*Thesium goetzeanum*  
*Thesium pallidum*  
*Thesium scirpioides*

### **Scrophulariaceae**

*Chaenostoma neglectum*  
*Chaenostoma patrioticum*  
*Diclis rotundifolia*  
*Gomphostigma virgatum*  
*Hebenstretia angolensis*  
*Hebenstretia comosa* Indigenous  
*Hebenstretia oatesii* subsp. *oatesii*  
*Hebenstretia rehmannii*  
*Jamesbrittenia aurantiaca*  
*Jamesbrittenia montana*  
*Jamesbrittenia stricta*  
*Limosella longiflora*  
*Limosella maior*  
*Manulea bellidifolia*  
*Manulea rhodantha* subsp. *aurantiaca*  
*Melanospermum rupestre*  
*Melanospermum transvaalense*  
*Nemesia fruticans*  
*Selago capitellata*  
*Selago densiflora*  
*Selago galpinii*  
*Teedia lucida*  
*Tetraselago longituba*  
*Zaluzianskya elongata*  
*Zaluzianskya rubrostellata*  
*Zaluzianskya spathacea*

### **Solanaceae**

*Cestrum parqui*; Naturalised; Invasive  
*Datura stramonium*; Naturalised; Invasive, NEMBA Category 1b

*Physalis angulata*; Naturalised; Invasive  
*Solanum aculeatissimum*; Naturalised  
*Solanum campylacanthum*  
*Solanum capense*  
*Solanum elaeagnifolium*; Naturalised; Invasive, NEMBA Category 1b  
*Solanum humile*  
*Solanum lichtensteinii*  
*Solanum panduriforme*  
*Solanum retroflexum*  
*Solanum sisymbriifolium*; Naturalised; Invasive, NEMBA Category 1b

### **Thymelaeaceae**

*Gnidia fastigiata*  
*Gnidia gymnostachya*  
*Gnidia nodiflora*  
*Lasiosiphon burchellii*  
*Lasiosiphon caffer*  
*Lasiosiphon kraussianus*  
*Lasiosiphon microcephalus*

### **Typhaceae**

*Typha capensis*

### **Valerianaceae**

*Valeriana capensis* var. *capensis*

### **Verbenaceae**

*Chascanum latifolium* var. *transvaalense*  
*Lantana rugosa*  
*Verbena bonariensis*; Naturalised; Invasive, NEMBA Category 1b  
*Verbena rigida*; Naturalised; Invasive

### **Vitaceae**

*Cissus diversilobata*

### **Xyridaceae**

*Xyris capensis*  
*Xyris gerrardii*

### **Zygophyllaceae**

*Tribulus terrestris*

## Appendix 3: Flora protected under the Mpumalanga Nature Conservation Act No. 10 of 1998.

### SCHEDULE 11: PROTECTED PLANT SPECIES (SECTION 69 (1) (a))

Common name	Scientific name
All species of tree ferns, excluding the bracken fern	All species of the Genus: <i>Cyathea capensis</i> and <i>Cyathea dregei</i>
All species of cycads in Republic of South Africa and the seedlings of the species of cycads referred to in Schedule 12	All species of the family <i>Zamiaceae</i> occurring in the Republic of South Africa and the seedlings of the species of <i>Encephalartos</i> referred to in Schedule 12
All species of yellow wood	<i>Podocarpus</i> spp.
All species of arum lilies	<i>Zantedeschia</i> spp.
"volstruiskos"	<i>Schizobasis intricata</i>
"knolklimp"	<i>Bowiea volubilis</i>
All species of red-hot pokers	<i>Kniphofia</i> spp.
All species of aloes, excluding: (a) all species not occurring in Mpumalanga and (b) the following species: all species of <i>haworthias</i> all species of <i>agapanthus</i> all species of <i>squill</i>	<i>Aloe</i> spp., excluding: (a) all species not occurring in Mpumalanga and (b) the following species: <i>Haworthia</i> spp. <i>Agapanthus</i> spp. <i>Scilla</i> spp.
All species of pineapple flower	<i>Eucomis</i> spp.
All species of dracaena	<i>Dracaena</i> spp.
All species of paintbrush	<i>Haemanthus</i> spp. and <i>Scadoxus</i> spp.
Cape poison bulb	<i>Boophone disticha</i>
All species of clivia	<i>Clivia</i> spp.
All species of brunsvigia	<i>Brunsvigia</i> spp.
All species of crinum	<i>Crinum</i> spp.
Ground lily	<i>Ammocharis coranica</i>
All species of fire lily	<i>Cyrtanthus</i> spp.
All species of elephantsfoot	<i>Dioscorea</i> spp.
River lily	<i>Hesperantha coccinea</i>
All species of gladioli	<i>Gladiolus</i> spp.
All species of watsonia	<i>Watsonia</i> spp.
Wild ginger	<i>Siphonochilus aethiopicus</i>
All species of orchids	All species of the family <i>Orchidaceae</i>
All species of the family proteaceae	All species of the family <i>Proteaceae</i>
All species of black stinkwood	<i>Ocotea</i> spp.
kiaat	<i>Pterocarpus angolensis</i>
tamboti	<i>Spirostachys africana</i>
The following species of euphorbias: <i>Euphorbia bernardii</i> and <i>Euphorbia grandialata</i>	The following species of euphorbias: <i>Euphorbia bernardii</i> and <i>Euphorbia grandialata</i>
Common bersama	<i>Bersama tysoniana</i>
Red ivory	<i>Berchemia zeyheri</i>
Pepperbark tree	<i>Warburgia salutaris</i>
All species of ardenia	<i>Adenia</i> spp.
Bastard onion wood	<i>Cassipourea gerrardii</i>
Assegai tree	<i>Curtisia dentata</i>
All species of olive trees	All species of the Genus <i>Olea</i>
All species of impala lilies	All species of the Genus <i>Adenium</i>

Kudu lily	Pachypodium saundersii
All species of brachystelma	Brachystelma spp.
All species of ceropegia	Ceropegia spp.
All species of huerniopsis and huernia	Huerniopsis and Huernia spp.
All species of duvalia	Duvalia spp.
All species of stapeliads	Stapelia spp.
All species of orbeanthus	Orbeanthus spp.
All species of orbeas	Orbea spp.
All species of orbeopsis	Orbeopsis spp.

#### SCHEDULE 12: SPECIALLY PROTECTED PLANT SPECIES (SECTION 69 (1) (b))

In this schedule "seedling" means a plant of which the diameter of the trunk or bulb, either above or below the ground, does not exceed 150 mm.

Common name	Scientific name
All plants, excluding seedlings, of the following species of cycads: dolomiticus, dyer, middelburg, eugene marais, heenan, inopinus, laevifolius, lanatus, lebombo, ngoyanus, paucidentatus, modjadje and villosus	All plants, excluding seedlings, of the following species of the Genus Encephalartos: E. dolomiticus, E. dyerianus, E. middelburgensis, E. eugene maraisii, E. heenanii, E. inopinus, E. laevifolius, E. lanatus, E. lebomboensis, E. ngoyanus, E. paucidentatus, E. transvenosus and E. villosus and any species derived from the above species
All plants of the following species of cycads: cupidus and humilus	All plants of the following species of the Genus Encephalartos: E. cupidus and E. humilus
All species of cycads in their natural habitat	All plants of the Genus Encephalartos in their natural habitat

# Appendix 4: Flora 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  
Diaphanranthe millarii  
Dioscorea ebutsnorum  
Encephalartos aemulans  
Encephalartos brevifoliolatus  
Encephalartos cerinus  
Encephalartos dolomiticus  
Encephalartos heenanii  
Encephalartos hirsutus  
Encephalartos inopinus  
Encephalartos latifrons  
Encephalartos middelburgensis  
Encephalartos nubimontanus  
Encephalartos woodii

## 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

Disa macrostachya  
Disa nubigena  
Disa physodes  
Disa procera  
Disa sabulosa  
Encephalartos altensteinii  
Encephalartos caffer  
Encephalartos dyerianus  
Encephalartos frederici-guilielmi  
Encephalartos ghellinckii  
Encephalartos humilis  
Encephalartos lanatus  
Encephalartos lehmannii  
Encephalartos longifolius  
Encephalartos natalensis  
Encephalartos paucidentatus  
Encephalartos princeps  
Encephalartos senticosus  
Encephalartos transvenosus  
Encephalartos trispinosus  
Encephalartos umbeluziensis  
Encephalartos villosus  
Euphorbia clivicola  
Euphorbia meloformis  
Euphorbia obesa  
Harpagophytum procumbens  
Harpagophytum zeyherii  
Hoodia gordonii  
Hoodia currorii  
Protea odorata  
Stangeria eriopus

## VULNERABLE SPECIES

### Flora

Aloe albida  
Encephalartos cycadifolius  
Encephalartos Eugene-maraisii  
Encephalartos ngovanus  
Merwillia plumbea  
Zantedeschia jucunda

## PROTECTED SPECIES

### Flora

Adenia wilmsii  
Aloe simii  
Clivia mirabilis

## Appendix 5: Curriculum vitae: Dr David Hoare

### 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 plant species specialist.
- Alien plant identification and control / management plans.
- 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 (IAVS)

Member, Ecological Society of America (ESA)

Member, International Association for Impact Assessment (IAIA)

Member, Herpetological Association of Africa (HAA)

### Employment history

1 December 2004 – present, Director, David Hoare Consulting (Pty) Ltd. Consultant, specialist consultant contracted to various companies and organisations.

1 January 2009 – 30 June 2009, Lecturer, University of Pretoria, Botany Dept.

1 January 2013 – 30 June 2013, Lecturer, University of Pretoria, Botany Dept.

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.

### Experience as consultant

Ecological consultant since 1995. Author of over 800 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.
- Pfab, M.F., Compaan, P.C., Whittington-Jones, C.A., Engelbrecht, I., Dumalisile, L., Mills, L., West, S.D., Muller, P., Masterson, G.P.R., Nevhutalu, L.S., Holness, S.D., **Hoare, D.B.** 2017. The Gauteng Conservation Plan: Planning for biodiversity in a rapidly urbanising province. *Bothalia*, Vol. 47:1. a2182. <https://doi.org/10.4102/abc.v47i1.2182>.

#### 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. **Error! Hyperlink reference not valid..**
- 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 Afrikaanse 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 34<sup>th</sup> 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, 46<sup>th</sup> 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 VIIIth 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 800 specialist consulting reports for various environmental projects from 1995 – present.

**Workshops / symposia attended:**

International Association for Impact Assessment Annual Congress, Durban, 16 – 19 May 2018.  
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.  
28<sup>th</sup> International Symposium on Remote Sensing of Environment, Somerset West, 27-31  
March 2000.  
Workshop on Vegetation Structural Characterisation: Tree Cover, Height and Biomass, 28<sup>th</sup>  
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.  
34<sup>th</sup> 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 Afrikanse Universiteit postgraduate symposium, 1997.  
South African Association of Botanists Annual Congress, Bloemfontein, January 1995.

# Terrestrial Animal Species Assessment

prepared in accordance with the  
*"Protocol for the Specialist Assessment and minimum report content requirements for  
environmental impacts on Terrestrial Animal Species"*

## Camden II Wind Energy Facility near Ermelo in Mpumalanga Province



David Hoare Consulting (Pty) Ltd



David Hoare  
Consulting (Pty) Ltd

Address:  
Postnet Suite #116  
Private Bag X025  
Lynnwood Ridge  
0040

41 Soetdoring Avenue  
Lynnwood Manor  
Pretoria

Telephone: 087 701 7629  
Cell: 083 284 5111  
Fax: 086 550 2053  
Email:  
david@davidhoareconsulting.co.za

# Terrestrial Animal Species Assessment

prepared in accordance with the  
*"Protocol for the Specialist Assessment and  
minimum report content requirements for  
environmental impacts on Terrestrial Animal  
Species"*

## Report for the proposed Camden II Wind Energy Facility near Ermelo in Mpumalanga Province.

Prepared by: Dr David Hoare  
Pr.Sci.Nat. (Botany, Ecology) 400221/05

For:  
Camden II Wind Energy Facility (RF) Propriety Limited  
53 Dudley Road,  
Parkwood,  
Johannesburg  
South Africa

27 June 2022

Report version: 1<sup>st</sup> draft

# TABLE OF CONTENTS

<b>TABLE OF CONTENTS .....</b>	<b>2</b>
<b>SPECIALIST DETAILS &amp; DECLARATION .....</b>	<b>4</b>
DECLARATION OF INDEPENDENCE:.....	4
DISCLOSURE: .....	4
<b>TERMS OF REFERENCE .....</b>	<b>5</b>
<b>INTRODUCTION .....</b>	<b>9</b>
PROJECT BACKGROUND .....	9
PROJECT DESCRIPTION .....	9
IDENTIFIED THEME SENSITIVITIES .....	11
<i>Animal Species theme</i> .....	11
<b>LISTED SPECIES THAT COULD OCCUR ON SITE.....</b>	<b>13</b>
ANIMAL SPECIES FLAGGED FOR THE STUDY AREA .....	13
<i>Neotis denhami (Denham's Bustard)</i> .....	13
<i>Geronticus calvus (Southern Bald Ibis)</i> .....	13
<i>Tyto capensis (African Grass Owl)</i> .....	13
<i>Sensitive species 2</i> .....	13
<i>Grus carunculata (Wattled Crane)</i> .....	13
<i>Sagittarius serpentarius (Secretarybird)</i> .....	14
<i>Crocidura maquassiensis (Maquassie Musk Shrew)</i> .....	14
<i>Ourebia ourebi ourebi (Oribi)</i> .....	14
OTHER LISTED SPECIES FOR THE STUDY AREA.....	14
PROTECTED ANIMALS .....	17
<b>METHODOLOGY .....</b>	<b>19</b>
SURVEY TIMING.....	19
FIELD SURVEY APPROACH .....	19
SOURCES OF INFORMATION .....	20
LIMITATIONS, ASSUMPTIONS & UNCERTAINTIES .....	20
<b>ASSESSMENT OUTCOMES.....</b>	<b>21</b>
HABITATS ON SITE.....	21
<i>Grassland</i> .....	23
<i>Wetlands</i> .....	23
<i>Pans</i> .....	23
<i>Current cultivation</i> .....	23
<i>Old lands</i> .....	23
<i>Exotic trees</i> .....	23
<i>Degraded areas</i> .....	23
<i>Transformed areas</i> .....	23
<b>DESCRIPTION OF POTENTIAL IMPACTS.....</b>	<b>25</b>
POTENTIAL SENSITIVE RECEPTORS IN THE GENERAL STUDY AREA.....	25
CONSTRUCTION PHASE IMPACTS .....	25
OPERATIONAL PHASE IMPACTS.....	25
DECOMMISSIONING PHASE IMPACTS .....	25
<b>ASSESSMENT OF IMPACTS.....</b>	<b>26</b>
CONSTRUCTION PHASE IMPACTS .....	26

<i>Direct mortality of fauna due to machinery, construction and increased traffic</i> .....	26
OPERATIONAL PHASE IMPACTS.....	27
<i>Direct mortality of fauna through traffic, illegal collecting, poaching and collisions and/or entanglement with infrastructure</i> .....	27
DECOMMISSIONING PHASE IMPACTS.....	28
CUMULATIVE IMPACTS.....	28
<i>Cumulative impacts on faunal habitat from construction clearing due to a number of projects</i> .....	28
<i>Cumulative impacts of direct faunal mortality due to a number of projects: construction phase</i> .....	29
<i>Cumulative impacts of direct faunal mortality due to a number of projects: operational phase</i> .....	29
SUMMARY OF MITIGATION MEASURES .....	30
<b>DISCUSSION AND CONCLUSIONS.....</b>	<b>31</b>
<b>BIBLIOGRAPHY AND REFERENCES: .....</b>	<b>32</b>
<b>APPENDICES: .....</b>	<b>33</b>
APPENDIX 1: ANIMAL SPECIES WITH A GEOGRAPHICAL DISTRIBUTION THAT INCLUDES THE STUDY AREA. ....	33
APPENDIX 2: FAUNA PROTECTED UNDER THE MPUMALANGA NATURE CONSERVATION ACT NO. 10 OF 1998.....	36
APPENDIX 3: VERTEBRATE ANIMAL SPECIES PROTECTED UNDER THE NATIONAL ENVIRONMENTAL MANAGEMENT: BIODIVERSITY ACT, 2004 (ACT 10 OF 2004) .....	38



# SPECIALIST DETAILS & DECLARATION

This report has been prepared in accordance with the "Protocol for the specialist assessment and minimum report content requirements for environmental impacts on **terrestrial animal species**", as promulgated in terms of Section 24 (5) of the National Environmental Management Act, 1998 (Act No. 107 of 1998), published in GN. No. 320 dated 20 March 2020. It has been prepared independently of influence or prejudice by any parties.

The details of Specialists are as follows:

Specialist	Qualification and accreditation
Dr David Hoare	PhD Botany SACNASP (Pr.Sc.Nat.) Reg. no. 400221/05 (Ecology, Botany)

## Declaration of independence:

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

## Disclosure:

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

Based on information provided to David Hoare Consulting (Pty) Ltd by the client and in addition to information obtained during the course of this study, David Hoare Consulting (Pty) Ltd presents the results and conclusion within the associated document to the best of the author's professional judgement and in accordance with best practice.



Dr David Hoare

20 June 2022

Date

# TERMS OF REFERENCE

The specialist study is required to follow the published Protocols, provided in full below for the assessment of impacts on Terrestrial Animal Species. Note that the Protocols require determination of the level of sensitivity, which then determines the level of assessment required, either a full assessment, or a Compliance Statement.

## PROTOCOL FOR THE SPECIALIST ASSESSMENT AND MINIMUM REPORT CONTENT REQUIREMENTS FOR ENVIRONMENTAL IMPACTS ON TERRESTRIAL ANIMAL SPECIES

This site sensitivity assessment follows the requirements of The Environmental Impact Assessment Regulations, as promulgated in terms of Section 24 (5) of the National Environmental Management Act, 1998 (Act No. 107 of 1998), published in GN. No. 320 dated 20 March 2020.

### General information

1.1 An applicant intending to undertake an activity identified in the scope of this protocol, on a site identified by the screening tool as being of “**very high**” or “**high**” sensitivity for terrestrial animal species, must submit a **Terrestrial Animal Species Specialist Assessment Report**.

1.2 An applicant intending to undertake an activity identified in the scope of this protocol, on a site identified by the screening tool as being of “**medium** sensitivity” for terrestrial animal species, must submit either a **Terrestrial Animal Species Specialist Assessment Report** or a **Terrestrial Animal Species Compliance Statement**, depending on the outcome of a site inspection undertaken in accordance with paragraph 4.

1.3 An applicant intending to undertake an activity identified in the scope of this protocol, on a site identified by the screening tool as being of “**low**” sensitivity for terrestrial animal species, must submit a **Terrestrial Animal Species Compliance Statement**.

1.4 Where the information gathered from the site sensitivity verification differs from the screening tool designation of “very high” or “high” for terrestrial animal species sensitivity on the screening tool, and it is found to be of a “low” sensitivity, then a **Terrestrial Animal Species Compliance Statement** must be submitted.

1.5 Where the information gathered from the site sensitivity verification differs from the screening tool designation of “low” terrestrial animal species sensitivity and it is found to be of a “very high” or “high” terrestrial animal species sensitivity, a **Terrestrial Animal Species Specialist Assessment** must be conducted.

1.6 If any part of the development falls within an area of confirmed “very high” or “high” sensitivity, the assessment and reporting requirements prescribed for the “very high” or “high” sensitivity, apply to the entire development footprint. Development footprint in the context of this protocol, means the area on which the proposed development will take place and includes the area that will be disturbed or impacted.

1.7 The **Terrestrial Animal Species Specialist Assessment** and the **Terrestrial Animal Species Compliance Statement** must be undertaken within the study area.

1.8 Where the nature of the activity is not expected to have an impact on species of conservation concern (SCC) beyond the boundary of the preferred site, the study area means the proposed development footprint within the preferred site.

1.9 Where the nature of the activity is expected to have an impact on SCC beyond boundary of the preferred site, the project areas of influence (PAOI) must be determined by the specialist in accordance with Species Environmental Assessment Guideline, and the study area must include the PAOI, as determined.

## **Terrestrial Animal Species Specialist Assessment**

2.1 The assessment must be undertaken by a specialist registered with the South African Council for Natural Scientific Professions (SACNASP), within a field of practice relevant to the taxonomic groups ("taxa") for which the assessment is being undertaken.

2.2 The assessment must be undertaken in accordance with the Species Environmental Assessment Guideline and must:

2.2.1 Identify the SCC which were found, observed or are likely to occur within the study area;

2.2.2 provide evidence (photographs) of each SCC found or observed within the study area, which must be disseminated by the specialist to a recognized online database facility immediately after the site inspection has been performed (prior to preparing the report contemplated in paragraph 3);

2.2.3 identify the distribution, location, viability and detailed description of population size of the SCC identified within the study area;

2.2.4 identify the nature and the extent of the potential impact of the proposed development to the population of the SCC located within the study area;

2.2.5 determine the importance of the conservation of the population of the SCC identified within the study area, based on information available in national and international databases including the IUCN Red List of Threatened Species, South African Red List of Species, and/or other relevant databases;

2.2.6 determine the potential impact of the proposed development on the habitat of the SCC located within the study area;

2.2.7 include a review of relevant literature on the population size of the SCC, the conservation interventions as well as any national or provincial species management plans for the SCC. This review must provide information on the need to conserve the SCC and indicate whether the development is compliant with the applicable species management plans and if not, a motivation for the deviation;

2.2.8 identify any dynamic ecological processes occurring within the broader landscape, that might be disrupted by the development and result in negative impact on the identified SCC, for example, fires in fire-prone systems;

2.2.9 identify any potential impact on ecological connectivity in relation to the broader landscape, resulting in impacts on the identified SCC and its long term viability;

2.2.10 determine buffer distances as per the Species Environmental Assessment Guidelines used for the population of each SCC;

2.2.11 discuss the presence or likelihood of additional SCC including threatened species not identified by the screening tool, Data Deficient or Near Threatened Species, as well as any undescribed species, or roosting and breeding or foraging areas used by migratory species where these species show significant congregations, occurring in the vicinity; and

2.2.12 identify any alternative development footprints within the preferred development site which would be of "low" or "medium" sensitivity as identified by the screening tool and verified through the site sensitivity verification.

2.3 The findings of the assessment must be written up in a **Terrestrial Animal Species Specialist Assessment Report**.

## **Terrestrial Animal Species Specialist Assessment Report**

3.1 This report must include as a minimum the following information:

3.1.1 contact details and relevant experience as well as the SACNASP registration number of the specialist preparing the assessment including a curriculum vitae;

3.1.2 a signed statement of independence by the specialist;

3.1.3 a statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;

3.1.4 a description of the methodology used to undertake the site sensitivity verification and impact assessment and site inspection, including equipment and modelling used where relevant;

3.1.5 a description of the mean density of observations/number of samples sites per unit area of site inspection observations;

3.1.6 a description of the assumptions made and any uncertainties or gaps in knowledge or data;

3.1.7 details of all SCC found or suspected to occur on site, ensuring sensitive species are appropriately reported;

3.1.8 the online database name, hyperlink and record accession numbers for disseminated evidence of SCC found within the study area;

3.1.9 the location of areas not suitable for development and to be avoided during construction where relevant;

3.1.10 a discussion on the cumulative impacts;

3.1.11 impact management actions and impact management outcomes proposed by the specialist for inclusion in the Environmental Management Programme (EMPr);

3.1.12 a reasoned opinion, based on the findings of the specialist assessment, regarding the acceptability or not, of the development related to the specific theme considered, and if the development should receive approval or not, related to the specific theme being considered, and any conditions to which the opinion is subjected if relevant; and

3.1.13 a motivation must be provided if there were any development footprints identified as per paragraph 2.2.12 above that were identified as having “low” or “medium” terrestrial animal species sensitivity and were not considered appropriate.

3.2 A signed copy of the assessment must be appended to the Basic Assessment Report or Environmental Impact Assessment Report.

## **Terrestrial Animal Species Compliance Statement**

5.1 The compliance statement must be prepared by a SACNASP registered specialist under one of the two fields of practice (Zoological Science or Ecological Science).

5.2 The compliance statement must:

5.2.1 be applicable within the study area;

5.2.2 confirm that the study area is of “low” sensitivity for terrestrial animal species; and

5.2.3 indicate whether or not the proposed development will have any impact on SCC.

5.3 The compliance statement must contain, as a minimum, the following information:

5.3.1 contact details and relevant experience as well as the SACNASP registration number of the specialist preparing the compliance statement including a curriculum vitae;

5.3.2 a signed statement of independence by the specialist;

5.3.3 a statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;

5.3.4 a description of the methodology used to undertake the site survey and prepare the compliance statement, including equipment and modelling used where relevant;

5.3.5 the mean density of observations/ number of samples sites per unit area;

5.3.6 where required, proposed impact management actions and outcomes or any monitoring requirements for inclusion in the EMPr;

5.3.7 a description of the assumptions made and any uncertainties or gaps in knowledge or data;

5.3.8 any conditions to which the compliance statement is subjected.

A signed copy of the Terrestrial Animal Species Compliance Statement must be appended to the Basic Assessment Report or the Environmental Impact Assessment Report.

# INTRODUCTION

## Project Background

ENERTRAG SOUTH AFRICA, a subsidiary of ENERTRAG AG, the German-based renewable energy company, is proposing to develop a Wind Energy Facility (WEF) of up to 200 MW near Camden Power Station in Mpumalanga Province. This will be part of the Camden Renewable Energy Complex that will include:

1. Camden I Wind Energy Facility (up to 200MW).
2. Camden I Wind Grid Connection (up to 132kV).
3. Camden up to 400kV Grid Connection and Collector substation.
4. Camden I Solar up to 100MW.
5. Camden I Solar up to 132kV Grid Connection.
6. Camden Green Hydrogen and Ammonia Facility, including grid connection infrastructure.
7. **Camden II Wind Energy Facility (up to 200MW).**
8. Camden II Wind Energy Facility up to 132kV Grid Connection.

Camden II Wind Energy Facility (RF) Propriety Limited has appointed WSP as the independent Environmental Assessment Practitioner (EAP) to facilitate the Environmental Impact Assessment (EIA) Process. This report relates specifically to the **Camden II Wind Energy Facility (up to 200 MW)** (the Project). ENERTRAG appointed David Hoare Consulting (Pty) Ltd to undertake this specialist assessment for the Project.

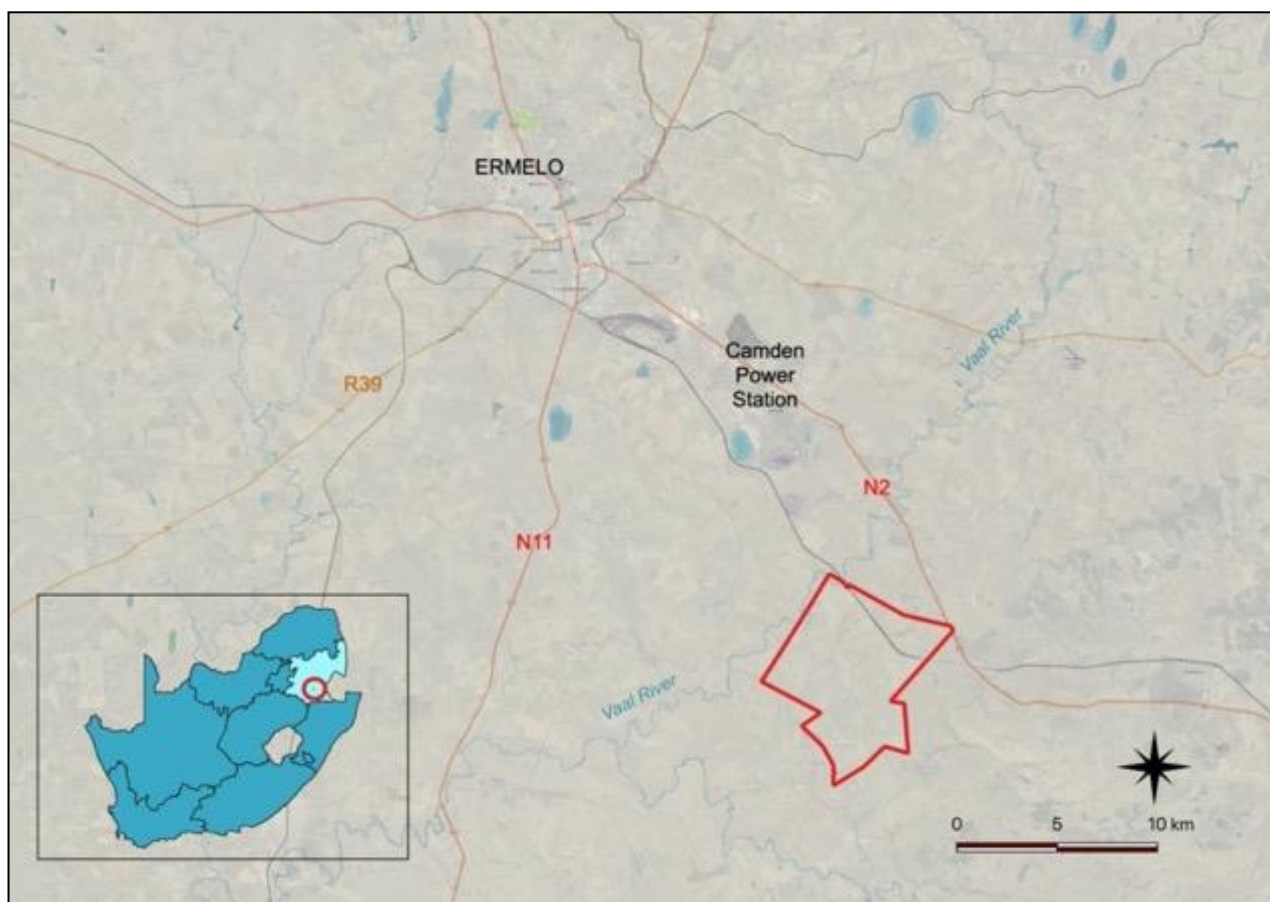
## Project description

The Camden II Wind Energy Facility is summarised as follows:

<b>Facility Name</b>	Camden II Wind Energy Facility
<b>Applicant</b>	Camden II Wind Energy Facility (RF) Propriety Limited
<b>Municipalities</b>	Msukaligwa Local Municipality of the Gert Sibande District Municipality
<b>Affected Farms</b>	<ul style="list-style-type: none"><li>o Adrianople 296 IT (Portion 0, 1, 2 and 3)</li><li>o Buhrmansvallei 297 IT (Portion 3, 4 and 5)</li><li>o Klipfontein 326 IT (Portion 5)</li><li>o De Emigratie 327 IT (Portion 3 and 6)</li></ul>
<b>Extent</b>	4300 ha
<b>Buildable area</b>	Approximately 200 ha, subject to finalization based on technical and environmental requirements
<b>Capacity</b>	Up to 200MW
<b>Number of turbines</b>	Up to 45
<b>Turbine hub height:</b>	Up to 200m
<b>Rotor Diameter:</b>	Up to 200m
<b>Foundation</b>	<ul style="list-style-type: none"><li>• Concrete foundations of approximately of 25m diameter x 4.5m deep will be required for each turbine, requiring approximately 2500m<sup>3</sup> concrete. Please note these dimensions may be larger as required by the geotechnical conditions.</li><li>• Concrete foundation will be constructed to support a mounting ring. Approximately 25m<sup>2</sup> diameter x 3m deep –</li></ul>

	500 – 650m <sup>3</sup> concrete. Excavation approximately 1000m <sup>2</sup> , in sandy soils due to access
<b>O&amp;M building footprint:</b>	Located near the substation. Septic/conservancy tanks (operational phase) with portable toilets for construction phase. Typical areas include: <ul style="list-style-type: none"> <li>- Operations building – 20m x 10m = 200m<sup>2</sup></li> <li>- Workshop – 15m x 10m = 150m<sup>2</sup></li> <li>- Stores - 15m x 10m = 150m<sup>2</sup></li> </ul>
<b>Construction camp laydown</b>	Typical area 100m x 50m = 5000m <sup>2</sup> . Sewage: Portable toilets.
<b>Temporary laydown or staging area:</b>	Typical area 220m x 100m = 22000m <sup>2</sup> . Laydown area could increase to 30000m <sup>2</sup> for concrete towers, should they be required.
<b>Cement batching plant (temporary):</b>	Gravel and sand will be stored in separate heaps whilst the cement will be contained in a silo.
<b>Internal Roads:</b>	Width of internal road – Between 5m and 6m. Length of internal road – Approximately 60km. Where required for turning circle/bypass areas, access or internal roads may be up to 20m to allow for larger component transport.
<b>Cables:</b>	The medium voltage collector system will comprise of cables up to and include 33kV that run underground, except where a technical assessment suggest that overhead lines are required, in the facility connecting the turbines to the onsite substation.
<b>IPP site substation and battery energy storage system (BESS):</b>	Total footprint will be up to 6.5ha in extent (5ha for the BESS and 1.5ha for the IPP portion of the substation). The substation will consist of a high voltage substation yard to allow for multiple (up to) 132kV feeder bays and transformers, control building, telecommunication infrastructure, access roads, etc.  The BESS storage capacity will be up to 200MW/800MWh with up to four hours of storage. It is proposed that Lithium Battery Technologies, such as Lithium Iron Phosphate, Lithium Nickel Manganese Cobalt oxides or Vanadium Redox flow technologies will be considered as the preferred battery technology. The main components of the BESS include the batteries, power conversion system and transformer which will all be stored in various rows of containers.

The project is located about 23 km south-east of Ermelo in Mpumalanga Provinces, South Africa (Figure 1). The site is just off the N2 (Ermelo to Piet Retief) road. The Eskom Camden Power Station is approximately 7 km to the north-north-east of the site. The roads on site are all gravel farm access roads.



**Figure 1: Location of the study area in Mpumalanga Province.**

## Identified Theme Sensitivities

A sensitivity screening report from the DFFE Online Screening Tool was requested in the application category:

Utilities Infrastructure|Electricity|Generation|Renewable|Wind

The DFFE Screening Tool report for the area (Figure 2) indicates the following ecological sensitivities:

Theme	Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
Animal Species Theme		X		

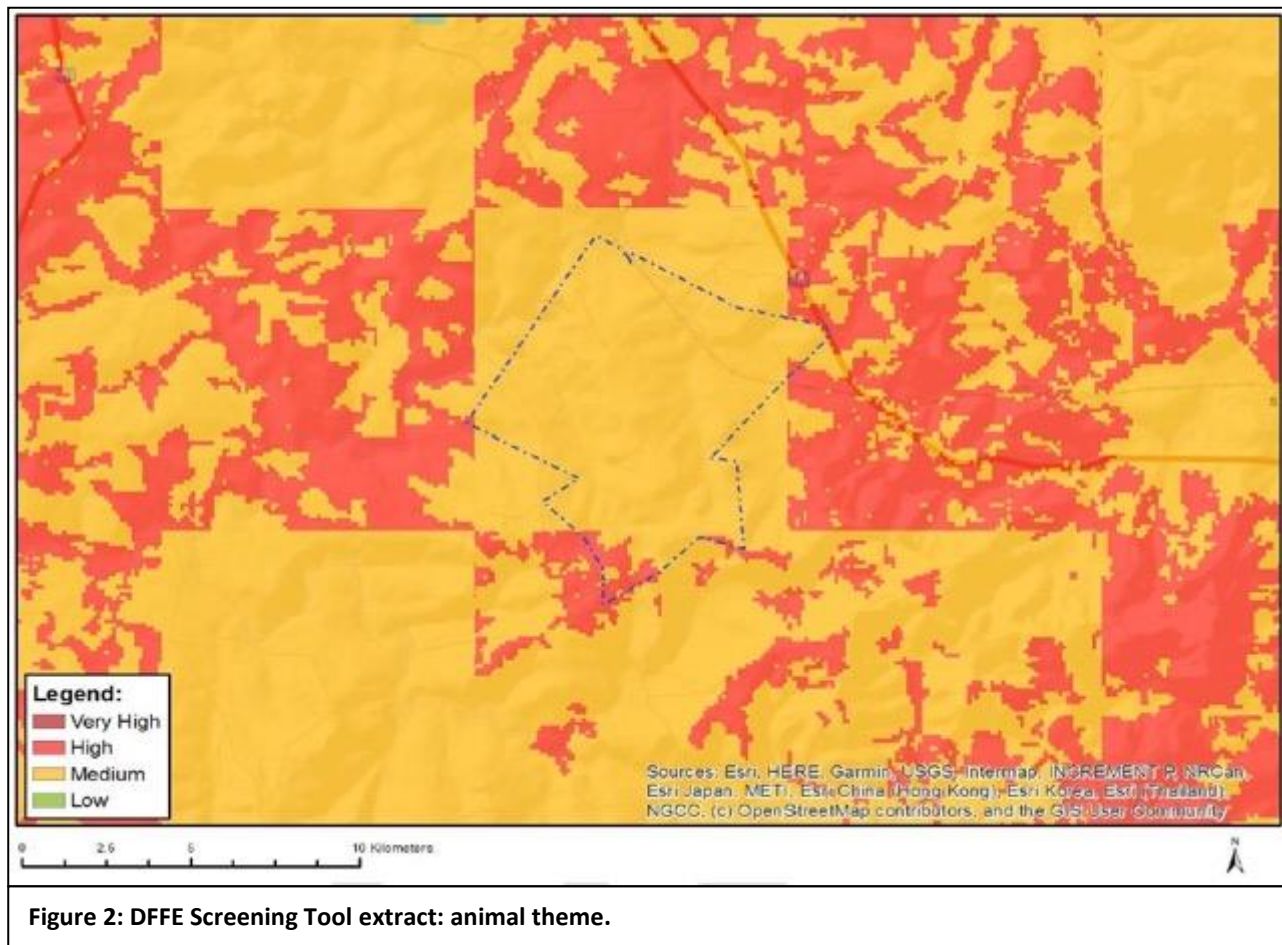
### ***Animal Species theme***

The animal species theme was highlighted as being of High sensitivity due the potential presence of the following species:

Sensitivity	Feature(s)
High	Aves-Neotis denhami
High	Aves-Geronticus calvus



Medium	Aves-Tyto capensis
Medium	Sensitive species 2
Medium	Aves-Geronticus calvus
Medium	Aves-Grus carunculata
Medium	Aves-Neotis denhami
Medium	Aves-Neotis denhami
Medium	Mammalia-Crocidura maquassiensis
Medium	Mammalia-Ourebia ourebi ourebi



**Figure 2: DFFE Screening Tool extract: animal theme.**

# Listed species that could occur on site

## Animal species flagged for the study area

A separate Avifaunal Specialist Assessment is undertaken for this project, therefore the assessment of birds is a more general one in which favourable habitat for mostly terrestrial species is considered, along with the animal assessments.

The following species have been flagged for the site in the DFFE Screening Report:

### ***Neotis denhami* (Denham's Bustard)**

Vulnerable

Has a wide but fragmented Afrotropical range. It occurs widely but sparsely over much of the mesic eastern half of South Africa (Taylor et al. 2015). Its distribution follows the escarpment region of the country, down to the coast, with one extension in eastern Mpumalanga extending inland towards Gauteng and the Waterberg. In the Western Cape, it follows the main Cape mountain ranges. The sour grassveld areas of Mpumalanga, from Wakkerstroom to Dullstroom, are the areas of distribution on the Highveld. Across its entire range, it appears to inhabit grassland and relatively sparse woodland, as well as croplands. It is a generalist feeder and its diet consists of insects, small vertebrates and plant material. The site is within the known distribution range of the species and there are suitable habitats on site, especially towards the south-eastern side of the study area. A detailed avifaunal assessment has been undertaken for this project where additional information can be obtained regarding this species.

### ***Geronticus calvus* (Southern Bald Ibis)**

The Southern Bald Ibis, listed as Vulnerable, is restricted to Lesotho, north-east South Africa and west Eswatini. The core range lies in the north-eastern Free State, Mpumalanga and the KwaZulu-Natal Drakensberg. The site is therefore near to the centre of its relatively restricted global distribution. It prefers high rainfall (>700 mm p.a.), sour and alpine grasslands, characterised by an absence of trees and a short, dense grass sward. It also occurs in lightly wooded and relatively arid country. It forages preferentially on recently burned ground, also using unburnt natural grassland, cultivated pastures, reaped maize fields and ploughed areas (Birdlife International 2022). A detailed avifaunal assessment has been undertaken for this project where additional information can be obtained regarding this species.

### ***Tyto capensis* (African Grass Owl)**

The African Grass Owl is listed as Vulnerable. It is confined to the higher rainfall areas in the eastern half of South Africa, where it typically roosts and breeds in tall, rank grass or sedges associated with damp substrates, such as permanent and non-perennial wetlands and streams. The Vaal River is an important corridor for the species. A detailed avifaunal assessment has been undertaken for this project where additional information can be obtained regarding this species.

### ***Sensitive species 2***

This is a large bird listed as Vulnerable. They are usually found in grasslands close to bodies of water or vleis. They prefer to nest near bodies of water that provide cover, but often feed in open savannas and grasslands. They can also be found in agricultural lands such as pastures, cropland, or fallow fields. They also often select habitats that include some trees, as they are able to roost in trees. A detailed avifaunal assessment has been undertaken for this project where additional information can be obtained regarding this species.

### ***Grus carunculata* (Wattled Crane)**

The Wattled Crane is listed regionally as Critically Endangered and globally as Vulnerable. It is found primarily in upland marshes. Birds in Mpumalanga breed on an ecologically distinct, plateau-like watershed about 50 x 20 km in extent, at an altitude of 1 850-2 300 m asl (Morrison and Bothma 1998), which includes some of the general areas surrounding Ermelo. Breeding pairs are sedentary but non-breeding floaters can move up to 130 km away from breeding sites. This means any suitable grassland habitat is potential metapopulation habitat. Based on available habitat on site, it is unlikely that breeding would take place on site. A detailed avifaunal assessment has been undertaken for this project where additional information can be obtained regarding this species.

### ***Sagittarius serpentarius* (Secretarybird)**

The Secretarybird, listed as Endangered, inhabits open landscapes, ranging from open plains and grasslands, to lightly wooded savanna, but is also found in agricultural areas and sub-desert. It is nomadic, but birds living in the moist grassland biome are less likely to be nomadic, although they will travel on average 20-30 km per day while foraging. There are various threats to this species, one of which is that overgrazing degrades favourable habitat. A detailed avifaunal assessment has been undertaken for this project where additional information can be obtained regarding this species.

### ***Crociodura maquassiensis* (Maquassie Musk Shrew)**

The Maquassie Musk Shrew (*Crociodura maquassiensis*), listed as Vulnerable, is endemic to South Africa, Eswatini and Zimbabwe, where it is found in moist grassland habitats in Savannah and Grassland Biomes. It appears to tolerate a wide range of habitats, although threats to the species have been inferred as being related to loss or degradation of moist, productive areas, such as rank grassland and wetlands (Taylor et al. 2016). The species is patchily distributed within the north-eastern part of South Africa. The study area is within the known distribution of this species in the sense that there are records in quarter degree grids throughout the Highveld, although not from the current grid or any nearby grids. It is, however, flagged in the DFFE Online Screening Tool as potentially occurring on site. It is therefore considered possible that it could occur on site and individuals could therefore possibly be affected by construction activities.

### ***Ourebia ourebi ourebi* (Oribi)**

The Oribi (*Ourebia ourebi*), listed as Endangered in South Africa and Least Concern globally, has a geographical distribution that includes the study area. It is widely distributed in Africa, but the subspecies found in South Africa has a more limited distribution that includes South Africa and Mozambique. The species inhabits savanna woodlands, floodplains and other open grasslands from sea level to 2200 m asl (in Mpumalanga). They reach their highest density on floodplains and moist tropical grasslands. They prefer open grassland in good condition containing a mosaic of short grass for feeding and tall grass for feeding and shelter. It has not been recorded in the grid in which the site is located, which is one of a group of grids in south-western Mpumalanga where the species does not appear to occur. Nevertheless, the area is within the overall distribution range of the species. Based on the gap in the distribution of the species, there is a low likelihood that it could occur on site within any suitable habitat, although it is flagged for the project in the Screening Tool.

## **Other listed species for the study area**

Vertebrate species (mammals, reptiles, amphibians) with a geographical distribution that includes the study area are listed in Appendix 1. All threatened (Critically Endangered, Endangered or Vulnerable) or near threatened vertebrate animals that could occur in the study area and have habitat preference that includes habitats available in the study area are discussed further.

### **Grey Rhebok**

The Grey Rhebok (*Pelea capreolus*), listed as Near Threatened, is endemic to South Africa, Lesotho and parts of Eswatini. They are predominantly browsers, feeding on ground-hugging forbs, and largely water independent, obtaining most of their water requirements from their food. Local declines in their population have been attributed to increased densities of natural predators, such as Black-backed Jackal, Caracals and Leopards. It has not been recorded in the grid in which the site is located, but has been recorded in areas to the north-east and many areas further to the south, therefore the site is within the overall distribution range of the species. There is a moderate likelihood that it could occur on site within any suitable habitat. However, it is a relatively mobile species and not necessarily dependent on any particular habitat. It is likely to move away from the path of any construction and development of parts of the study area.

### **Black-footed Cat**

The Black-footed Cat (*Felis nigripes*), listed as Vulnerable, has been previously recorded in the grid in which the project is located, as well as in four surrounding grids. Its known distribution is inland throughout South Africa, except within the winter-rainfall part of the country. It also occurs in Botswana and Namibia. The current project area is towards the edge of the distribution range of the species. The species is nocturnal and carnivorous, favouring any vegetation cover that is low and not too dense. They make use of dens in the daytime, which can be abandoned termite mounds, or dens dug by other animals, such as aardvark, springhares or cape ground squirrels. Local declines in their population have

been attributed to increased densities of natural predators, such as Black-backed Jackal, Caracals and Leopards. They are highly vulnerable to domestic carnivores. The study area is suited to this species and it has a high probability of occurring there.

#### Leopard

The Leopard (*Panthera pardus*), listed as Vulnerable, has a wide habitat tolerance, but with a preference for densely wooded areas and rocky areas. They have large home ranges, males having ranges of about 100 km<sup>2</sup> and females 20 km<sup>2</sup>, but do not migrate easily. It has not been recorded in any of the adjacent or nearby grids and the overall distribution shows a gap in its distribution in current study area. There is therefore a low probability of this species occurring on site.

#### African Marsh Rat

The African Marsh Rat (*Dasymys robertsii*), listed as Vulnerable, is patchily distributed in northern South Africa and Zimbabwe. Within South Africa it is found primarily in savanna and lowveld areas, where it is dependent on river and wetland systems. Its distribution coincides with the Limpopo watershed. Distribution records suggest that the species is not likely to occur in the study area.

#### Spotted-necked Otter

The Spotted-necked Otter (*Hydricetus maculicollis*), listed as Vulnerable, is widely but patchily distributed in the higher parts of the eastern half of South Africa. It is also found in lakes and large rivers throughout much of Africa south of 10°N. They are restricted to areas of permanent fresh water where there is good shoreline cover and an abundant prey base (small fishes). They prefer water that is not silt-laden and is unpolluted, although have been known to occur in polluted rivers. The site is within the known distribution of this species and there are historical records for one nearby grid to the north-east, although not from the current grid. There is potentially suitable habitat for this species on site within the small dams.

#### Cape Clawless Otter

The Cape Clawless Otter (*Aonyx capensis*), listed as Near Threatened, is widely but patchily distributed throughout South Africa, and is also the most widely found otter in Africa. It is aquatic and seldom found far from permanent water, which needs to be fresh. The site is within the known distribution of this species and there are historical records for one adjacent grid to the north-east, although not from the current grid. There is potentially suitable habitat for this species on site, although water quality may be an issue. It is therefore considered possible that it occurs on site.

#### African Striped Weasel

The African Striped Weasel (*Poecilogale albinucha*), listed as Near Threatened, is found throughout most of South Africa, except for the arid interior, and into central Africa. It has not been recorded in the grid in which the site is located, but has been recorded in two adjacent grids, and the site is within the overall distribution range for the species. It is found primarily in moist grasslands and fynbos, where adequate numbers of prey may be found. It is considered likely that it could occur on site.

#### Brown Hyaena

The Brown Hyaena (*Parahyaena brunnea*), listed as Near Threatened, is found in a band running down the centre of the country, expanding into the entire northern parts of the country. There is a gap in the distribution around the current study area, but there is a possibility that vagrant individuals could extend into this area. The species is found in desert areas, particularly along the west coast, semi-desert, open scrub and open woodland savannah (Mills & Hes 1997). It is a solitary scavenger that travels vast distances every day in search of food. It has a medium chance of occurring in the study area since the distribution range includes the study area, however there are no historical records from nearby. It is a mobile animal that is likely to move away from the path of any construction and development of parts of the site is therefore highly unlikely to have any negative effect on the species. It is considered that there is a low likelihood of it occurring on site.

#### South African Hedgehog

The South African Hedgehog (*Atelerix frontalis*), listed as Near Threatened, is found in a large part of the central part of South Africa, extending down to the south-eastern coast, and is also found in Namibia, Botswana, Zimbabwe, Lesotho and Eswatini. It requires ample ground cover for cover, nesting and foraging and prefers dense vegetation and rocky outcrops. The site is well-within the known distribution of this species and there are historical records for nearby grids

in all directions, and it has been recorded from the current grid. There is therefore a high probability of the study area being suitable for this species. It is considered likely that it could occur on site.

#### Swamp Musk Shrew

The Swamp Musk Shrew (*Crocidura mariquensis*), listed as Near Threatened, is found in the north-eastern part of South Africa, extending down to the south-eastern coast. It occurs in wetlands and waterlogged grasslands, predominantly in KwaZulu-Natal, Mpumalanga, Limpopo, Gauteng and North West Provinces. The site is well-within the known distribution of this species and there are historical records for nearby grids in all directions, and it has been recorded from the current grid. There is therefore a high probability of the study area being suitable for this species. It is considered likely that it could occur on site.

#### Highveld Golden Mole

The Highveld Golden Mole (*Amblysomus septentrionalis*), listed as Near Threatened, is found across the Mpumalanga Highveld from Wakkerstroom northwards to Ermelo and Barberton and westwards through Standerton to north-eastern Free State. It occurs within meadows and edges of marshes in high-altitude grassland in Mpumalanga. They are restricted to friable soils in valleys and on mountainsides. The site is within the known distribution of this species, although higher densities of records occur further east. There are historical records for an adjacent grid to the south-west, but it has not been recorded from the current grid. There is therefore a medium probability of the study area being suitable for this species. It is considered possible that it could occur on site and individuals could be affected by construction activities, if suitable habitat is damaged.

#### White-tailed Rat

The White-tailed Rat (*Mystromys albicaudatus*), listed as Vulnerable, is endemic to South Africa and Lesotho, where it is found primarily in Highveld grasslands, but extending into adjacent Fynbos and Karoo areas. It is terrestrial, but never found in soft, sandy substrates, rocks, wetlands or river banks, and do not occur in transformed habitat. The study area is on the edge of the known distribution of this species, with most of Mpumalanga appearing to be a gap in the occurrence of the species. There is therefore a low probability of the study area being suitable for this species. It is considered unlikely that it would occur on site.

#### Vlei Rat

The Vlei Rat (Grassland-type) (*Otomys auratus*), listed as Near Threatened, is near-endemic to South Africa, occurring in the north-eastern half of the country, associated with mesic grasslands and wetlands within alpine, montane and sub-montane regions. It is likely to be associated with sedges and grasses in densely-vegetated wetlands with wet soils. The study area is well within the known distribution of this species and there are historical records for the grid in which the study area is located, as well as two adjacent grids. There is therefore a high probability of the study area being suitable for this species. It is considered likely that it occurs on site and the proposed development could therefore affect this species.

#### Coppery grass lizard

The Coppery Grass Lizard (*Chamaesaura aenea*), listed as Near Threatened, is endemic to South Africa, where it is found in western Eswatini, Limpopo, Mpumalanga, Gauteng, KwaZulu-Natal, north-eastern Free State and Eastern Cape. It is found on grassy slopes and plateau of the eastern escarpment and Highveld, where it probably shelters in the base of grass tussocks. The study area is within the known distribution of this species and there are historical records for two adjacent grids to the north and south, although not from the current grid. There is therefore a moderate probability of the study area being suitable for this species, including suitable habitat within the project area.

#### Large-scaled grass lizard

The Large-scaled Grass Lizard (*Chamaesaura macrolepis*), listed as Near Threatened, is endemic to South Africa, Eswatini and Zimbabwe. In South Africa it is found in Limpopo, Mpumalanga, and KwaZulu-Natal. It is found in grassland, especially rocky, grassy hillsides. Its main distribution is within the Indian Ocean Coastal Belt part of KwaZulu-Natal, but there are scattered records on the Highveld. The study area is marginally within the known distribution of this species in the sense that there are records in quarter degree grids up to Gauteng and there are historical records for one nearby grid to the north-east, although not from the current grid. There is therefore a moderate to low probability of the study area being suitable for this species, including suitable habitat within the project area. It is considered a low likelihood that it could occur on site.

### Breyer's Long-tailed Seps

The Breyer's Long-tailed Seps (*Tetradactylus breyeri*), listed as Vulnerable, is endemic to South Africa, where it is found in Free State, Mpumalanga, and KwaZulu-Natal. It is found in montane and Highveld grassland. The study area is marginally within the known distribution of this species in the sense that there are records in quarter degree grids throughout the Highveld, extending from Blyde River Canyon to the Drakensberg, although not from the current grid or any nearby grids. There is therefore a low probability of the study area being suitable for this species, including suitable habitat within the project area. It is considered unlikely that it would occur on site.

### Striped Harlequin Snake

The Striped Harlequin Snake (*Homoroselaps dorsalis*), listed as Near Threatened, is endemic to South Africa, where it is found in western Eswatini, Limpopo, Mpumalanga, Gauteng, KwaZulu-Natal, and Free State. It is partly fossorial and known to inhabit old termitaria in grassland habitat. Most of its range is at moderately high elevations, but it also occurs close to sea level in KwaZulu-Natal. The study area is within the known distribution of this species and there are historical records for one adjacent grid to the north, although not from the current grid. There is therefore a moderate probability of the study area being suitable for this species, including suitable habitat within the project area. It is considered likely that it could occur on site.

### The Giant Bull Frog

The Giant Bull Frog (*Pyxicephalus adspersus*) previously listed as Near Threatened, is found in seasonal shallow grassy pans, vleis and other rain-filled depressions in open flat areas of grassland or savanna and, at the limits of its distribution, in Nama Karoo and thicket. For most of the year the species remains buried up to 1 m underground. They emerge only during the peak of the rainy season to forage and breed. If conditions are extremely dry, they may remain cocooned underground for several years. Long distances often separate suitable breeding sites. In order to breed, they require shallow, rain-filled depressions that retain water long enough for the tadpoles to metamorphose. Before and after breeding, bullfrogs forage in open grassland, feeding mostly on insects, but also on other frogs, lizards, snakes, small birds and rodents. After breeding males generally bury themselves within 100 m of the breeding site, but females may disperse up to 1 km away. Based on habitat requirements, there is a medium probability that this species occurs in the study area.

## Protected animals

There are a number of animal species protected according to the National Environmental Management: Biodiversity Act (Act No. 10 of 2004) (see Appendix 3). 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 3, marked with the letter "N". This includes the following species:

1. Black Wildebeest (does not occur on site),
2. Oribi (unlikely to occur on site),
3. White Rhinoceros (doesn't occur on site),
4. Black-footed Cat,
5. Serval,
6. Leopard (probably does not occur on site),
7. Cape Clawless Otter,
8. Spotted-necked Otter,
9. Cape Fox,
10. Honey Badger,
11. South African Hedgehog,
12. Brown Hyena, and
13. Giant Bullfrog.

There are additional species protected under the Mpumalanga Nature Conservation Act (Act No. 10 of 1998) (see Appendix 2). These include the following that have a geographical distribution that includes the site:

1. Giant Bullfrog,
2. South African Hedgehog,
3. Honey Badger,
4. Aardwolf,
5. Brown Hyaena,
6. Mountain Reedbuck,
7. Black Wildebeest,
8. Klipspringer,
9. Orbi,
10. Steenbok,
11. Eland,
12. Cape Clawless Otter
13. Spotted-necked Otter,
14. All species of reptiles, except the water leguaan, rock leguaan and all species of snakes, of which the following have a geographical distribution that includes the site:
  - Marsh terrapin
  - Leopard tortoise
  - Common dwarf gecko
  - Spotted dwarf gecko
  - Van Son's gecko
  - Delalande's sandveld lizard
  - Burchell's sand lizard
  - (Spotted sand lizard)
  - Coppery grass lizard
  - Cape grass lizard
  - Large-scaled grass lizard
  - Common girdled lizard
  - Common crag lizard
  - Yellow-throated plated lizard
  - Breyer's long-tailed seps
  - Short-headed legless skink
  - Thin-tailed legless skink
  - Wahlberg's snake-eyed skink
  - Cape skink
  - Red-sided skink
  - Speckled rock skink
  - Variable skink
  - Montane dwarf burrowing skink
  - Common flap-necked chameleon
  - Eastern ground agama
  - Southern rock agama

# METHODOLOGY

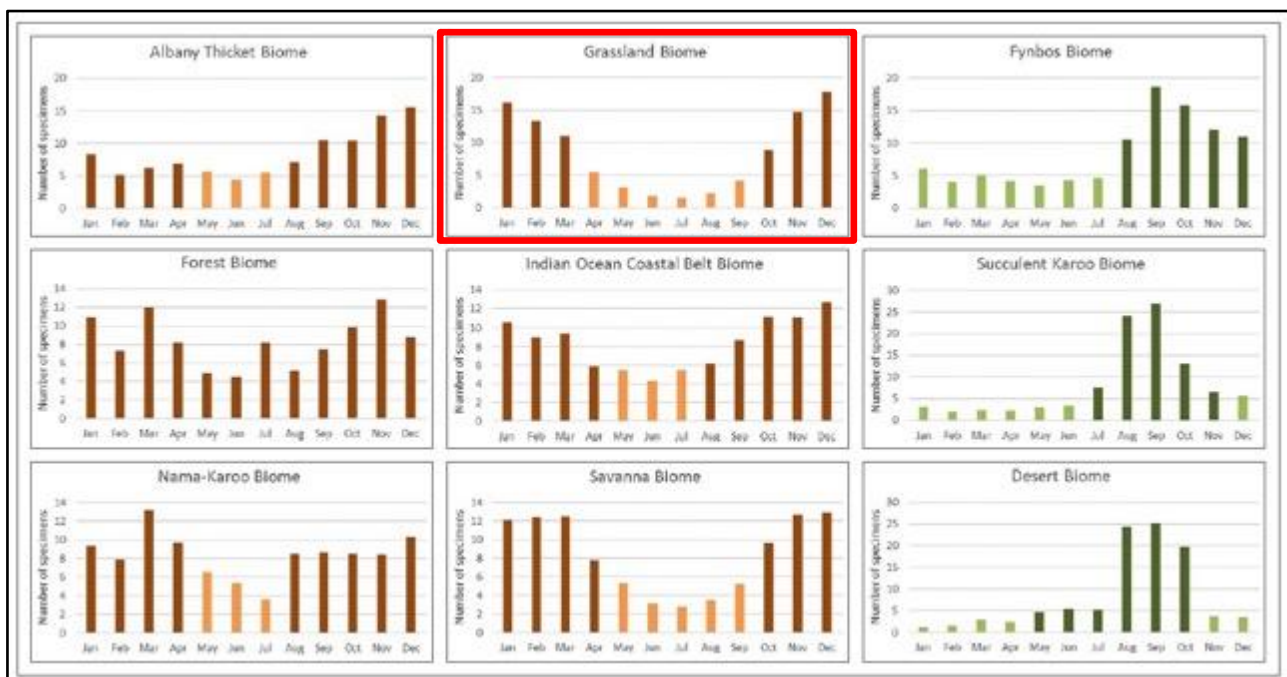
The detailed methodology followed as well as the sources of data and information used as part of this assessment is described below.

## Survey timing

The study commenced as a desktop-study followed by a site-specific field study on 3–7 February 2020. The site is within the Grassland Biome with a peak rainfall season in summer, which occurs from October to March (Figure 3). There is, however, a delay between rainfall and vegetation growth, which means the peak growing season is from November to April, with most perennial species characteristic of the vegetation being easily identifiable from January to March. The timing of the survey was therefore ideal in terms of assessing the vegetation condition in terms of suitable animal habitat on the site.

## Field survey approach

During the field survey, all major natural variation on site was assessed and select locations were traversed on foot.



**Figure 3: Recommended survey periods for different biomes (Species Environmental Assessment Guidelines).**

Aerial imagery from Google Earth was used to identify and assess habitats suitable for animal species that could occur on site. Patterns identified from satellite imagery were verified on the ground. During the field survey, particular attention was paid to ensuring that all habitat variability was covered physically on the ground.



## Sources of information

Lists of animal species that have a geographical range that includes the study area were obtained from literature sources (Bates et al., 2014 for reptiles, du Preez & Carruthers 2009 for frogs, Mills & Hes 1997 and Friedmann and Daly, 2004 for mammals). This was supplemented with information from the Animal Demography Unit website ([adu.uct.ac.za](http://adu.uct.ac.za)) and literature searches for specific animals, where necessary.

## Limitations, Assumptions & Uncertainties

The following assumptions, limitations, uncertainties are listed regarding the assessment of the site:

- Inventory surveys of animal species occurring on a site are difficult to achieve within the time-frames associated with an EIA. In order to compile a comprehensive site-specific list of the biota on site, studies would be required that would include different seasons and be undertaken over a much longer timeframe including extensive sampling. It is more important to know of fauna of value, as well as ecological processes. Therefore, the assessment attempts to identify threatened and other significant species, important habitats, and ecological processes.
- Compiling the list of species that could potentially occur on site is limited by the density of collection records for the area. The list of animal species that could potentially occur on site was therefore taken from a wider area and from literature sources that may include species that do not occur on site and may miss species that do occur on site.
- The assessment is based on a field survey conducted 3-7 February 2020. The current study is based on an extensive site visit as well as a desktop study of the available information. The time spent on site was adequate for understanding general patterns across affected areas. The seasons in which the fieldwork (peak summer flowering period) was conducted was ideal for assessing the composition and condition of the vegetation, which is also suitable for assessing habitat condition and suitability for animals.

# ASSESSMENT OUTCOMES

## Habitats on site

The site is within an area of natural grassland. The grassland contains variation due to changes in topography, slope inclination, surface rockiness and the influence of water-flow and water retention in the landscape. A broad classification of the natural habitat units on site, which also reflects relatively uniform plant species compositional units, is as follows:

Natural habitats:

1. **Natural grassland** (open grassland on undulating plains – the condition is not indicated in the habitat map although there is a gradient from heavily grazed poor condition to moderate condition);
2. **Wetlands** (permanent and seasonal wetlands in drainage valleys, including channels, where they occur);
3. **Pans** (palustrine wetlands in roundish depressions with flat basin floors, often with no outlet for water flow);

The total amount of natural habitat remaining on site is 48% of the study area (2400 hectares), the low proportion due to loss of habitat from existing land-use, as well as degradation. The largest factor that has led to loss of natural habitat is cultivation – currently the combination of current cultivation and old lands is a total of 47% of the study area (2320 hectares).

Transformed and degraded areas:

4. **Old lands** (secondary grasslands on previously cultivated areas);
5. **Exotic trees** (stands of exotic trees);
6. **Degraded areas** (disturbed areas with bare ground, weeds or waste ground).
7. **Current cultivation** (areas currently cultivated and fallow lands);
8. **Transformed** (areas such as roads and buildings where there is no vegetation).

NATURAL VERSUS SECONDARY GRASSLAND	
Natural grassland	Areas of original vegetation in which the soil has not been mechanically disturbed, including areas that are in poor condition due to <b>overgrazing, trampling, invasion</b> by weeds or alien invasive species, <b>inappropriate fire regimes</b> , or any other factor that drives natural change in species composition or vegetation structure. The key factor is that the original plants continue to exist, often resprouting after defoliation from sub-surface stems or other storage organs.
Secondary grassland	Areas of vegetation where the original grassland vegetation has been lost through direct <b>disturbance of the soil</b> that results in physical removal of the original plants, the most common cause of which is ploughing, but could be other mechanical factors. The vegetation that then develops is as a result of recolonization of the area through propagation.

A map of habitats within the study area and adjacent areas is provided in Figure 4.

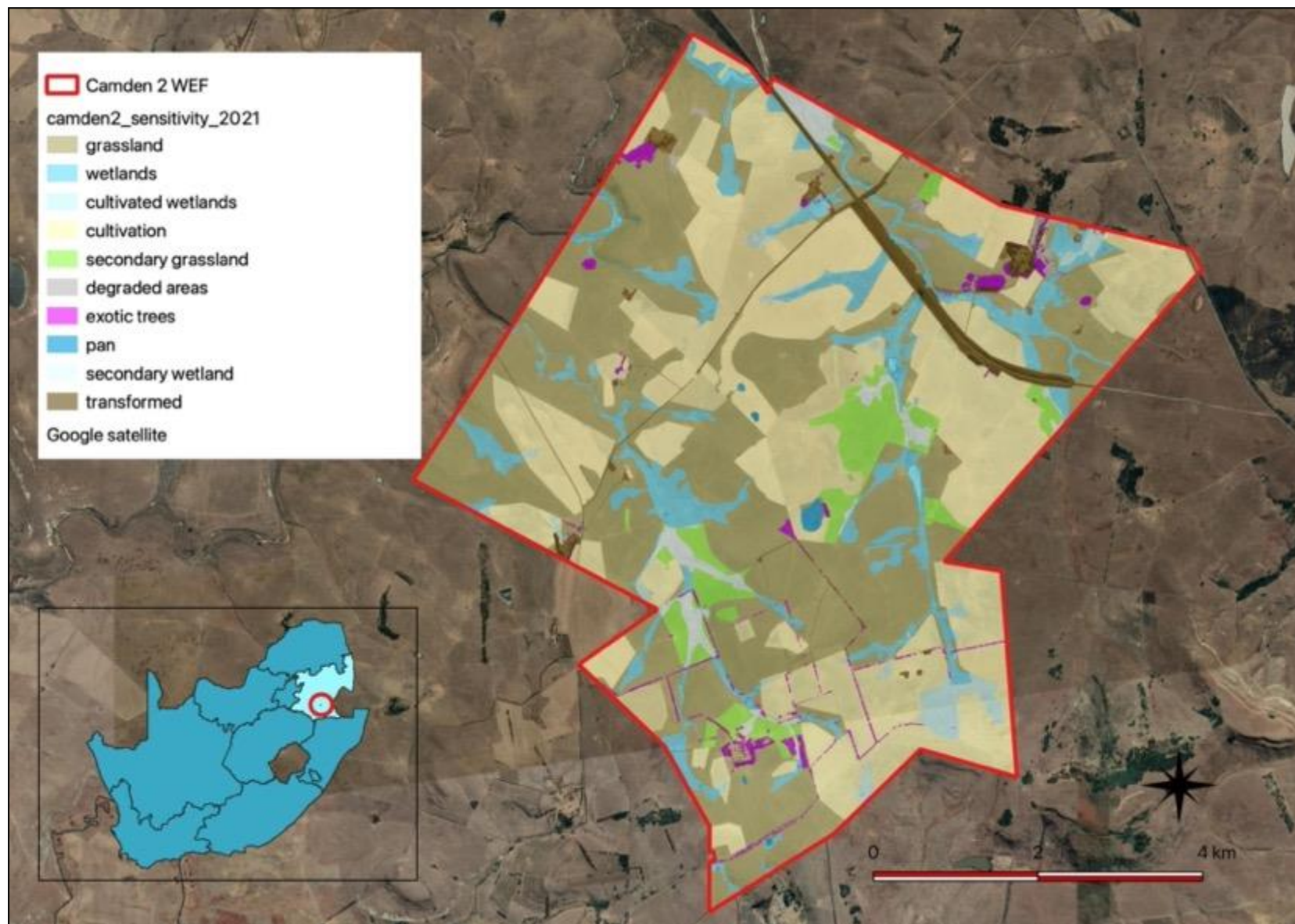


Figure 4: Main habitats of the study area.

### ***Grassland***

The general study area is characterised by an open grassland on the undulating hills and plains, and is representative of the listed ecosystem that occurs on site (Eastern Highveld Grassland). It is generally a short to moderate height tussock grassland with closed canopy cover. The soil depth varies, as does the amount of surface rock cover, but tends to have shallow soil. This is the most widespread vegetation community on site, occurring on all the relatively flat plains areas. It is also the area that has been most subject to cultivation.

### ***Wetlands***

There are numerous valley bottom wetlands in the study area, which starts as a flat, wide area in the upper reaches and become progressively more concentrated and channelled downstream. They flow north-westwards towards the Vaal River just outside of the study area. The drainage areas are important habitat for animals, providing refuge and shelter, water when it is available, palatable vegetation when surrounding areas are in drought, and softer and deeper soils for burrowing animals. The habitat is also an important flood-attenuation component of the landscape, and a reservoir for soil water. If it occurs on site, this is the habitat in which the protected Giant Bullfrog would be found.

### ***Pans***

A small number of pans were recorded within the study area, of different sizes. They are an important hydrological component of the landscape and often contain a flora that is unique to this habitat.

### ***Current cultivation***

These are areas that, according to recent satellite imagery, are currently being cultivated, or were recently cultivated (within the last 5 years). If not under crops, they would be a ploughed land, or a fallow land with either weeds or a cover crop. From an ecological or biodiversity perspective, these areas have no natural habitat and have no plant or vegetation biodiversity value. The soil profile has been completely disturbed, removing all original vegetation, including geophytic and resprouting plant species. In the Grassland Biome of South Africa, a large proportion of the indigenous biodiversity consists of herbaceous and low shrubby species that re-sprout seasonally, after fire, or after defoliation from grazing animals, and can persist under these conditions. In cultivated areas, it is possible through natural succession, or through active rehabilitation, to restore a perennial cover of grasses, but the original biodiversity is permanently lost. They also have little value for animal biodiversity, except for species that forage in cultivated areas.

### ***Old lands***

These are areas that were previously ploughed for cultivation but have been left for an extended period without ploughing. Through natural succession processes, they generally develop a perennial cover of grasses, but these secondary grasslands are species poor and the original diversity of resprouting species is usually entirely absent. Non-grass species diversity usually consists of re-seeding and weedy species, and sometimes animal- and/or bird-dispersed woody species.

On aerial photographs and satellite images with adequate resolution, these areas are often recognisable by the presence of residual plough lines and other structural features often present in cultivated fields.

### ***Exotic trees***

There are planted windrows on the roadsides in various parts of the site, as well as within homestead complex areas. These are mostly deliberately planted some decades ago and are not alien invasive species. There are, however, various places on site where alien invasive species have become established in previously disturbed areas. In both cases, the underlying natural grassland is lost.

### ***Degraded areas***

Any areas where the original vegetation is lost due to continuous degradation, such as trampling, severe overgrazing, or some other factor, it is mapped as degraded. These areas are unlikely to restore to natural grassland, even with removal of the drivers of the degradation.

### ***Transformed areas***

Areas where natural habitat no longer exists due to development of infrastructure, such as roads, buildings, and other hard surfaces. Current cultivation is also transformed, but has not been replaced by built infrastructure, therefore the soil surface can be colonized by plants, if cultivation is stopped.

***Amount of each type of habitat in the study area:***

Habitat	Status	Area in hectares	Proportion of total area (%)
Grassland	Natural	1926	38.9
Wetlands	Natural	464	9.4
Pans	Natural	10	0.2
Exotic trees	Degraded	67	1.4
Degraded areas	Degraded	24	0.5
Old lands	Secondary	314	6.3
Current cultivation	Transformed	2006	40.5
Transformed	Transformed	140	2.8
<b>TOTAL</b>		<b>4951</b>	<b>100.0%</b>

# DESCRIPTION OF POTENTIAL IMPACTS

## Potential sensitive receptors in the general study area

A summary of the potential ecological issues for the study area is as follows (issues assessed by other specialists, e.g. on birds and on wetland and hydrological function, are not included here):

- Possible presence of various listed animal species on site.
- Presence of important habitat on site for animal species.
- Importance of the site as a corridor through the landscape, primarily due to connected areas of wetlands and grasslands.

## Construction Phase Impacts

Direct impacts include the following:

1. Loss of faunal habitat;
2. Direct mortality of fauna due to machinery, construction and increased traffic.

## Operational Phase Impacts

Ongoing direct impacts will include the following:

1. Direct mortality of fauna through traffic, illegal collecting, poaching and collisions and/or entanglement with infrastructure.

## Decommissioning Phase Impacts

Direct impacts will include the following:

1. Loss of faunal habitat;
2. Direct mortality of fauna due to machinery, construction and increased traffic.

# ASSESSMENT OF IMPACTS

A detailed assessment, as per the requirements of the protocol for the specialist assessment and minimum report content requirements of environmental impacts on terrestrial animal species for activities requiring environmental authorisation, (20 March 2020), of the significance of all impacts during all phases of the project (Construction, Operation, Decommissioning and Cumulative) is provided below. This also includes all proposed mitigation measures and provides assessment before and after the implementation of proposed mitigation measures.

The proposed site is identified by the national web-based environmental screening tool as being medium or high sensitivity for Animal Species, and the protocol therefore requires that the sensitivity be confirmed on site, and the level of assessment determined by the outcome of the sensitivity verification. If animal SCC are confirmed or suspected to occur on site then the results must be written up in a Terrestrial Animal Species Assessment Report.

Detailed discussion of each impact, including justification for assigned scores, is provided below.

## Construction Phase Impacts

Impact 1		Loss of faunal habitat	
Issue	Clearing of natural habitat for construction		
Description of Impact			
Construction activities will require clearing of natural habitat, to be replaced by the infrastructure. This will result in permanent local loss of habitat.			
Type of Impact	Direct		
Nature of Impact	Negative		
Phases	Construction		
Criteria	Without Mitigation	With Mitigation	
Extent	1	1	
Duration	5	5	
Reversibility	3	3	
Magnitude (severity of impact)	2	1	
Probability	4	3	
Significance	44 (MODERATE)	30 (LOW)	
Mitigation actions			
The following measures are recommended:	<ul style="list-style-type: none"><li>No driving of vehicles off-road outside of construction areas.</li><li>Apply mitigation measures recommended in the Terrestrial Biodiversity Assessment to minimize loss of natural vegetation.</li></ul>		
Monitoring			
The following monitoring is recommended:	As per management plans.		

### *Direct mortality of fauna due to machinery, construction and increased traffic*

Impact 2 Direct mortality of fauna	
Issue	Direct mortality of fauna due to presence of traffic and heavy machinery
Description of Impact	
Construction activities will require use of heavy machinery and vehicles, as well as placement of various obstructions that may be hazardous	

Type of Impact	Direct	
Nature of Impact	Negative	
Phases	Construction	
Criteria	Without Mitigation	With Mitigation
Extent	1	1
Duration	2	2
Reversibility	1	1
Magnitude (severity of impact)	2	1
Probability	3	2
Significance	18 (LOW)	10 (VERY LOW)
Mitigation actions		
The following measures are recommended:	<ul style="list-style-type: none"><li>• It is a legal requirement to obtain permits for specimens or protected species that will be lost due to construction of the project.</li><li>• Conduct a pre-construction walk-through of natural habitat within the development footprint prior to construction activities commencing in order to move any individual animals, such as tortoises, where required.</li><li>• Personnel on site should undergo environmental induction training, including the need to abide by speed limits, to minimise risk of collisions with wild animals on roads in rural areas.</li><li>• Proper waste management must be implemented as per the conditions stipulated in the EMPr, ensuring no toxic or dangerous substances are accessible to wildlife. This should also apply to stockpiles of new and used materials to ensure that they do not become a hazard.</li><li>• No collecting, hunting or poaching of any animal species.</li><li>• During construction, personnel to be educated about protection status of species, including distinguishing features, to be able to identify protected species.</li><li>• Appropriate lighting should be installed to minimize impacts on nocturnal animals, as per visual specialist assessment.</li></ul>	
Monitoring		
The following monitoring is recommended:	As per management plans.	

## Operational Phase Impacts

***Direct mortality of fauna through traffic, illegal collecting, poaching and collisions and/or entanglement with infrastructure***

Impact 3		Direct mortality of fauna
Issue	Direct mortality of fauna due to presence of traffic and heavy machinery	
Description of Impact		
Operational activities will require use of heavy machinery and vehicles, as well as placement of various obstructions that may be hazardous		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	Construction	



Criteria	Without Mitigation	With Mitigation
Extent	1	1
Duration	4	4
Reversibility	1	1
Magnitude (severity of impact)	2	1
Probability	3	2
Significance	24 (LOW)	14 (VERY LOW)
Mitigation actions		
The following measures are recommended:	<ul style="list-style-type: none"><li>It is a legal requirement to obtain permits for specimens or protected species that will be lost due to construction of the project.</li><li>Personnel on site should undergo environmental induction training, including the need to abide by speed limits, the increased risk of collisions with wild animals on roads in rural areas.</li><li>Proper waste management must be implemented as per the conditions stipulated in the EMPr, ensuring no toxic or dangerous substances are accessible to wildlife. This should also apply to stockpiles of new and used materials to ensure that they do not become a hazard.</li><li>No collecting, hunting or poaching of any animal species.</li><li>During operation, personnel to be educated about protection status of species, including distinguishing features, to be able to identify protected species.</li><li>Appropriate lighting should be installed to minimize impacts on nocturnal animals, as per visual specialist assessment.</li></ul>	
Monitoring		
The following monitoring is recommended:	As per management plans.	

## Decommissioning Phase Impacts

Decommissioning phase impacts are identical in nature and rating to that of the construction phase impacts. Please refer to the construction phase for assessment.

## Cumulative Impacts

### *Cumulative impacts on faunal habitat from construction clearing due to a number of projects*

Cumulative impacts on faunal habitat from construction clearing due to a number of projects		
Impact 4		
Issue	Loss of faunal habitat	
Description of Impact		
Construction activities will require clearing of natural habitat, to be replaced by the infrastructure. This will result in possible loss of habitat for populations of SCC.		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	Construction	
Criteria	Overall impact of the proposed project considered in isolation	Cumulative impact of the project and other projects in the area

Extent	1	3
Duration	5	5
Reversibility	3	3
Magnitude (severity of impact)	2	3
Probability	4	4
Significance	44 (MODERATE)	56 (MODERATE)

**Cumulative impacts of direct faunal mortality due to a number of projects: construction phase**

Impact 5		Cumulative impacts of direct faunal mortality due to a number of projects	
Issue		Loss of faunal habitat	
Description of Impact			
Construction activities will require clearing of natural habitat, to be replaced by the infrastructure. This will result in possible loss of habitat for populations of SCC.			
Type of Impact		Direct	
Nature of Impact		Negative	
Phases		Construction	
Criteria		Overall impact of the proposed project considered in isolation	Cumulative impact of the project and other projects in the area
Extent		1	3
Duration		2	2
Reversibility		1	1
Magnitude (severity of impact)		2	3
Probability		3	4
Significance		18 (LOW)	36 (MODERATE)

**Cumulative impacts of direct faunal mortality due to a number of projects: operational phase**

Impact 6		Cumulative impacts of direct faunal mortality due to a number of projects	
Issue		Loss of faunal habitat	
Description of Impact			
Construction activities will require clearing of natural habitat, to be replaced by the infrastructure. This will result in possible loss of habitat for populations of SCC.			
Type of Impact		Direct	
Nature of Impact		Negative	
Phases		Operation	
Criteria	Overall impact of the proposed project considered in isolation	Cumulative impact of the project and other projects in the area	
Extent	1	3	
Duration	4	4	
Reversibility	1	1	
Magnitude (severity of impact)	2	3	
Probability	3	4	
Significance	24 (LOW)	44 (MODERATE)	

## Summary of mitigation measures

The following mitigation measures are recommended to address known potential impacts:

- No driving of vehicles off-road outside of construction areas.
- It is a legal requirement to obtain permits for specimens or protected species that will be lost due to construction of the project.
- Conduct a pre-construction walk-through of natural habitat within the development footprint, undertaken in the correct season where possible (considering all administrative and legal processes and requirements), prior to construction activities commencing in order to move any individual animals, such as tortoises, where required.
- Personnel on site should undergo environmental induction training, including the need to abide by speed limits, the increased risk of collisions with wild animals on roads in rural areas.
- Proper waste management must be implemented as per the conditions stipulated in the EMPr, ensuring no toxic or dangerous substances are accessible to wildlife. This should also apply to stockpiles of new and used materials to ensure that they do not become a hazard.
- No collecting, hunting or poaching of any animal species.
- During construction and operation, personnel to be educated about protection status of species, including distinguishing features, to be able to identify protected species.
- Appropriate lighting should be installed to minimize impacts on nocturnal animals, as per visual specialist assessment.

# DISCUSSION AND CONCLUSIONS

There are a number of threatened animal species that are flagged for the site, as well as others not directly flagged that may occur there. The majority of the flagged animal species are birds, which are assessed in a dedicated avifaunal assessment and not covered in detail here. The two non-bird species flagged for the site are the Maquassie Musk Shrew and the Oribi. Both could possibly occur on site, but the likelihood is low. These animals may make use of various habitats available on site, which consists mostly of grasslands and wetlands within shallow drainage valleys. The infrastructure planned for the site has been located partly in transformed areas (areas with no remaining natural habitat) and partly in natural areas. There is therefore a possibility of affecting habitat that may be utilized by animal species of concern, but it is not considered that the site is important for any of these species.

The main concern in terms of threatened animal species is direct loss of habitat. Fragmentation of habitat is assessed but will be very limited due to the placement of infrastructure as well as existing patterns of transformation on site. There may also be direct mortality of individual animals, but these are unlikely to be SCC.

An assessment of these impacts indicates that they will have a significance of low or very low.

# BIBLIOGRAPHY AND REFERENCES:

- ALEXANDER, G. & MARAIS, J. 2007. A guide to the reptiles of southern Africa. Struik, Cape Town.
- BATES, M.F., BRANCH, W.R., BAUER, A.M., BURGER, M., MARAIS, J., ALEXANDER, G.J. & DE VILLIERS, M.S. 2014. Atlas and Red List of the Reptiles of South Africa. Suricata 1, South African National Biodiversity Institute. ISBN 978-1-919976-84-6.
- BIRDLIFE INTERNATIONAL (2022) Species factsheet: *Geronticus calvus*. Downloaded from <http://www.birdlife.org> on 08/06/2022.
- BRANCH, W.R. (1988) South African Red Data Book—Reptiles and Amphibians. South African National Scientific Programmes Report No. 151.
- DU PREEZ, L. & CARRUTHERS, V. 2009. A complete guide to the frogs of southern Africa. Random House Struik, Cape Town.
- FRIEDMANN, Y. & DALY, B. (eds.) 2004. The Red Data Book of the Mammals of South Africa: A Conservation Assessment: CBSG Southern Africa, Conservation Breeding Specialist Group (SSC/IUCN), Endangered Wildlife Trust, South Africa.
- IUCN (2001). *IUCN Red Data List categories and criteria: Version 3.1*. IUCN Species Survival Commission: Gland, Switzerland.
- MARAIS, J. 2004. A complete guide to the snakes of southern Africa. Struik Publishers, Cape Town.
- MILLS, G. & HES, L. 1997. The complete book of southern African mammals. Struik Publishers, Cape Town.
- MINTER, L.R., BURGER, M., HARRISON, J.A., BRAACK, H.H., BISHOP, P.J. and KLOEPFER, D. (eds.) 2004. Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland. SI/MAB Series #9. Smithsonian Institution, Washington, DC.
- MUCINA, L. AND RUTHERFORD, M.C. (editors) 2006. Vegetation map of South Africa, Lesotho and Swaziland: an illustrated guide. *Strelitzia* 19, South African National Biodiversity Institute, Pretoria.
- PASSMORE, N.I. & CARRUTHERS, V.C. (1995) South African Frogs; a complete guide. Southern Book Publishers and Witwatersrand University Press. Johannesburg.
- SKELTON, P. 2001. A complete guide to the freshwater fishes of southern Africa. Struik Publishers, Cape Town.
- TAYLOR, M.R., PEACOCK, F. & WANLESS, R.M. (eds.) 2015. The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. Birdlife South Africa, Johannesburg.
- TAYLOR PJ, BAXTER R, POWER RJ, MONADJEM A, CHILD MF. 2016. A conservation assessment of *Crocidura maquassiensis*. In Child MF, Roxburgh L, Do Linh San E, Raimondo D, Davies-Mostert HT, editors. The Red List of Mammals of South Africa, Swaziland and Lesotho. South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa.
- TOLLEY, K. & BURGER, M. 2007. Chameleons of southern Africa. Struik Publishers, Cape Town.

# APPENDICES:

## Appendix 1: 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:

#### ARTIODACTYLA:

##### Bovidae:

Red hartebeest

Springbok

<sup>N</sup>Black wildebeest

Blue wildebeest

Blesbok

Plains zebra

Klipspringer

<sup>N</sup>Oribi EN

Grey rhebok NT

Warthog

Bushpig

Steenbok

Mountain reedbuck

Common duiker

Eland

Bushbuck

#### PERRISODACTYLA:

##### Rhinocerotidae:

<sup>N</sup>White rhinoceros

#### HYRACOIDEA:

##### Procavidae:

Rock hyrax

#### CARNIVORA:

##### Felidae:

Caracal

<sup>N</sup>Black-footed cat VU

African wild cat

<sup>N</sup>Serval

<sup>N</sup>Leopard VU

##### Mustelidae:

<sup>N</sup>Cape clawless otter NT

Striped polecat

<sup>N</sup>Spotted-necked otter NT

<sup>N</sup>Honey badger

African striped weasel NT

##### Herpestidae:

Water mongoose

Yellow mongoose

Slender mongoose

Dwarf mongoose

Banded mongoose

White-tailed mongoose

Suricate

##### Canidae:

Black-backed jackal

<sup>N</sup>Cape fox

##### Viveridae:

Small-spotted genet

Large-spotted genet

##### Hyaenidae:

<sup>N</sup>Brown hyaena NT

Aardwolf

#### INSECTIVORA:

##### Eulipotyphla:

<sup>N</sup>South African hedgehog NT

Reddish-grey musk shrew

Greater musk shrew

Tiny musk shrew

Maquassie musk shrew VU

Swamp musk shrew NT

Lesser grey-brown musk shrew

Dark-footed forest shrew

Forest shrew

Least dwarf shrew

Lesser dwarf shrew

##### Chrysochloridae:

Highveld golden mole NT

#### LAGOMORPHA:

##### Leporidae:

Cape/desert hare

Scrub/savannah hare

Natal red rock rabbit

Hewitt's red rock rabbit

#### PRIMATA:

##### Cercopithecidae:

Vervet monkey

#### RODENTIA:

##### Muridae:

Tete veld rat

Namaqua rock mouse

Common mole rat  
 Grey climbing mouse  
 Brant's climbing mouse  
 Chesnut climbing mouse  
 Multimammate mouse  
 Pygmy mouse  
 White-tailed rat VU  
 Angoni vlei rat  
 Vlei rat (grassland type) NT  
 Striped mouse  
 Pouched mouse  
 Fat mouse  
 Highveld gerbil  
 Tree rat  
Bathyergidae:  
 Cape mole-rat  
Myoxidae:  
 Woodland dormouse  
 Rock dormouse  
Hystriidae:  
 Cape porcupine  
Thryonomyidae:  
 Greater cane rat

MACROSCELIDEA:  
Macroscelididae:  
 Eastern rock sengi

TUBULIDENTATA:  
Orycteropodidae:  
 Aardvark

## Reptiles:

Pelomedusidae:  
 (Marsh terrapin)  
Testudinidae:  
 (Leopard tortoise)  
Gekkonidae:  
 (Common dwarf gecko)  
 Spotted dwarf gecko  
 Van Son's gecko  
Amphisbaenidae:  
Lacertidae:  
 Delalande's sandveld lizard  
 Burchell's sand lizard  
 (Spotted sand lizard)  
Cordylidae:  
 Coppery grass lizard NT  
 Cape grass lizard  
 (Large-scaled grass lizard NT)  
 Common girdled lizard  
 Common crag lizard  
Platysauridae:  
Gerrhosauridae:  
 Yellow-throated plated lizard  
 (Breyer's long-tailed seps VU)

Scincidae:  
 Short-headed legless skink  
 Thin-tailed legless skink  
 Wahlberg's snake-eyed skink  
 Cape skink  
 Red-sided skink  
 Speckled rock skink  
 Variable skink  
 Montane dwarf burrowing skink  
Varanidae:  
 (Southern rock monitor)  
 Nile monitor  
Chamaeleonidae:  
 (Common flap-necked chameleon)  
Agamidae:  
 Eastern ground agama  
 Southern rock agama  
Typhlopidae:  
 Bibron's blind snake  
Leptotyphlopidae:  
 Peter's thread snake  
Pythonidae:  
Viperidae:  
 Puff adder  
 Rhombic night adder  
Lamprophiidae:  
 Black-headed centipede eater  
 (Bibron's stiletto snake)  
 Striped harlequin snake NT  
 Spotted harlequin snake  
 Common house snake  
 Aurora snake  
 Yellow-bellied snake  
 Spotted rock snake  
 Olive ground snake  
 Dusky-bellied water snake  
 Brown water snake  
 Cape wolf snake  
 (Short-snouted grass snake)  
 Cross-marked grass snake  
 Spotted grass snake  
 Striped grass snake  
 Many-spotted snake  
 South African slug eater  
 Mole snake  
Elapidae:  
 Sundevall's garter snake  
 Rinkhals  
Colubridae:  
 Red-lipped snake  
 Southern brown egg-eater  
 Rhombic egg eater  
 (Boomslang)  
 (Southeastern green snake)  
 Western Natal green snake  
 Spotted bush snake

**Amphibians**

Bushveld rain frog  
Mozambique rain frog  
Guttural toad  
Flat-backed toad  
Raucous toad  
Red toad  
Painted reed frog  
(Yellow-striped reed frog)  
Bubbling kassina  
Rattling frog  
Snoring puddle frog  
Striped grass frog  
Common platanna  
Boettger's caco  
Bronze caco  
(Mountain caco)  
Common river frog  
Cape river frog  
<sup>N</sup>Giant bullfrog  
Striped stream frog  
Clicking stream frog  
Tremolo sand frog  
Natal sand frog  
Tandy's sand frog



## Appendix 2: Fauna protected under the Mpumalanga Nature Conservation Act No. 10 of 1998.

### SCHEDULE 1: SPECIALLY PROTECTED GAME (SECTION 4 (1) (a))

Common name	Scientific name
Elephant	<i>Loxodonta africana</i>
All species of rhinoceros	All species of the Family Rhinocerotidae

### SCHEDULE 2: PROTECTED GAME (SECTION 4 (1) (b))

Common name	Scientific name
AMPHIBIANS, REPTILES AND MAMMALS	
bullfrog	<i>Pyxicephalus adspersus</i>
All species of reptiles excluding the water leguaan, rock leguaan and all species of snakes	All species of the Class Reptilia excluding <i>Varanus niloticus</i> , <i>Varanus exanthematicus</i> and all species of the Sub Order Serpentes
Riverine rabbit	<i>Bungolagus monticularis</i>
hedgehog	<i>Atelerix frontalis</i>
Samango monkey	<i>Cercopithecus mitis</i>
bushbaby	<i>Otolemur crassicaudatus</i>
Lesser bushbaby	<i>Galago moholi</i>
Honey-badger	<i>Mellivora capensis</i>
pangolin	<i>Manis temminckii</i>
aardwolf	<i>Proteles cristatus</i>
Cape hunting dog	<i>Lycaon pictus</i>
Brown hyaena	<i>Hyaena brunnea</i>
antbear	<i>Orycteropus afer</i>
Mountain zebra	<i>Equus zebra zebra</i>
Hartmann's zebra	<i>Equus zebra hartmannae</i>
hippopotamus	<i>Hippopotamus amphibius</i>
giraffe	<i>Girrafa camelopardalis</i>
nyala	<i>Tragelaphus angasi</i>
Red duiker	<i>Cephalophus natalensis</i>
Blue duiker	<i>Philantomba monticola</i>
reedbuck	<i>Redunca arundinum</i>
Mountain reedbuck	<i>Redunca fulvorufula</i>
Sable antelope	<i>Hippotragus niger</i>
Roan antelope	<i>Hippotragus equinus</i>
Black wildebeest	<i>Connochaetes gnou</i>
tsessebe	<i>Damaliscus lanatus</i>
Lichtenstein's hartebeest	<i>Alcelaphus lichtensteinii</i>
klipspringer	<i>Oreotragus oreotragus</i>
oribi	<i>Ourebia ourebi</i>
steenbok	<i>Raphicerus campestris</i>
Sharpe's grysbok	<i>Raphicerus sharpei</i>
sun	<i>Neotragus moschatus</i>
Grey rhebok	<i>Pelea capreolus</i>
eland	<i>Taurotragus oryx</i>
waterbuck	<i>Kobus ellipsiprymnus</i>
Cape clawless otter	<i>Aonyx capensis</i>
Spotted necked otter	<i>Lutra maculicollis</i>

SCHEDULE 4: PROTECTED WILD ANIMALS (SECTION 4 (1) (d))

Common name	Scientific name
Spotted hyaena	Crocuta Crocuta
Cheetah	Acinonyx jubatus
Leopard	Panthera pardus
Lion	Panthera leo
African buffalo	Syncerus caffer

## Appendix 3: 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

#### 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

#### 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

#### 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

#### 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