Terrestrial Ecology Scoping

Camden 1 Solar Facility near Ermelo in Mpumalanga Province

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Terrestrial Ecology Scoping report for the proposed Camden 1 Solar Facility near Ermelo in Mpumalanga Province.

Location:
South of Ermelo in Mpumalanga Province

for

ENERTRAG South Africa (Pty) Ltd
Pegasus Building 1,
210 Amarand Avenue
Menlyn Maine
Pretoria

30 November 2021

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SPECIALIST DETAILS & DECLARATION

This report has been prepared in accordance with Section 13: General Requirements for Environmental Assessment Practitioners (EAPs) and Specialists as well as per Appendix 6 of GNR 982 – Environmental Impact Assessment Regulations and the National Environmental Management Act (NEMA, No. 107 of 1998 as amended 2017) and Government Notice 704 (GN 704). It has been prepared independently of influence or prejudice by any parties.

The details of Specialists are as follows –

Table 1: Details of Specialist

Specialist	Qualification and accreditation	Client	Signature
Dr David Hoare (Pr.Sci.Nat.)	PhD Botany	ENERTRAG	 Date: 30/11/2021

Details of Author:
Dr David Hoare

PhD (Botany) – Nelson Mandela Metropolitan University, Port Elizabeth

Professional Natural Scientist, South African Council for Natural Scientific Professions, 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).

_____ 30 November 2021

Dr David Hoare Date

TERMS OF REFERENCE

Where the sensitivity in the Screening Report from the web-based Online Screening Tool has been confirmed to be VERY HIGH, a Terrestrial Biodiversity Specialist Assessment is required, for terrestrial biodiversity features.

The specialist assessment must be prepared by a SACNASP registered specialist with expertise in the field of terrestrial biodiversity.

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

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

- a description of the ecological drivers or processes of the system and how the proposed development will impact these;
- ecological functioning and ecological processes (e.g. fire, migration, pollination, etc.) that operate within the preferred site;
- the ecological corridors that the proposed development would impede including migration and movement of flora and fauna;
- 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;
- a description of terrestrial biodiversity and ecosystems on the preferred site, including:
    - main vegetation types;
    - threatened ecosystems, including listed ecosystems as well as locally important habitat types identified;
    - ecological connectivity, habitat fragmentation, ecological processes and fine- scale habitats; and
    - species, distribution, important habitats (e.g. feeding grounds, nesting sites, etc.) and movement patterns identified;
- 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
- the assessment must be based on the results of a site inspection undertaken on the preferred site and must identify:
    - terrestrial critical biodiversity areas (CBAs), including:
        i. the reasons why an area has been identified as a CBA;
        ii. 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;
        iii. theimpactonspeciescompositionandstructureofvegetationwith an indication of the extent of clearing activities in proportion to the remaining extent of the ecosystem type(s);
        iv. the impact on ecosystem threat status;
        v. the impact on explicit subtypes in the vegetation;
        vi. the impact on overall species and ecosystem diversity of the site; and
        vii. the impact on any changes to threat status of populations of species of conservation concern in the CBA;
    - terrestrial ecological support areas (ESAs), including:
        i. the impact on the ecological processes that operate within or across the site;
        ii. the extent the proposed development will impact on the functionality of the ESA; and
        iii. 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;

- protected areas as defined by the National Environmental Management: Protected Areas Act, 2004 including-
    i. 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;
- priority areas for protected area expansion, including-
    i. (a) the way in which in which the proposed development will compromise or contribute to the expansion of the protected area network;
- SWSAsincluding:
    ii. (a) the impact(s) on the terrestrial habitat of a SWSA; and
    iii. (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);
- FEPA subcatchments, including-
    i. (a) theimpactsoftheproposeddevelopmentonhabitatconditionand
    ii. species in the FEPA sub catchment;
- indigenous forests, including:
    i. (a) impact on the ecological integrity of the forest; and
    ii. (b) percentage of natural or near natural indigenous forest area lost and a statement on the implications in relation to the remaining areas.

The findings of the assessment must be written up in a Terrestrial Biodiversity Specialist Assessment Report, which must contain, as a minimum, the following information:

- contact details of the specialist, their SACNASP registration number, their field of expertise and a curriculum vitae;
- a signed statement of independence by the specialist;
- a statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;
- a description of the methodology used to undertake the site verification and impact assessment and site inspection, including equipment and modelling used, where relevant;
- 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;
- a location of the areas not suitable for development, which are to be avoided during construction and operation (where relevant);
- additional environmental impacts expected from the proposed development;
- any direct, indirect and cumulative impacts of the proposed development;
- the degree to which impacts and risks can be mitigated;
- the degree to which the impacts and risks can be reversed;
- the degree to which the impacts and risks can cause loss of irreplaceable resources;
- proposed impact management actions and impact management outcomes proposed by the specialist for inclusion in the Environmental Management Programme (EMPr);
- 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;
- 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
- any conditions to which this statement is subjected.

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.

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 1 site:

- The assessment is based on a single reconnaissance site visit from 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. If necessary, additional surveys will be recommended to compenstate for any short-coming related to describing seasonal floristic patterns on site in detail.
- 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, this was not possible for this study.
- Rare and threatened plant and animal species are, by their nature, usually very difficult to locate and can be easily missed.
- The faunal component of the study relies primarily on existing information, as available in various spatial databases and published accounts. These databases are not intended for fine-scale use and the reliability and adequacy of these data sources relies heavily on the extent to which the area has been sampled in the past. Many remote areas have not been well sampled with the result that the species lists for an area do not always adequately reflect the actual fauna and flora present at the site. In order to counter the likelihood that the area has not been well sampled in the past and in order ensure a conservative approach, the species lists derived for the site from the literature were obtained from an area significantly larger than the study area and are likely to include a much wider array of species than actually occur at the site. This ensures that no species of potential conservation concern are missed ion the assessment. The study excludes Bats, Avifauna, Aquatic Ecology and Invertebrates.

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INTRODUCTION

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 250 MW near Camden Power Station in Mpumalanga Province. This will be part of the Camden Renewable Energy Complex that will include:

- Camden I Wind Energy Facility
- Camden I Solar Energy Facility
- Camden Green Hydrogen and Ammonia Facility
- Camden II Wind Energy Facility
- Camden common collector substation and 400kV line.

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

Project description

The Camden I Solar Facility is summarised as follows:

Facility Name	Camden I Solar Energy Facility
Applicant	Camden I Solar Energy Facility (RF) Propriety Limited
Municipalities	Msukaligwa Local Municipality of the Gert Sibande District Municipality
Affected Farms[1]	Portion 1 of Welgelegen Farm No. 322
Extent	297 ha
Buildable area	Approximately 280 ha
Capacity	Up to 100MW
Power system technology	Solar PV
Operations and Maintenance (O&M) building footprint:	Located near the substation. Septic tanks with portable toilets Typical areas include: - Operations building – 20m x 10m = 200m^2 - Workshop – 15m x 10m = 150m^2 Stores - 15m x 10m = 150m^2
Construction camp and laydown area	Typical construction camp area 100m x 50m = 5,000m2. Typical laydown area 100m x 200m = 20,000m2. Sewage: Septic tanks and portable toilets
Cement batching plant (temporary):	Gravel and sand will be stored in separate heaps whilst the cement will be contained in a silo. The footprint will be around 0.5ha. Maximum height of the silo will be 20m.

[1] Based on the current conceptual layout.

Internal Roads:	Width of internal road – Between 4m and 5m, this can be increased to 6m on bends. Length of internal road – Approximately 8km.
Cables:	Communication, AC and DC cables.
Independent Power Producer (IPP) site substation and battery energy storage system (BESS):	Total footprint will be up to 4ha in extent. The substation will consist of a high voltage substation yard to allow for multiple (up to) 400kV feeder bays and transformers, control building, telecommunication infrastructure, access roads, etc. The associated BESS storage capacity will be up to 100MW/400MWh 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.

APPROACH & METHODOLOGY

The study commenced as a desktop-study followed by a site-specific field study from the 3rd – 7th February 2020. This report provides a Scoping level description of the site and assessment of the proposed project from a terrestrial ecology perspective. The detailed methodology followed as well as the sources of data and information used as part of this assessment is described below.

Species of conservation concern

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

Red List plant species

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

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

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

Protected trees

Regulations published for the National Forests Act (Act 84 of 1998) (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 Biodiversity Information System website (http://sibis.sanbi.org/) for quarter degree grids in which species have been previously recorded. Species that have been recorded anywhere in proximity to the site (within 100 km), or where it is considered possible that they could occur there, were listed and were considered as being at risk of occurring there.

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

- National Environmental Management: Biodiversity Act (Act No 10 of 2004); and
- Mpumalanga Nature Conservation Act (Act No. 10 of 1998).

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

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

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

Mammal threat status is according to Child et al. (2016), reptile threat status is according to Bates et al. 2014, and amphibian threat status is according to Minter et al. (2004).

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

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

Habitat sensitivity

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

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

3. Habitats in which various species of plants or animals occur that may be protected or are considered to have high conservation status are considered to be sensitive.

Field surveys

The study area was visited and assessed to confirm patterns identified from the desktop assessment. One site visit was undertaken on 3rd – 7th 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 SCC, 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 SCC, 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. A preliminary checklist of species occurring on site was collected during the survey (Appendix 3, highlighted in green). Plant names follow Germishuizen *et al*. (2005). The season of the survey was favourable, and it 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 DEA 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 in 2017 (NEMA, 2017), under the National Environmental Management Act, (Act No. 107 of 1998). According to these Regulations under Listing Notice 1 (GRN No. 327), Listing Notice 2 (GRN No 325) and Listing Notice 3 (GRN No 324), the activities listed are identified as activities that may 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)

As the principal national act regulating biodiversity protection, NEM:BA, which is administered by DEA, 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 the Biodiversity Act, the developer has a responsibility for:

- The conservation of endangered ecosystems and restriction of activities according to the categorisation of the area (not just by listed activity as specified in the EIA regulations).
- Promote the application of appropriate environmental management tools in order to ensure integrated environmental management of activities thereby ensuring that all development within the area are in line with ecological sustainable development and protection of biodiversity.
- Limit further loss of biodiversity and conserve endangered ecosystems.

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

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

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

Alien and Invasive Species

Chapter 5 of NEM:BA 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 NEM:BA, was published in Government Notice R598 in Government Gazette 37885 in 2014 (NEM:BA, 2014). The Alien and Invasive Species (AIS) lists were subsequently published in Government Notice R 864 of 29 July 2016 (NEM:BA, 2016).

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.

The National Environmental Management: Biodiversity Act (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.
3)

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

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

The EIA Regulations (2014, as amended) include three lists of activities that require environmental authorisation:

- Listing Notice 1: activities that require a basic assessment (GNR. 327 of 2014, as amended),
- Listing Notice 2: activities that require a full environmental impact assessment report (EIR) (GNR. 325 of 2014, as amended),
- Listing Notice 3: activities that require a basic assessment in specific identified geographical areas only (GNR. 324 of 2014, as amended).

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

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

GNR 1187: Amendment of Critically Endangered, Endangered, Vulnerable and Protected Species List
Published under Section 56(1) of the National Environmental Management: Biodiversity Act (Act No. 10 of 2004).

Government Notice No. 40733 of 2017: Draft National Biodiversity Offset Policy
Published under the National Environmental Management Act (Act No. 107 of 1998). 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*". Biodivesity 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, CBAs, 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 wetlands requires authorisation (Section 21 of the National Water Act of 1998). A "watercourse" in terms of the National Water Act (Act 36 of 1998) means:

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

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

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.

Other Acts

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

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

SENSITIVITIES IDENTIFIED FROM DEA ONLINE SCREENING TOOL

The National Web based Environmental Screening Tool is a geographically based web-enabled application which allows a proponent intending to submit an application for environmental authorisation in terms of the Environmental Impact Assessment (EIA) Regulations 2014, as amended to screen their proposed site for any environmental sensitivity.

The Screening Tool also provides site specific EIA process and review information, for example, the Screening Tool may identify if an industrial development zone, minimum information requirement, Environmental Management Framework or bio-regional plan applies to a specific area.

Further to this, the Screening Tool identifies related exclusions and/ or specific requirements including specialist studies applicable to the proposed site and/or development, based on the national sector classification and the environmental sensitivity of the site.

Finally, the Screening Tool allows for the generating of a Screening Report referred to in Regulation 16(1)(v) of the Environmental Impact Assessment Regulations 2014, as amended whereby a Screening Report is required to accompany any application for Environmental Authorisation.

The tool was queries in relation to the following infrastructure:

1. Utilities Infrastructure => Electricity => Generation => Renewable => Solar=>PV.

The features identified from the Screening Tool in the section below are only those that relate to Terrestrial Biodiversity and are in relation to the following themes:

1. Animal species theme;
2. Plant species theme;
3. Terrestrial biodiversity theme.

These themes are described below. Note that bats and avifauna are assessed in separate specialist studies and are not covered in this report.

Animal species theme

The animal species theme indicates that the site is within two sensitivity classes, namely **LOW** and **MEDIUM** (Figure 1). The level of the sensitivity classification would suggest that no threatened species are dependent on the site for survival.

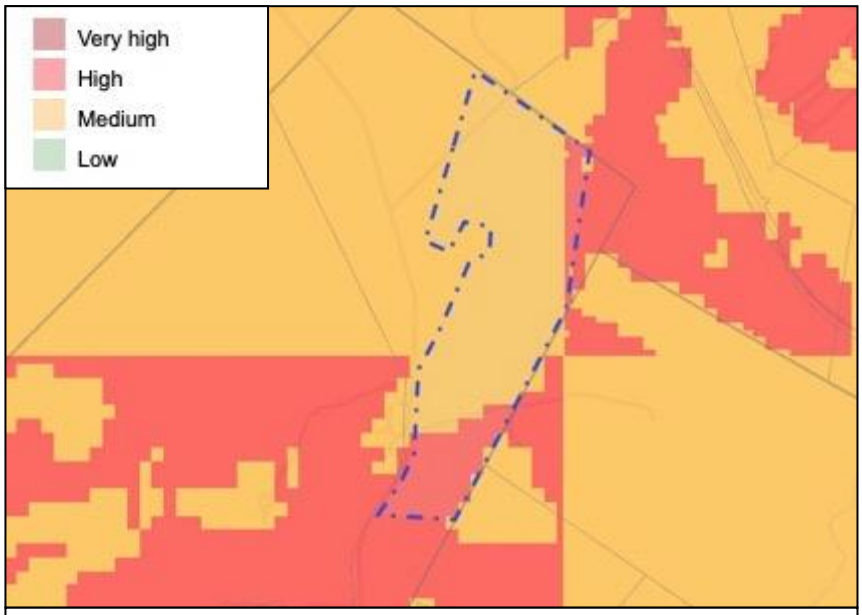

Figure 1: DEA Screening Tool extract: animal species theme.

According to the "PROCEDURES TO BE FOLLOWED FOR THE ASSESSMENT AND MINIMUM CRITERIA FOR REPORTING OF IDENTIFIED ENVIRONMENTAL THEMES IN TERMS OF SECTION 24(5)(a) AND (h) OF THE NATIONAL ENVRONMENTAL MANAGEMENT ACT, 1998, WHEN APPLYING FOR ENVIRONMENTAL AUTHORISATlON", the sensitivity ratings for animal species are as follows:

1. MEDIUM SENSITIVITY RATING:
    a. Suspected habitat for species of conservation concern based either on there being records for the species collected in the past prior to 2002 or being a natural area included in a habitat.
    b. Species of conservation concern listed in the IUCN Red List of Threatened Species or South Africa's National Red List website as Critically Endangered, Endangered or Vulnerable according to the IUCN Red List 3.1 Categories and Criteria.
2. HIGH SENSITIVITY RATING:
    a. Confirmed habitat for SCC.
    b. SCC, listed on the IUCN Red List of Threatened Species or South Africa's National Red List website as Critically Endangered, Endangered or Vulnerable, acccording to the IUCN Red List 3.1 Categories and Criteria and under the national category of Rare.
    c. The species highlighted in the on-line tool are *Ourebia ourebi* (Oribi) and *Crocidura maquassiensis* (Makwassie Musk Shrew), and sSensitive Species 2, as well as various bird species, which are assessed by an Avian Specialist. A full list for the site is assessed in Appendix 4 and from page 38 to 43.

    These areas are unsuitable for development due to a very likely impact on SCC.

A more comprehensive analysis of animal species that have a geographical distribution that includes the site is provided in a section below. This identifies both threatened and protected species of terrestrial animals that could potentially occur on site, as well as habitats in which they are likely to be found, if they occurred on site.

Plant species theme

The plant species theme indicates that the site is within two sensitivity classes, namely **MEDIUM** and **LOW** (Figure 2). No additional information is provided, but the level of the sensitivity classification would suggest that no threatened species are dependent on the site for survival.

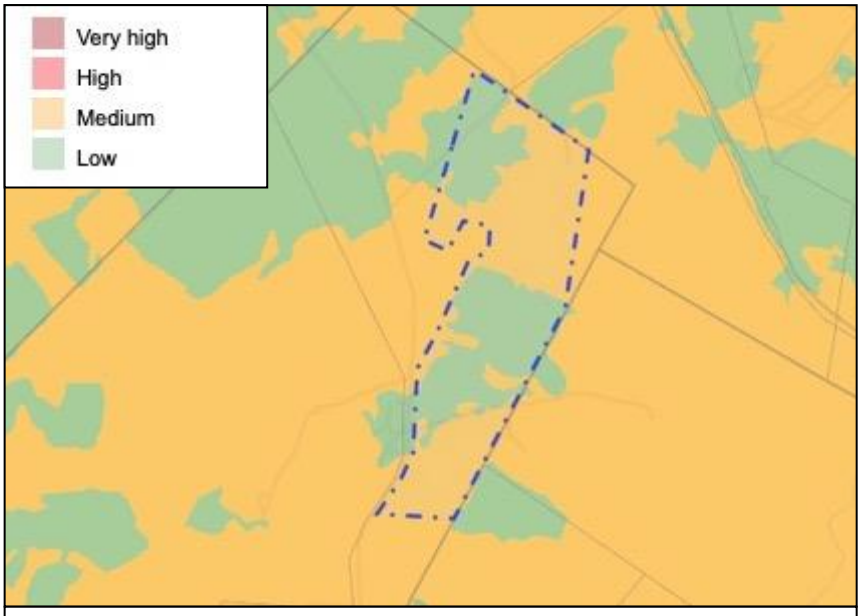

Figure 2: DEA Screening Tool extract: plant species theme.

According to the "PROCEDURES TO BE FOLLOWED FOR THE ASSESSMENT AND MINIMUM CRITERIA FOR REPORTING OF IDENTIFIED ENVIRONMENTAL THEMES IN TERMS OF SECTION 24(5)(a) AND (h) OF THE NATIONAL ENVRONMENTAL MANAGEMENT ACT, 1998, WHEN APPLYING FOR ENVIRONMENTAL AUTHORISATION", the sensitivity ratings for animal species are as follows:

- MEDIUM SENSITIVITY RATING:
    a. Suspected habitat for species of conservation concern based either on there being records for the species collected in the past prior to 2002 or being a natural area included in a habitat.
    b. Species of conservation concern listed in the IUCN Red List of Threatened Species or South Africa's National Red List website as Critically Endangered, Endangered or Vulnerable according to the IUCN Red List 3.1 Categories and Criteria.
    c. There are seven plant species listed for the site, according to the on-line tool, four are unnamed and the other three species are *Khadia carolinensis*, *Pachycarpus suaveolens* and *Aspidoglossum xanthosphaerum*. A full assessed list for the area is provided in Appendix 1.
- LOW SENSITIVITY RATING:
    a. Areas where no natural habitat remains.
    b. Natural areas where there is no suspected occurrence of species of conservation concern.

A more comprehensive analysis of plant species that have a geographical distribution that includes the site is provided in a section below. This identifies both threatened and protected species of plants that could potentially occur on site, as well as habitats in which they are likely to be found, if they occurred on site.

Terrestrial biodiversity theme

The terrestrial biodiversity theme indicates that the site is within two sensitivity classes, namely **VERY HIGH** and **LOW** (Figure 3). According to the on-line screening tool, the sensitivity layer takes into account the following sub-layers:

- CBAs national;
- Indigenous Forest Patches
- South African Protected Areas;
- Strategic Water Source Areas;
- Threatened Ecosystems;
- Freshwater Ecosystems;
- Focus Areas Protected Area Expansion.

Specific issues highlighted in the on-line tool for the site are as follows:

1. Freshwater Ecosystems Priority Area subcatchment (not assessed here);
2. Strategic Water Source Area (not assessed here);
3. CBA1 (see Figure 8, page 33)
4. Endangered Ecosystem (Eastern Highveld Grassland, listed as Vulnerable – see Figure 6, page 27, Chrissiesmeer Panveld is listed as Endangered – see Figure 7, page 32);
5. South African Protected Areas, Langcarel Private Nature Reserve (note that this has been assessed as being an error – no protected area exists for the site, according to the landowner and no protected area for this site exists in the SANBI BGIS layer of formal or informal protected areas – see discussion on page 34).

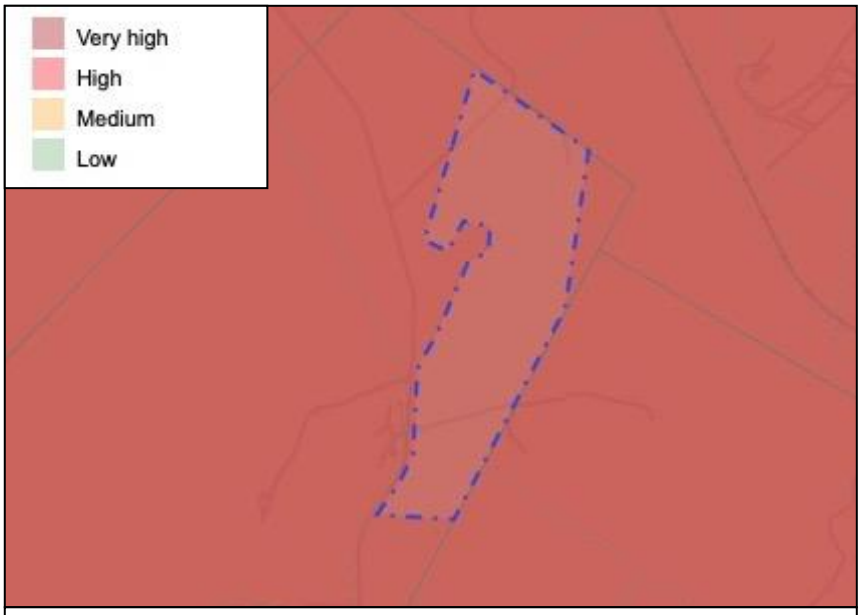

Figure 3: DEA Screening Tool extract: terrestrial biodiversity theme.

A more comprehensive analysis of terrestrial ecosystems, biodiversity conservation plans and protected ecosystems for the geographical area that includes the site is provided in a section below. These show that the area that includes the site contains CBAs and Threatened Ecosystems. This is followed by a detailed description of ecosystems occurring on site, as identified from the field survey and interpretation of aerial imagery. This description shows that some parts of the site no longer contain natural habitat and are therefore placed in a lower sensitivity category than that given here (see Figure 10 on page 46).

DESCRIPTION OF STUDY AREA

Location

The project is located about 8 km south to south-east of Ermelo in Mpumalanga Provinces, South Africa (Figure 4). The site is halfway between the N11 (Ermelo to Amersfoort) and the N2 (Ermelo to Piet Retief). Camden Power Station (Eskom) is on the north-eastern border of the site. The roads on site are all gravel farm access roads. The site (study area) is in the quarter degree grids 2629DB and 2630CA, between 26°36'32.5" S and 26°41'40.0 S latitude, and between 29°58'30.0 E and 30°06'00.0 E longitude.

Site conditions

There are three (3) farm portions assessed here. Within this study area, significant parts are either currently or previously cultivated, the exception being wetland areas and areas of grassland with shallow soils that are not suitable for cultivation. Natural areas on site are used for animal production. The general area contains various secondary roads leading from the main access roads, and a number of homestead complexes. There are groves of exotic trees scattered throughout the general study area, but mostly clustered around homesteads and farm infrastructure, where they act as shelter and wind-breaks, and there are also characteristic wind-rows of oak trees along both sides of the road in nearby areas. The vegetation in the study area is used primarily for livestock grazing and is affected to some degree by this useage, but not to the extent that any severe degradation was noted on site. With the exception of cultivated areas

Figure 4: Location of the study area.

and infrastructure, the remaining vegetation and habitats in the study area appear to be largely in a natural state and reflecting what would be expected according to the natural relationship between the physical environment and the vegetation.

Topography and drainage

The study area is situated just to the north of the Vaal River, but is not within the floodplain of the river. The drainage lines on site are lower order streams and are mostly seasonal. Drainage valleys on site vary from being relatively shallow to being steeper within moderately sloping hills overlooking the valleys. The site therefore includes moderately steeply sloping topography in combination with undulating terrain (Figure 5). The elevation on site varies from 1615 to 1756 m above sea level, an elevation difference of approximately 140 m across a distance of over 5 km. The highest point in the study area is in the west-central part, on the summit of a round hill. The lowest point is on the southern boundary, where the main drainage line exits the site, to enter directly into the Vaal River about 4 km further south. The steepest parts of the landscape are in the hills overlooking this main drainage line.

The study area is drained by various small drainage lines that coalesce into larger, channelled valley-bottom systems. There is a variety of different wetland types, ranging from channelled permanent wetlands in valley bottoms, to more seasonal drainages, as well as seepages on some hillsides. There are also a number of small water bodies, as well as a large pan. These are mapped as a separate habitat, but the extent and location of these in terms of legislated wetlands will need to be confirmed by a proper wetland assessment.

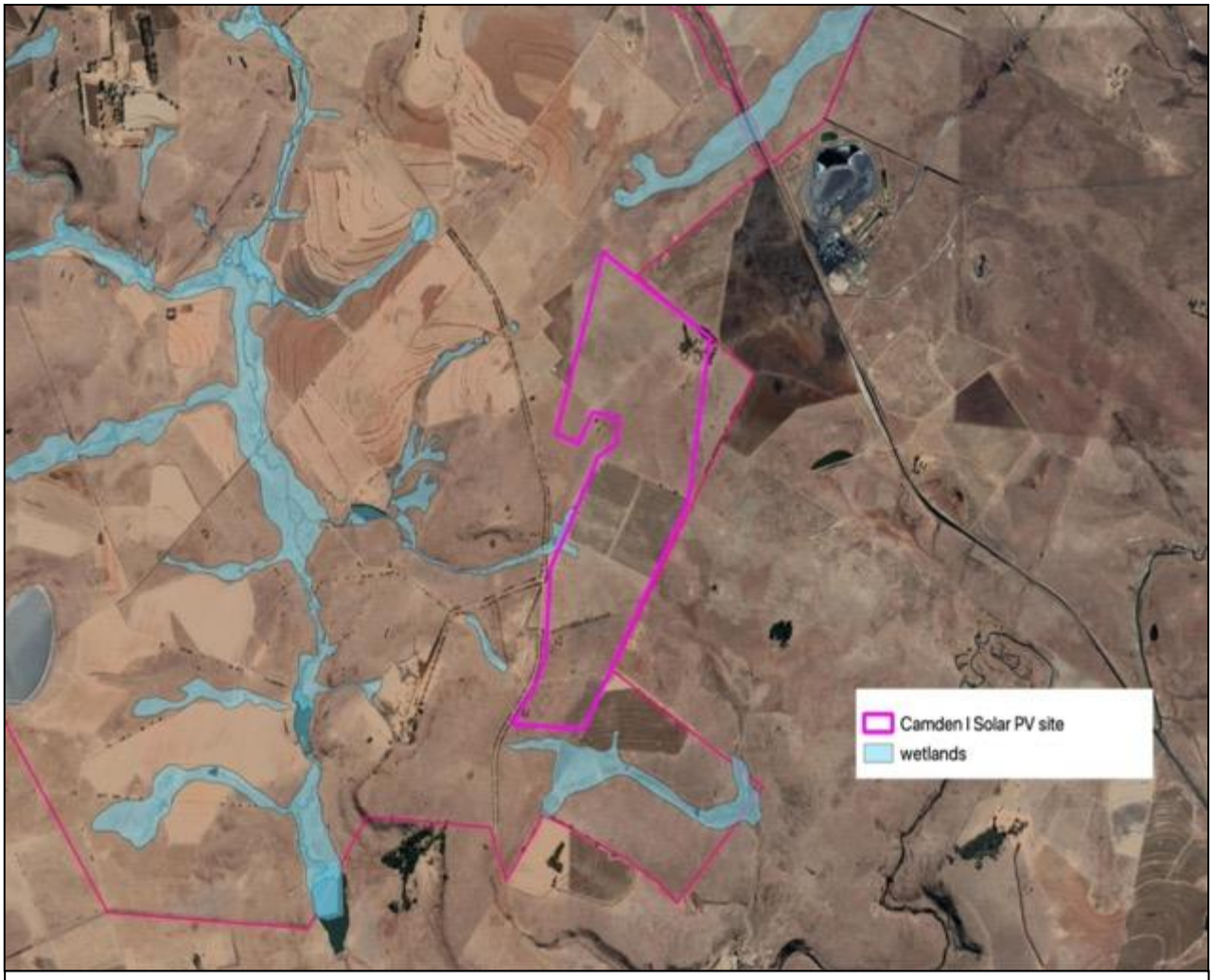

Figure 5: Main wetlands draining the study area.

Regional vegetation patterns

There is one regional vegetation type occurring in the study area, namely Eastern Highveld Grassland (Figure 6). It is probable that terrestrial vegetation patterns reflect the major vegetation types, namely Eastern Highveld Grassland. The vegetation types that occur in the study area and nearby areas are briefly described below.

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

Figure 6: Regional vegetation types of the study area.

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

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

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

Table 2: Conservation status of different vegetation types occurring in the study area.

Vegetation Type	Target (%)	Conserved (%)	Transformed (%)	Conservation status	
				Driver *et al*. 2005; Mucina *et al*., 2006	National Ecosystem List (NEM:BA)
Eastern Highveld Grassland	24	0.3	44	Endangered	Vulnerable
Chrissiesmeer Panveld					Endangered

According to scientific literature (Driver *et al*., 2005; Mucina *et al*., 2006), as shown in Table 2, 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 7). It spatially co-incides partially with Eastern Highveld Grassland, but is defined on different criteria.

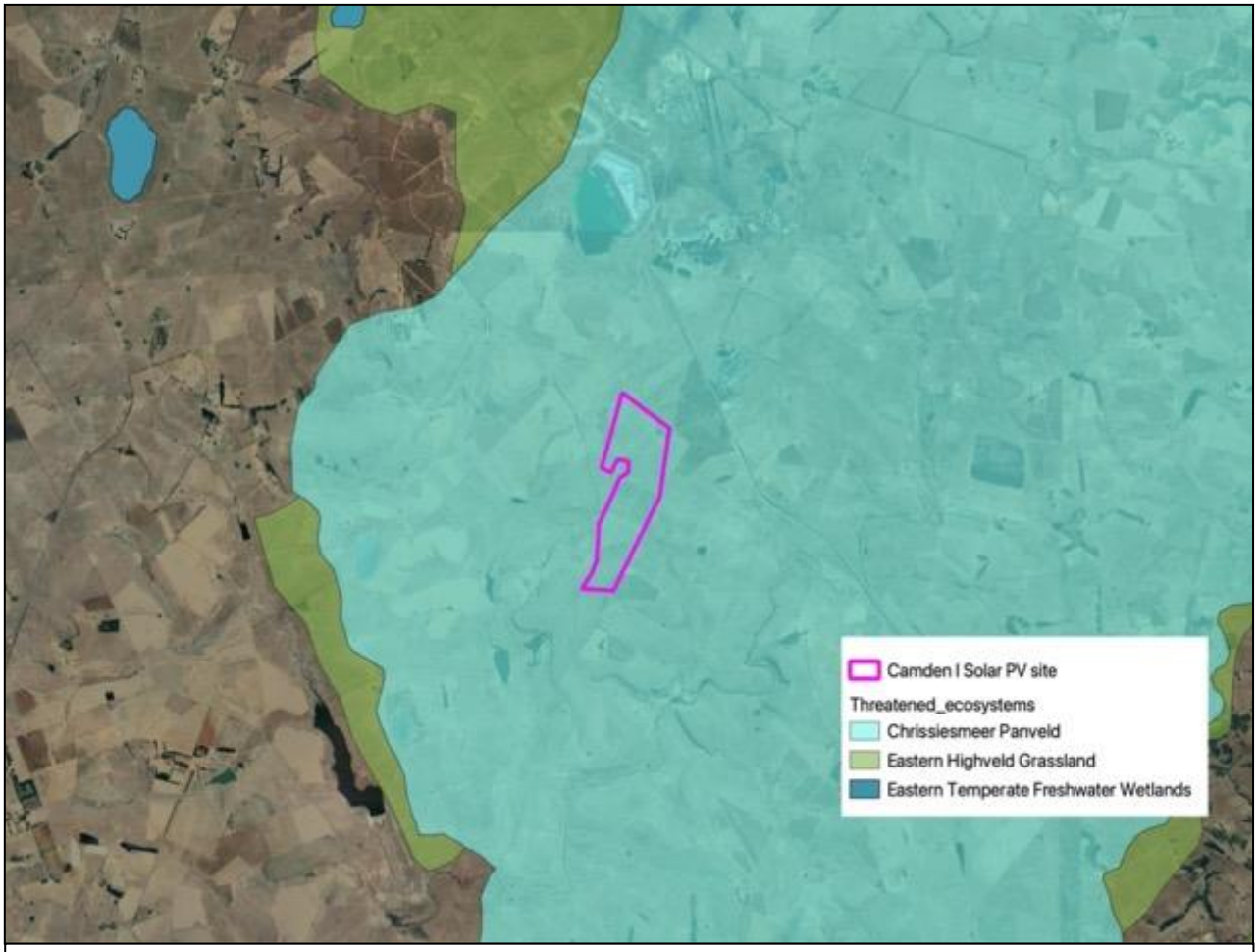

Figure 7: Distribution of listed ecosystems relative to the site.

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).

This map (Figure 8) shows features within the study area within six of these classes, as follows:

1. Protected Areas: (National Parks and Nature Reserves): Approximately a third of the site on the south-eastern side is shown as a protected area. This is, however, incorrect (see discussion below).
2. Critical Biodiversity Areas (CBA): Irreplaceable: A significant area in the south-eastern part of the site is within a "CBA: Irreplaceable" area. These categorized areas are associated with the Olifants River and all natural areas linked to it.
3. Critical Biodiversity Areas (CBA): Optimal: A significant area in the southern part of the site is within a "CBA: Optimal" area. These categorized areas are associated with the Olifants River and all natural areas adjacent to it.
4. Ecological Support Area: (Local Corridor): There is a large wetland area adjacent and to the north of the Olifants River (near the southern part of the site) that is mapped within this class.
5. Ecological Support Area: (Protected Area Buffer): There is a 1 km buffer around the designated protected area, shown only as a line in Figure 6 in order to show the underlying categories.

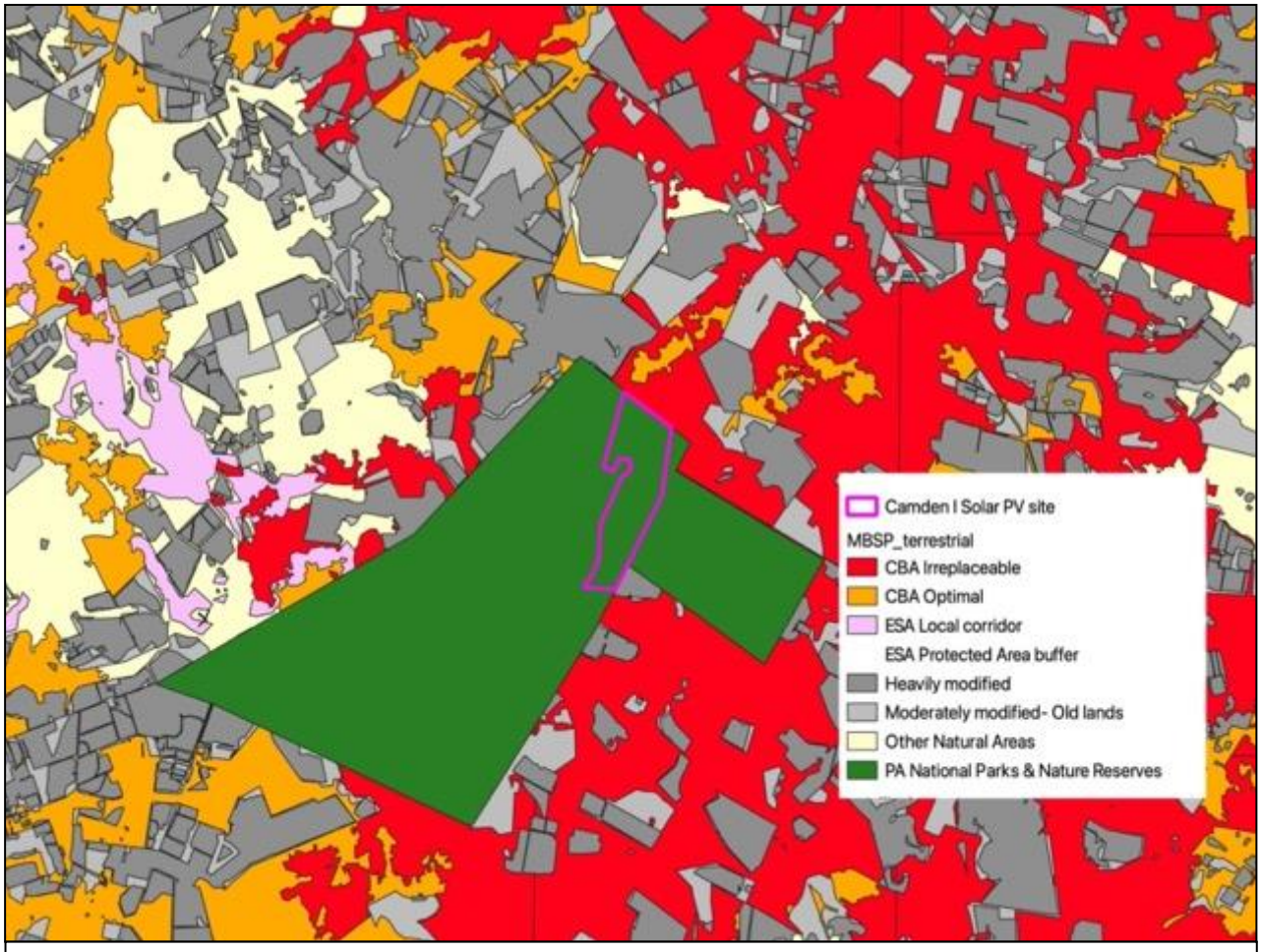

Figure 8: Mpumalanga CBA map for the study area.

6. Other Natural Areas (ONA): There are patches throughout the site mapped as ONA.
7. Heavily or moderately modified: Remaining areas on site, associated primarily with cultivation.

The part of the site shown as a Protected Area occupies the parts of the site on the Farm Welgelegen 322 IT (green area in Figure 8). According to the land owner (Mr L. Reyneke), the farm is NOT a protected area and he is not aware of it ever being so. The 1:50 000 topocadastral maps do not indicate the farm as a protected area. A map of National (formal and informal) protected areas obtained from the SANBI BGIS website does not indicate the area to be a protected area. A GIS spatial layer indicating proposed protected area expansion areas (the National Parks Area Expansion Strategy layer) does not indicate the area as protected and nor does it indicate proposed expansion of the protected area network into this area. On the basis of these various data sources, it is assumed that the designation of the area as protected in the Mpumalanga Biodiversity Sector Plan (MBSP) is an error.

In the absence of any other information to the contrary (the MBSP layer does not provide an indication of the classification of areas within the "Protected Area", in terms of CBA1, CBA2, ESA or ONA), it is assumed that any areas of natural habitat within the "Protected Area" (i.e. excluding any modified areas) would have been designated as CBA1, the next-highest category. This is on the basis that these areas are within two different listed ecosystems (Chrissiesmeer Panveld, listed as Endangered, and Eastern Highveld Grassland, listed as Vulnerable) and it is likely that the conservation planning process would have counted these areas as secured before searching for additional "Irreplaceable" sites.

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 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. CBAs in the Province can be divided into two sub-categories, which are described in more detail below:

- Irreplaceable (parts of the site are within this sub-category), and
- Optimal (northern parts of the site are within this sub-category).

Critical Biodiversity Area: Irreplaceable

This category comprises areas considered critical for meeting biodiversity targets and thresholds, and which are required to ensure the persistence and of species and the functioning of ecosystems. Such biodiversity or landscape facets is usually at risk of being lost due to the remaining distribution being below target. For example, only known sites for certain threatened species, or areas of high connectivity value which have high risk of having connectivity disrupted (i.e. critical corridor linkages in the landscape).

In the MBSP, the "CBA: Irreplaceable" category has Level 3 sub-categories (not provided in the data that accompanies the CBA map):

- CBA: Irreplaceable (100% irreplaceable).
- CBA: High Irreplaceability (80-100% irreplaceable).
- CBA: Critical linkages. These are areas of the natural landscape that represent the only remaining and highly constrained linkages which, if lost, would result in the breakage of the large corridor network as a whole (i.e. pinch point on corridor). These areas are thus vital in maintaining the linkage of the corridor and its associated biodiversity related processes.
- Critically Endangered Threatened Ecosystems (gazetted).

Critical Biodiversity Area: Optimal

The "CBA Optimal" areas, previously referred to as "Important & Necessary in MBCPv1", are the best localities out of a larger selection of available PUs as they are optimally located to meet both the various biodiversity targets and the criteria defined by either the Marxan design or cost layers. These areas have a irreplaceability (or frequency selection score) of less than 80%. In Marxan, this is categorised as the "Best" solution and is essentially the most efficient and thus optimal solution to meet all biodiversity conservation targets while avoiding high cost areas as much as possible.

Even though these areas may display a lower Irreplaceability value or selection frequency score than the previous categories, it must be noted that these areas collectively reflect the smallest area required to meet the feature targets and as such, they are also regarded as CBAs.

Proposed protected areas

According to the National Parks Area Expansion Strategy (NPAES), 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**.

Red List plant species of the study area

Lists of plant species previously recorded in the study area were obtained from the South African National Biodiversity Institute (SANBI) website (http://newposa.sanbi.org/). These are listed in Appendix 3. In order to ensure that all possible species were considered for the area, a much larger area was searched for potential species of concern and the total Red and Orange list flora of Mpumalanga was considered here. Despite this broader search, there are a relatively small number of species that were identified of conservation concern that could potentially occur in the broad area that includes the project area.

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

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

The list contains 18 species listed in an IUCN threat category (Critically Endangered, Endangered or Vulnerable) or Near Threatened category (see Table 5 above) of which **10 have a high possibility of occurring in the general area** and in the type of habitats available in the study area. A further five could possibly occur there. This does not mean that they will occur there, only that the review has identified that these are species that should be assessed as possibly occurring in the area. None of these species were encountered on site, but a more detailed survey of specific habitats would be required to detect them, if they occurred there.

Key habitat for most of these species is grassland or marshy areas (wetlands).

None of the species recorded on site (see Appendix 3) are listed in any threat category.

Protected plants (National Environmental Management: Biodiversity Act)

Plant species protected under the National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004) are listed in Appendix 6. None of the species on this list were encountered on site and none are considered likely to occur there, although some have a geographical distribution that includes the study area.

Protected plants (Mpumalanga Nature Conservation Act)

All plant species protected under the Northern Cape Nature Conservation Act, 2009 (Act 9 of 2009) are listed in Appendix 5. A number of species were found on site that are protected according to the Mpumalanga Nature Conservation Act, 2009 (Act 9 of 2009). From the field survey, this includes the following: *Aloe ecklonis*, *Boophone disticha*, *Brunsvigia radulosa*, and *Gladiolus papilio*. Note that these plants were recorded during a general reconnaissance survey. It is likely that other individuals of these species, as well as individuals potentially from other protected species could potentially occur on site. Despite not being threatened, any impacts on these species will require a permit from the relevant authorities.

Protected trees

Tree species protected under the National Forest Act are listed in Appendix 2. There are none with a geographical distribution that includes the region in which the proposed project is located. There are five species that have a geographical distribution that ends south of the study area, namely *Boscia albitrunca, Curtisia dentata, Elaeodendron croceum, Prunus africana* and *Pittosporum viridiflorum*.

Boscia albitrunca
This is a small to medium-sized of up to 7 m tall with a dense, roundish crown and smooth, white to greyish-white trunk. It is found in the drier parts of South Africa, as well as in the northern savanna parts of the country, but also extending some of the way down the eastern seaboard. There are no records of this species in the general area that includes the project site (POSA or iNaturalist), and none were seen in the field near to or in the vicinity of the site. It is therefore highly unlikely that it could occur in the study area. No trees of this species were seen on site and it is considered unlikely that it occurs there. In the unlikely event that it is found to occur there, it is unlikely that any more than a few individuals would be found.

Curtisia dentata
A medium to tall evergreen tree (up to 15 m in height. It has a clean, unbuttressed bole and the bark is smooth and grey or cinnamon-coloured. The leaves have pointed tips and toothed edges, and are arranged in opposite pairs. The leaf surface is smooth and dark glossy green, while the stalks and the twigs are covered in silky reddish hair. It is usually immediately recognizable due to the striking contrast between its dark, glossy foliage and its sprays of cream-white berries. It grows in the forests of South Africa and Swaziland, ranging from sea level to 1800 meters elevation, and from Cape Town in the south to Limpopo province in the north. In deep Afromontane forest it grows into a tall tree, but on open mountain slopes and by the coast it remains a small bushy tree. There are no records of this species in the general area that includes the project site (POSA or iNaturalist), and none were seen in the field near to or in the vicinity of the site. It is therefore highly unlikely that it could occur in the study area. No trees of this species were seen on site and it is considered unlikely that it occurs there.

Elaeodendron transvaalense

A small to medium-sized, bushy tree that grows up to 6-8 m. In other areas the tree may reach 18 m. It has a conspicuously pale grey, smooth bark that is sometimes finely fissured horizontally. Its dwarf spur-branchlets are characterized by a cluster of leaves at the tips. The leaves are often arranged in threes, but can alternate or are arranged spirally on longer stems. They are narrow and linear to narrowly elliptic, light green to dull grey-green. With the entire to finely toothed margin, the leaves are characterized by conspicuous net veins on both sides. It is found in forests, bushveld, scrub, thornveld and woodland, along streams and often on termite mounds. Widespread in Southern Africa, including Angola, Namibia, Botswana, Zambia, Zimbabwe, Swaziland and Mozambique. In South Africa it is restricted to eastern, summer rainfall areas from the KwaZulu-Natal coast northwards through eastern Mpumalanga into Limpopo and North West provinces. There are no records of this species in the general area that includes the project site (POSA or iNaturalist), and none were seen in the field near to or in the vicinity of the site. It is therefore highly unlikely that it could occur in the study area. No trees of this species were seen on site and it is considered unlikely that it occurs there.

Prunus africana

Prunus africana is a medium to large, handsome evergreen tree with a spreading crown of 10 to 20 m when mature. It can become quite huge under frost-free conditions, but is usually medium-sized in gardens. The main stem is straight, with dark brown bark, cracking in a characteristic oblong pattern. The leaves are smooth, shiny dark green above, paler beneath, with prominent midribs, shallowly serrated margins, pinkish petioles, and when crushed, have a faint smell of almonds. *Prunus africana* is confined to evergreen forests from near the coast to the mist belt and montane forests in KwaZulu-Natal, Eastern Cape, Swaziland, Mpumalanga, Zimbabwe and tropical Africa. There are no records of this species in the general area that includes the project site (POSA or iNaturalist), and none were seen in the field near to

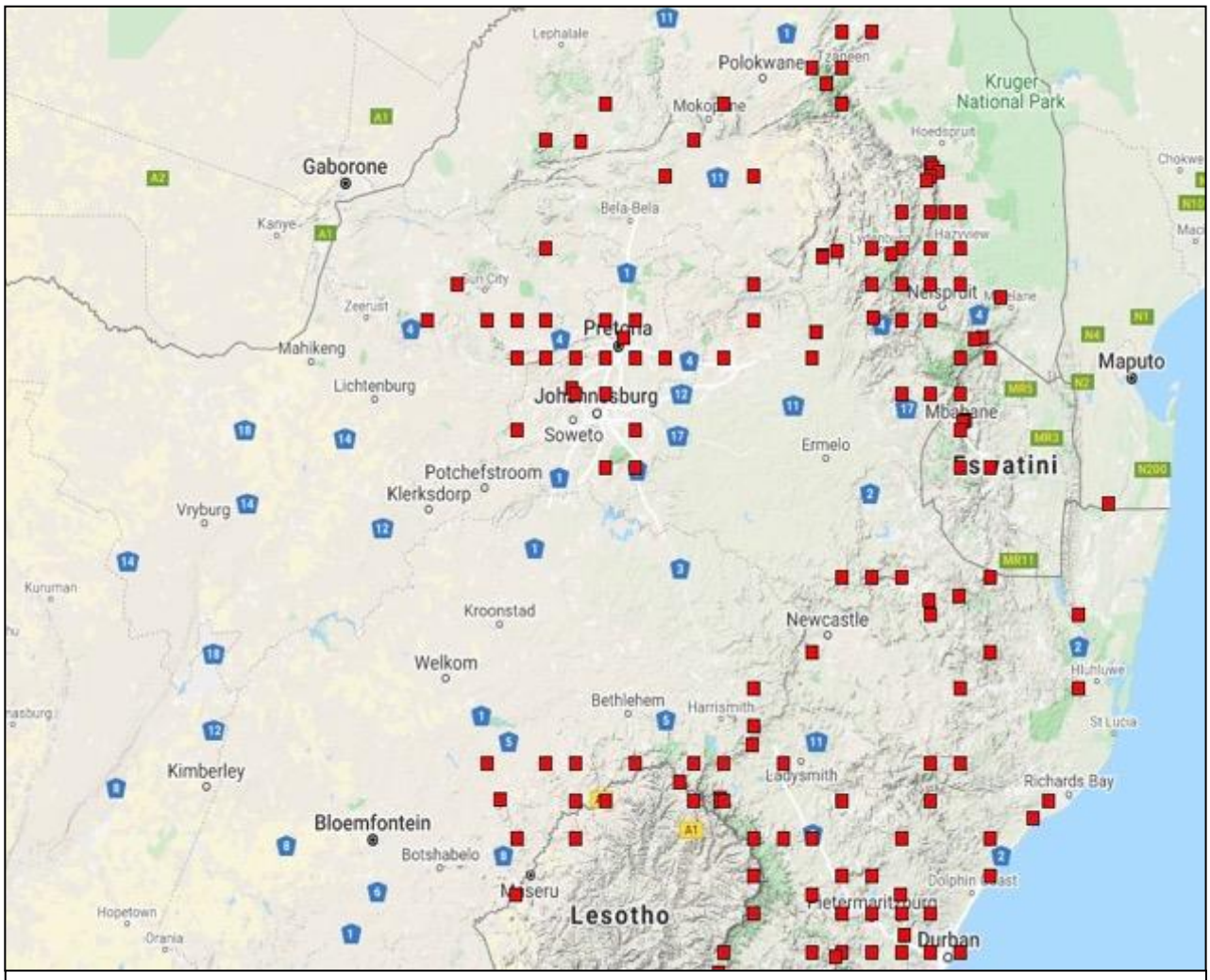

Figure 9: Recorded distribution of *Pittosporum viridiflorum*.

or in the vicinity of the site. It is therefore highly unlikely that it could occur in the study area. No trees of this species were seen on site and it is considered unlikely that it occurs there.

Pittosporum viridiflorum
This species occurs primarily in a band along the southern part of the country, extending up the east coast, where, from Lesotho northwards, it extends further inland (see Figure 9). It occurs in Gauteng and in the escarpment zone, but not on the Highveld part of Mpumalanga (Figure 9). It is considered unlikely that it occurs in the study area. In the unlikely event that it is found to occur there, it is unlikely that any more than a few individuals would be found. There are no records of this species in the general area that includes the project site (POSA or iNaturalist), and none were seen in the field near to or in the vicinity of the site. It is therefore highly unlikely that it could occur in the study area.

No trees or woody plants of significant size were found on site, with the exception of the exotic *Eucalyptus* trees in two groves on site, and scattered *Salix babylonica* along the banks of the Olifants River. For all five species listed here, there was a distribution gap associated with the southern Highveld part of Mpumalanga, even if the species occurred in all surrounding areas (see example provided for *Pittosporum viridiflorum* in Figure 5). This partially reflects an absence of indigenous forest patches in this area, the habitat in which many of these protected trees occur.

In summary, no species of protected trees were found or are likely to occur in the geographical area that includes the site.

Vertebrate animal species of the study area

Vertebrate species (mammals, reptiles, amphibians) with a geographical distribution that includes the study area are listed in Appendix 4. 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 below.

Mammals
There are 81 mammal species that have a geographical distribution that includes the study area, of which fourteen are listed in a conservation category of some level (see Appendix 3). This is a relatively moderate diversity of mammals compared to other parts of South Africa. Based on the natural state of the study area and surrounding areas, it is considered likely that some of these species could occur on site. Listed species with a geographical range that includes the site are discussed in more detail below to evaluate the potential for them to ocur on site.

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 masl (in Mpumalanga). They reach their highest density on floodplains and mosit 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. **The proposed development is therefore highly unlikely to have any negative effect on the species, even though it could possibly occur there.**

Grey Rhebok
The Grey Rhebok (*Pelea capreolus*), listed as Near Threatened, is endemic to South Africa, Lesotho and parts of Swaziland. In the south and southwest, their distribution is associated with the rocky hills of mountain Fynbos and the Little Karoo (Taylor et al. 2016). They are predominantly browsers, feeding on ground-hugging forbs, and largely water independent, obtaining most of their water requirements from their food (Taylor et al. 2016). 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 grids to the north-east and many grids further to the south, so the site is within the overall distribution range of the species. There is

therefore 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. **The proposed development is therefore highly unlikely to have any negative effect on the species, even though it could possibly occur there.**

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. It's known distribution is on the inland part of most of South Africa, but seemingly not 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 but the species is highly likely to occur in the area. 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 probably occurs there. **The proposed developments may possibly have a negative effect on the species.**

Leopard

The Leopard (*Panthera pardus*), listed as Vulnerable, has a wide habitat tolerance, but with a preference for densely wooded areas and rocky areas. In montane and rocky areas of the Eastern, Western and Northern Cape, they prey on dassies and klipspringers. They have large home ranges, but do not migrate easily, males having ranges of about 100 km^2 and females 20 km^2. It has not been recorded in any of the adjacent or nearby grids and the overall distribution shows a gap in its distribution that includes the current study area. There is therefore a low probability of this species occurring on site, and if it did occur there it would probably be at very low densities. **The proposed project could possibly displace individuals, in the unlikely event that they occur there, but is unlikely to have a significant effect on overall population densities.**

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. They may be found in seasonal rivers in the Karoo, provided suitable-sized pools persist. 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 and that individuals could be affected by construction activities, if suitable habitat is damaged.**

Spotted-necked Otter

The Spotted-necked Otter (*Hydrictus 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, but are known to occur in relatively polluted rivers, such as the Braamfonteinspruit, Jukskei and Blesbokspruit in Gauteng. 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, although water quality may be an issue. **It is therefore considered possible that it occurs on site and that individuals could be affected by construction activities, if suitable habitat is damaged.**

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 (excluding Namibia). 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 and individuals could be affected by construction activities, if suitable habitat is damaged**.

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 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 or that individuals could be affected by construction activities.**

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 Swaziland. 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 and individuals could be affected by construction activities, if suitable habitat is damaged.**

Maquassie Musk Shrew

The Maquassie Musk Shrew (*Crocidura 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. The species is patchily distributed within the north-eastern quadrant 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. 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 possible that it would occur on site and individuals could therefore possibly be affected by construction activities.**

Swamp Musk Shrew

The Swamp Musk Shrew (*Crocidura mariquensis*), listed as Near Threatened, is found in a large part of 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 eastern 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 and individuals could be affected by construction activities, if suitable habitat is damaged.**

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 eastThere are historical records for an adjacent grid to the south-wesst, 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 “hole” 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.**

Of the species currently listed as threatened or protected (see Appendix 5 for list of protected species), eight of those listed in Table 4 are considered to have a medium to high probability of occurring on site and being potentially negatively affected by proposed activities associated with the proposed projects.

Table 4: Mammal species of conservation concern with a likelihood of occurring on site.

Scientific name	Common name	Status	Likelihood of occurrence
Ourebia ourebi	Oribi	Endangered	Low
Pelea capreolus	Grey Rhebok	Near Threatened, protected	Medium
Felis nigripes	Black-footed Cat	Vulnerable, protected	High
Panthera pardus	Leopard	Vulnerable, protected	Low
Aonyx capensis	Cape Clawless Otter	Near Threatened, protected	Medium
Hydrictus maculicollis	Spotted-necked Otter	Vulnerable, protected	Medium
Poecilogale albinucha	African Striped Weasel	Near Threatened	Medium
Parahyaena brunnea	Brown hyaena	Near Threatened	Low
Atelerix frontalis	South African Hedgehog	Near Threatened, protected	High
Crocidura maquassiensis	Maquassie Musk Shrew	Vulnerable	Medium
Crocidura mariquensis	Swamp Musk Shrew	Near Threatened	High
Amblysomus septentrionalis	Highveld Golden Mole	Near Threatened	Medium
Mystromys albicaudatus	White-tailed Rat	Vulnerable	Low
Otomys auratus	Vlei Rat	Near Threatened	High

Reptiles
A total of 60 reptile species have a geographical distribution that includes the study area in which the project site is found (Alexander & Marais 2007, Bates *et al*. 2014, Branch 1988, Marais 2004, Tolley & Burger 2007). This is a moderate diversity compared to average diversity in other parts of the country. Of the reptile species that could potentially occur in the study area, four have been listed in a threat category.

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. **It is considered likely that it could occur on site and individuals could be affected by construction activities, if suitable habitat is damaged.**

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. It's 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 nort-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 and individuals could be affected by construction activities, if suitable habitat is damaged.**

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 and individuals are therefore unlikely to be affected by construction activities.**

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 grids 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 and individuals could be affected by construction activities, if suitable habitat is damaged.**

There are therefore three reptile species of conservation concern that could potentially occur in the study area and that may therefore be affected by the proposed projects.

Table 5: Reptile species of conservation concern with a likelihood of occurring on site.

Scientific name	Common name	Status	Likel;ihood of occurrence
Chamaesaura aenea	Coppery grass lizard	Near Threatened	Medium to High
Chamaesaura macrolepis	Large-scaled Grass Lizard	Near Threatened	Low
Tetradactylus breyeri	Breyer's Long-tailed Seps	Vulnerable	Low
Homoroselaps dorsalis	Striped Harlequin Snake	Near Threatened	Medium to High

Amphibians

A total of 24 frog species have a geographical distribution that includes the general study area in which the project site is found (Du Preez & Carruthers 2009). Some of these species are only marginally present in the study area due to the fact that their distribution range ends close to the study area. Of the frog species that could potentially occur in the study area, none are listed in a threat category, but one species is listed as protected, according to National legislation, the Giant Bullfrog.

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.

It is concluded that the site contains habitat that is suitable for various frog species, although only one species of conservation concern is likely to occur in the study area. One frog species of concern is therefore potentially likely to be affected by development in the study area, as shown in Table 6.

Table 6: Amphibian species of conservation concern with a likelihood of occurring on site.

Scientific name	Common name	Status	Likelihood of occurrence
Pyxicephalus adspersus	Giant Bullfrog	Protected	Medium

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 6). 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 4, marked with the letter "N". This includes the following species:

1. Black Wildebeest (doesn't 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 5). 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.

Habitats on site

The site is within an area of natural grassland. A general view over the site is given in Figure 10. 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:

1. **Grassland** (open grassland on undulating plains);
2. **Wetlands** (seasonal wetlands in drainage valleys);
3. **Floodplain grasslands** (flat areas of grassland on the river floodplain);
4. **Pans** (seasonally inundated areas on the river floodplain);
5. **Secondary wetlands** (cultivated or previously cultivated wetland areas);
6. **Secondary grassland** ((secondary grasslands on old lands);
7. **Cultivation** (areas currently cultivated and fallow lands);
8. **Exotic trees** (stands of exotic trees);
9. **Degraded areas** (disturbed areas with weeds or waste ground).

A preliminary map of habitats within the study area and adjacent areas is provided in Figure 10.

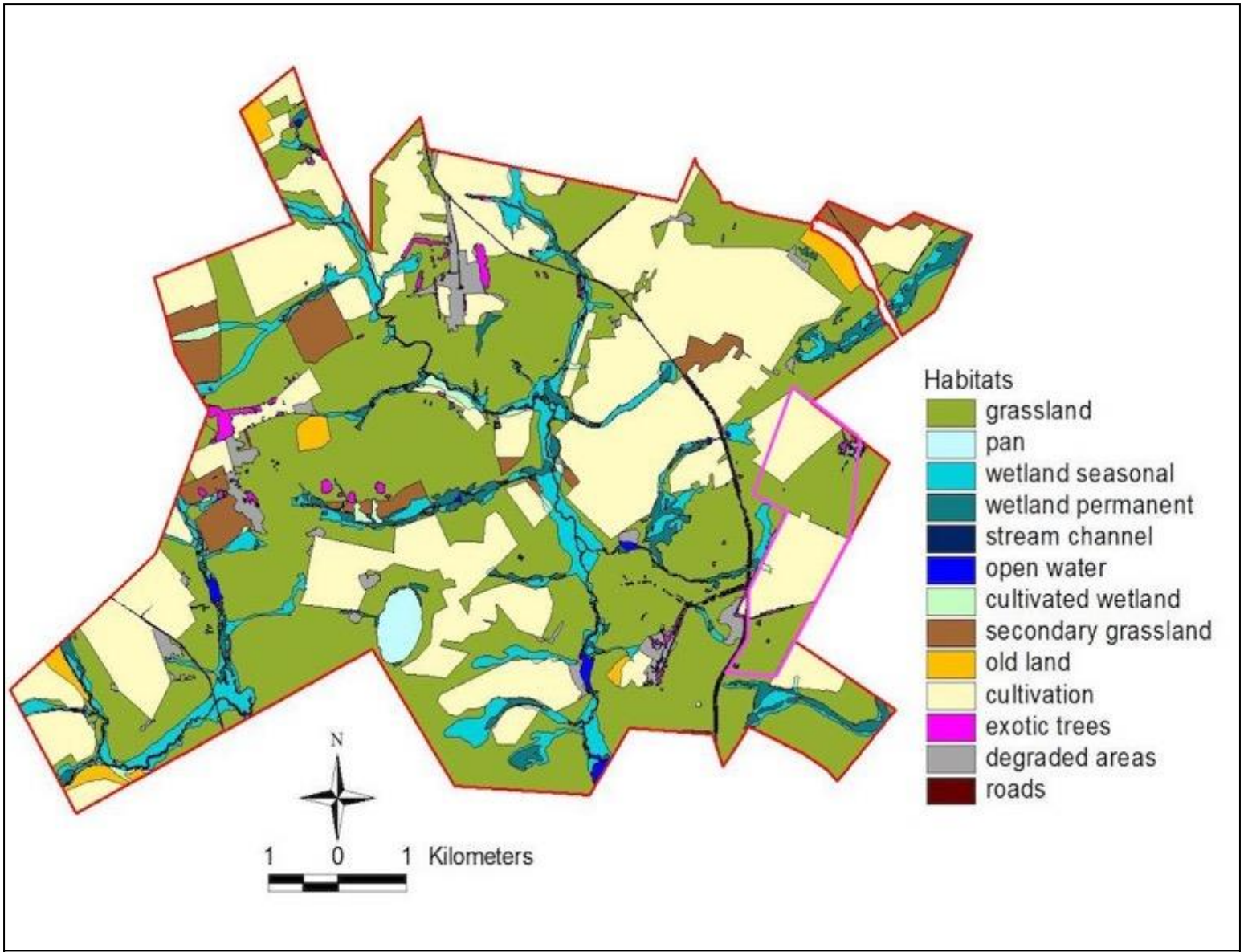

Figure 10: Main habitats of the study area.

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. A typical view of this vegetation, as found on site, is shown in Figure 11. This was 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.

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, Bewsia biflora, Brachiaria serrata, Diheteropogon amplectens, 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^2 sampling area. This rivals the local richness of some of the most species-rich grasslands anywhere in the country.

The Provincially protected plant species, *Aloe ecklonis*, was recorded within this unit. It is also potential habitat for three Vulnerable and two Near Threatened plant species, preferred habitat for three Near Threatened reptiles and five mammals that could occur on site, and is representative of the listed ecosystem that occurs on site (Eastern Highveld Grassland).

Figure 11: Grassland vegetation in the study area.

Pans

Two pans were recorded within the study area, one large and one very small. They are an important hydrologicval component of the landscape and often contain a flora that is unique to this habitat. An example of vegetation within a pan is shown in Figure 12.

Figure 12: Pan vegetation dominated by *Leersia hexandra* and *Eleocharis* sp.

Valley bottom wetlands

There is one main valley bottom wetland in the study area, which starts as a flat, wide area on the northern boundary of the site (at the coal conveyer). It flows southwards towards the middle of the study area, which is the approximate location of a small grove of exotic trees, where it narrows and changes direction towards the east. Through this area it flows through some rocky patches and then empties onto the floodplain. At the upper end of this valley, the wetland has been affected on both sides by historical cultivation and it has also been partially dammed upstream of there by the construction of the conveyer and the associated service road. Additionally, there is a small impoundment within the bed of the valley about two-thirds of the way down to the trees. Despite these impacts, the lower reaches of this valley system are in good condition and support healthy vegetation (see Figure 13).

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.

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.

Figure 13: Valley bottom wetland.

Habitat sensitivity

To determine ecological sensitivity in the study area, 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 of these areas should be 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. There are large parts of the study area that fall within CBAs (see Figure 7 on page 32) Much of the remainder of the study area is heavily modified. The CBA map therefore corresponds with the distribution of remaining natural habitat on site.

In terms of other species of concern, including both plants and animals, the preferred habitat of each of these can be determined or has been described. They are, however, distributed amongst different habitats on site, which means that no single habitat is primarily important as habitat for species of concern.

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

1. CBA "Irreplaceable" areas: The Mpumalanga Biodiversity Sector Plan (MBSP) (Mpumalanga Parks and Tourism Agency 2014) shows areas on site within various conservation planning categories, including areas designated as "CBA: Irreplaceable". These are areas that are required to meet biodiversity targets (for biodiversity pattern and ecological process features), the implication being that there are no other areas that meet the biodiversity criteria for meeting these conservation planning objectives. The Provincial policy is that they should remain in a natural state. Where possible, impacts on these areas should be minimised.

2. 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), except where the wetlands fall within a CBA "Irreplaceable" area, in which case they should be considered to be "No-Go" areas.

3. 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). However, the first two are included almost entirely within a CBA: Irreplaceable area on site, so is already discussed in point 1 above. The second is a wetland vegetation type and is covered in point 2 above.

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 ecologicval 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 natural grasslands, especially those in a moderate to good condition.

5. Plant species of concern: There are a number of listed plant species that could potentially occur on site. The key habitats are grasslands and wetlands. There are also various protected species that could potentially occur on site

Based on this information, a map of habitat sensitivity on site is provided in Figure 14. This shows main habitat sensitivity classes on site, as follows:

1. LOW for all transformed areas.
2. MEDIUM-LOW for secondary grasslands in previously cultivated areas.

3. MEDIUM for cultivated wetlands.
4. MEDIUM-HIGH for all remaining natural habitat on site.
5. HIGH for remaining natural habitat within “CBA: Irreplaceable” and “CBA:Optimal” areas.
6. VERY HIGH for intact natural wetlands.

Principles for minimizing impacts

The sensitivity assessment indicates areas that are considered to be sensitive for various reasons, but they are not all necessarily equally vulnerable to degradation in the case of localized impacts. There are some factors to take into account in order to minimize impacts due to possible development of wind infrastructure on site:

1. It is important to protect the ecosystem processes that support the ecological patterns on site and in surrounding areas. Important ecosystem processes in grasslands and wetlands (the two main ecosystems on site) include hydrological functions (water production, water purification, flood attenuation), soil protection and erosion control, habitat for fauna (including insect and bird pollinators), forage for animal production, and biodiversity. Some of these functions are dispersed, for example, habitat area, pollination services, and soil protection, whereas others are very linear, for example, most hydrological functions.
2. Healthy ecosystems have strong interactions within ecosystem components and weaker interactions across boundaries. It is therefore important to protect core areas of ecosystems and locate potential impacts to boundary areas.
3. Fragmentation has a strong impact on ecosystem health. It is therefore preferable to locate impacts at or close to existing disturbances, and to cluster impacts rather than dispersing them.

On the basis of these factors, it is recommended that development be concentrated within transformed areas, including cultivated areas, as well as in degraded areas. Any infrastructure proposed to be located within remaining natural habitat should be located as close to the edge of these areas as possible and should be clustered to minimize overall fragmentation.

Anticipated impacts associated with a wind energy facility are related to access road construction, turbine foundations, laydown areas, crane pads and substation infrastructure. The access roads usually have the biggest footprint and impact. The turbine bases, crane pads and laydown areas are fairly small in comparison. The advantage of the current site in terms of access roads is that there are not too many steep areas to traverse, there are existing farm roads, and there are existing transformed areas. Laydown areas are relatively flexible to locate and crane pads do not necessarily require vegetation clearing. Loss of small areas within grassland areas can be mitigated to some degree, damaged areas can be rehabilitated, and remediation can be undertaken to improve the overall status of the landscape. Careful location of infrastructure can, however, lead to the best possible outcome in terms of habitat loss.

Table 7: Restrictions for development within different sensitivity classes.

Sensitivity category	Sensitivite features	Restrictions
LOW	• None	• None
MEDIUM-LOW	• None	• None
MEDIUM	• Wetlands (disturbed)	• Restrictions according to National Water Act, i.e. require a permit (Water Use License) for any activities that impact on a wetland or watercourse

MEDIUM-HIGH	• Grasslands	• Limit disturbance and transformation as much as possible, i.e. minimize impacts • Locate infrastructure near margins, cluster infrastructure, take shortest routes from existing roads
HIGH	• CBA areas	• Avoid, if possible • Limit disturbance and transformation as much as possible, i.e. minimize impacts • Locate infrastructure near margins, cluster infrastructure, take shortest routes from existing roads
VERY HIGH	• Wetlands	• Avoid, if possible • If unavoidable, restrictions according to National Water Act • Apply mitigation measures to minimize impacts

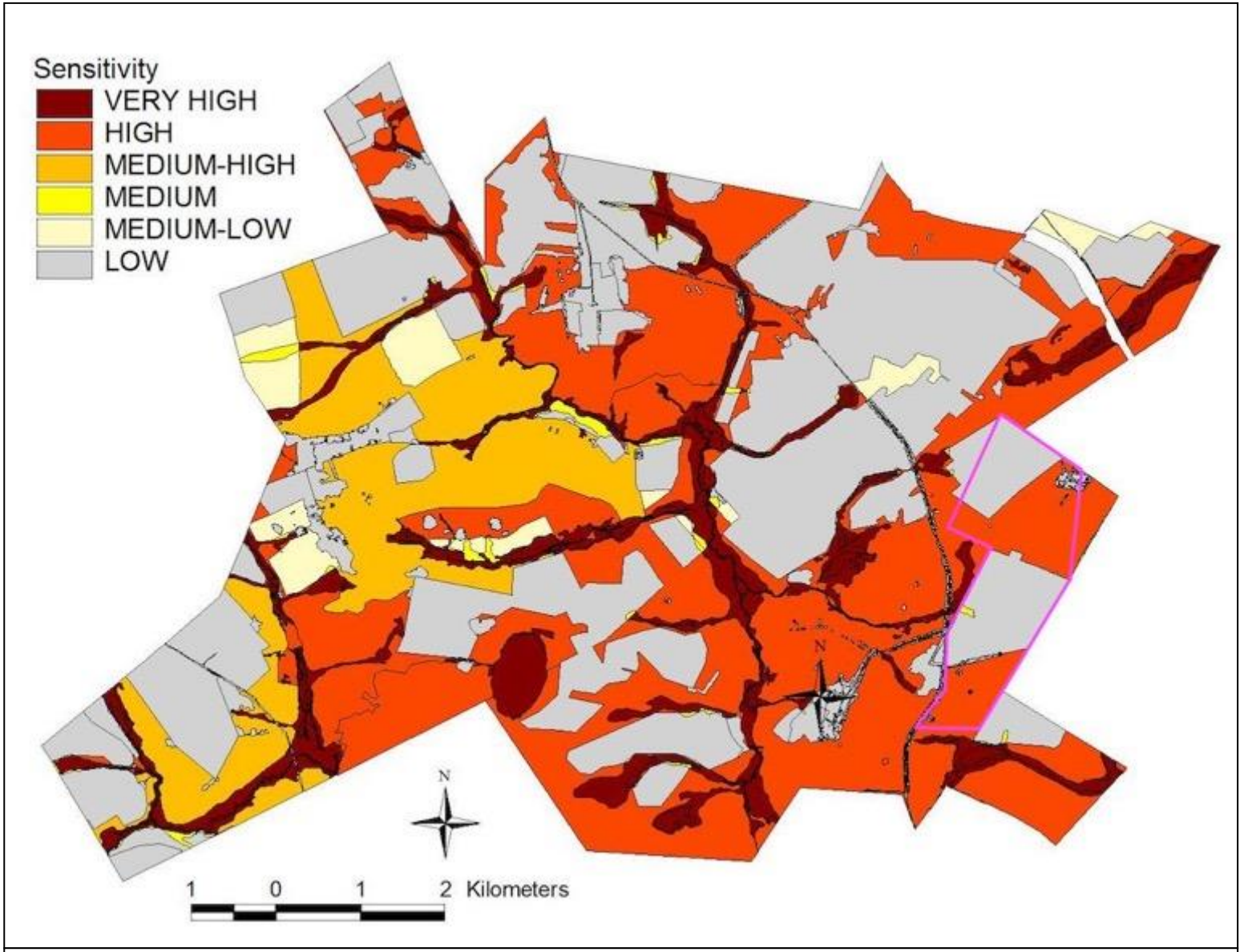

Figure 14: Habitat sensitivity of the broad study area, including CBAs (current site outlined in pink).

POSSIBLE IMPACTS

Proposed infrastructure in relation to sensitivities

The proposed infrastructure includes the following:

Solar PV area
This is located within grassland and cultivated areas, as well as a small area of wetland. They therefore affect areas either with HIGH sensitivity (within CBA1 areas), or areas with LOW sensitivity (within cultivated lands).

Construction camps
These are located within natural grassland areas. They therefore affect areas with HIGH sensitivity.

SS & BESS (2 alternative sites)
Both of these alternatives occur within natural grassland areas, and Alternative 1 includes a small amount of wetland. They therefore both affect areas with HIGH sensitivity.

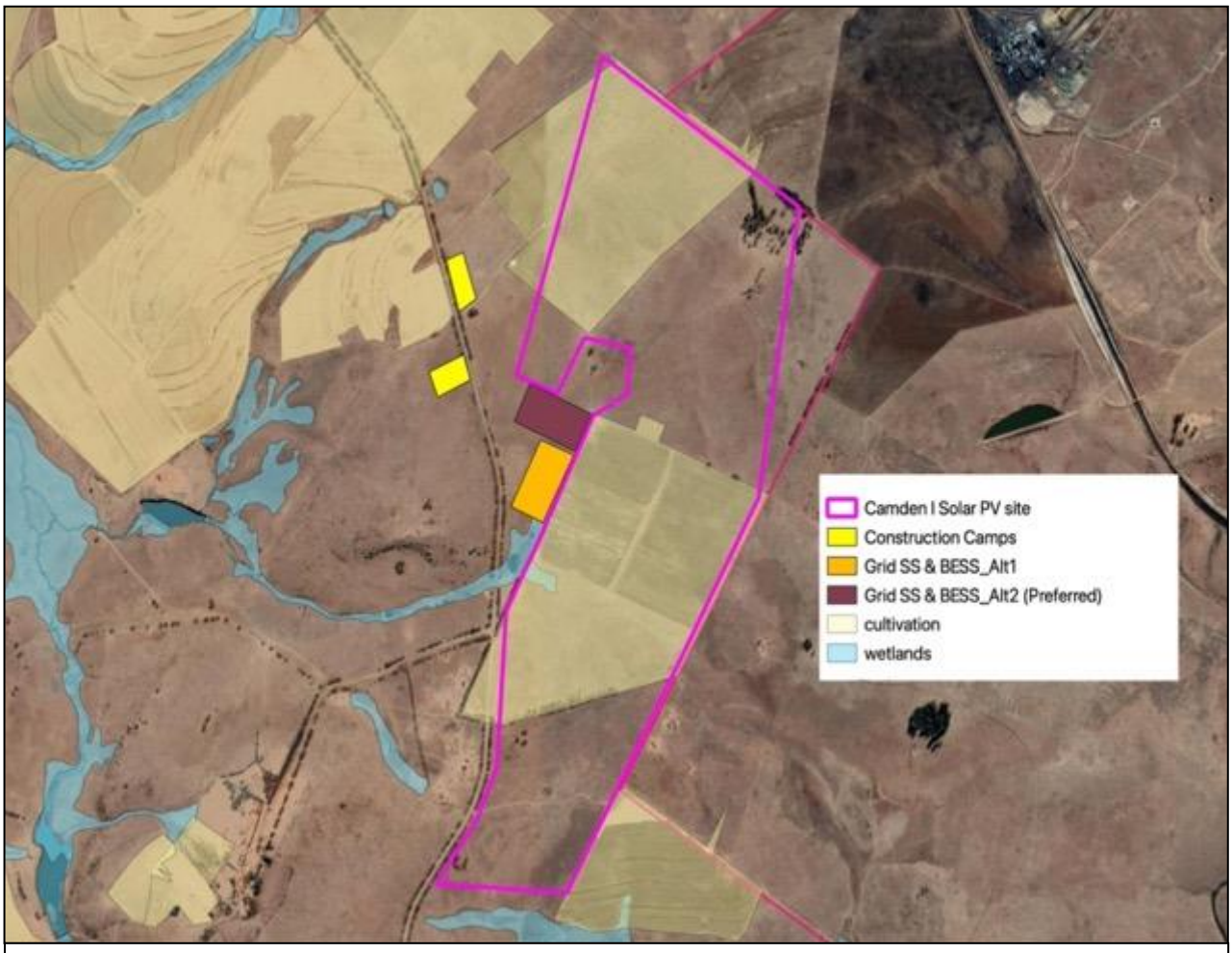

Figure 15: Location of proposed infrastructure relative to wetlands and cultivated areas.

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. Fragmentation of natural habitat (grassland and wetlands).
3. Invasion by alien invasive plant species, leading to degradation of habitat.

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. Specific recommendations will form part of the outcome of the EIA.

Terms of reference for EIA

The relative sensitivity of habitats in different parts of the study area differs from location to location. The sensitivity assessment was done as a screening exercise primarily through interpretation of aerial imagery in combination with habitat assessments that were not within specific footprint areas. Although footprint areas have been designated as sensitive in some cases, it is important to assess footprint areas in detail to ascertain whether local conditions justify the sensitivity categorisation or not. It is therefore important that all footprint areas within mapped sensitive areas (MEDIUM-HIGH, HIGH and VERY HIGH) are assessed in the field to confirm sensitivity.

DISCUSSION AND CONCLUSIONS

The project study area for the proposed projects consists largely of natural habitat within a rural area. Currently, the rates of transformation within the vegetation in this general region is moderately high, although on-site habitats have not been transformed to as high degree as surrounding areas. The regional vegetation type 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). Significant proportions of the remaining natural habitat on site therefore has to be considered to possibly have high biodiversity value, which is reflected in the Provincial Conservation Plan assessment of the area. The proposed project will therefore potentially have impacts on areas of natural habitat that have potentially high biodiversity value.

The Provincial Conservation Plan erroneously depicts the entire site as occurring within a National Protected Area. This status is contradicted by the land owner and there is no other supporting information to confirm that it is protected. However, the result of this error is that all areas within this protected zone have been classified in the conservation plan as having very high conservation value. Due to the fact that vegetation within this "protected" part of the site is within a listed ecosystem (Eastern Highveld Grassland), this sensitivity has been upheld here, although on-site condition of habitat does not warrant this at all locations where it is demarcated as protected.

A number of threatened or near threatened plant species could potentially occur on site. This includes seven species listed as Vulnerable and three species listed as Near Threatened for which there is a high probability that they occur on site. There are also two Endangered plant species and three Near Threatened plant species for which there is a moderate probability that they may occur on site. The likely habitat for these various species includes both grasslands and wetlands, i.e. there is no single habitat in which there is a greater or lesser likelihood of encountering threatened or near threatened plant species. Protection of the wetland-related habitats and remaining grassland habitat will reduce the likelihood of any of these species being affected, although site-specific searches would need to be undertaken to assess whether any of them occur or not.

There are no plant species occurring on site or likely to occur there that are protected according to the National Environmental Management: Biodiversity Act.

There are some plant species protected according to the Mpumalanga Nature Conservation Act that were recorded on site and it is highly probable that additional species protected according to this Act occur on site. None of these species are of conservation concern, but the fact that they are protected means that a permit will be required for their removal. This is a standard flora permit obtained from the provincial department, but which requires more detailed field information to be collected.

There are a number of fauna of possible conservation concern that were assessed as having a possibility of occurring on site. The preferred habitat of these is distributed across the available habitat types occurring on site. No single habitat therefore stands out as being of greater value overall.

For any infrastructure components that are proposed to be located within areas where natural habitat is found, it is likely that loss of natural habitat will happen. The location of any impact is important and infrastructure should be located so as to minimize impacts on natural areas as much as possible. In principle, infrastructure should therefore be located near to existing disturbance and in such a way as to minimise fragmentation of existing habitat, and affect the lowest number of different habitats as possible.

The DEA online screening tool identifies Terrestrial Biodiversity as a theme of very high sensitivity. Possible reasons on site for this sensitivity include CBAs national, South African Protected Areas, and Threatened Ecosystems. 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 that do not warrant this classification.

Conclusions

At the site-specific scale, various sensitivities have been identified, primarily related to natural habitat, but also to individual species of concern. However, it is possible that these can be minimised or avoided with the application of appropriate mitigation or management measures, primarily in relation to where proposed infrastructure will be located. There will probably be residual impacts, primarily on natural habitat. **The amount of habitat that will be lost to the project may or may not be significant in terms of local patterns and diversity that could be affected, depending on local conditions**. It is therefore important that site-specific assessments be undertaken at locations where infrastructure is located within natural areas.

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APPENDICES:

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

Sources: see text.

Taxon	Latest (IUCN version 3.1) Conservation Status**	Habitat and distribution	Flowering Time	Probability of occurrence*
Alepidea attenuata APIACEAE	Near Threatened	Dullstroom, Lydenburg, Machadodorp, Swaziland, Gauteng, Wolkberg Mountains and Sasolburg. Wetlands in grassland up to 2200 m.	Summer	**MEDIUM** (within known overall distribution, although no nearby records)
Alepidea cordifolia APIACEAE	Endangered	Widespread across the eastern highveld of Mpumalanga, the eastern Free State, and north-western KwaZulu-Natal. It occurs along the north and north-eastern borders of Lesotho and is also found in Swaziland, on the Eastern Highlands of Zimbabwe and the Chimanimani Mountains of Mozambique. Forest margins, west and south facing mountain slopes and near drainage lines or islands within wetlands. Open grassland or on forest margins, often amongst rocks and/or along streams.	Summer,, mostly February to March	**MEDIUM** (within known overall distribution)
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	**MEDIUM** (within known overall distribution)
Aspidoglossum xanthosphaerum APOCYNACEAE	Vulnerable	Mpumalanga, Groenvlei and Ermelo. Closest known record is from Breyten and just to the west of Ermelo. Montane grassland, marshy sites, 1800 m.	Unknown	**HIGH**
Bowiea volubilis subsp. volubilis HYACINTHACEAE	Vulnerable	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 screes, sometimes found scrambling at the margins of karroid, succulent bush in		**LOW** (site within gap in distribution, habitat not suitable)

		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.		
Brachystelma gerrardii APOCYNACEAE	Endangered	KwaZulu-Natal, Waterberg, Wolkberg and Swaziland. 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 Swaziland 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.		**HIGH**
Gladiolus malvinus IRIDACEAE	Vulnerable	Dullstroom to Belfast, south of Ermelo and towards Vryheid. Lydenburg Montane Grassland, Eastern Highveld Grassland. Dolerite outcrops in grassland, around 2000 m. Recently recorded just to south of site close to Vaal River.		**HIGH**
Gladiolus paludosus IRIDACEAE	Vulnerable	Witbank to Lydenburg, and southwards to Piet Retief and Wakkerstroom. Wetlands or marshes in high altitude grassland that remain wet throughout the year or dry out for only a short period.		**HIGH**
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.		**HIGH**
Habenaria barbertonii ORCHIDACEAE	Near Threatened	Gauteng and Mpumalanga. Rocky hillsides, in bushveld in association with acacias, 1000-1500 m.	February to March	**MEDIUM** (habitat may not be suitable)
Khadia carolinensis AIZOACEAE	Vulnerable	Carolina and Belfast. Eastern Highveld Grassland, Lydenburg Montane Grassland, Rand Highveld Grassland. Well-drained, sandy loam soils among rocky outcrops, or at the edges of sandstone sheets, Highveld Grassland, 1700 m.		**HIGH**
Kniphofia typhoides ASPHODELACEAE	Near Threatened	Gauteng, Limpopo, Mpumalanga, North West, Parys to Lydenburg to Paulpietersburg to Newcastle. Low lying wetlands and seasonally wet areas in climax Themeda triandra grasslands on		**MEDIUM** (habitat may not be suitable)

		heavy black clay soils, tends to disappear from degraded grasslands.		
Merwilla plumbea HYACINTHACEAE	Near Threatened	Widespread in eastern half of South Africa. Also in Swaziland and Lesotho. Montane mistbelt and Ngongoni grassland, rocky areas on steep, well drained slopes. 300-2500 m.		**HIGH**
Miraglossum davyi APOCYNACEAE	Vulnerable	Dullstroom, Middelburg and Standerton. Grassland (Lydenburg Montane Grassland, Soweto Highveld Grassland, Eastern Highveld Grassland).		**HIGH**
Nerine gracilis AMARYLLIDACEAE	Vulnerable	Free State, Gauteng, Mpumalanga, North West. Belfast and Ermelo to Wolmaransstad. Undulating grasslands in damp areas.		**HIGH**
Pachycarpus suaveolens APOCYNACEAE	Vulnerable	Gauteng and Mpumalanga to Swaziland. Lydenburg Montane Grassland, Eastern Highveld Grassland, Soweto Highveld Grassland. Short or annually burnt grasslands, 1400-2000 m.		**HIGH**
Riocreuxia aberrans APOCYNACEAE	Near Threatened	Dullstroom to Ermelo. Grassland. Wedged in cracks among rocks on exposed quartzite ridges.		**LOW** (habitat not suitable)

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

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

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

The species in ***bold*** have a geographical distribution that is close to the study area.

Appendix 3: Plant species previously recorded in the general area.

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 http://newposa.sanbi.org/ accessed on 14 February 2020. 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 www.inaturalist.org, which are photographic observ ations 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. hybridusvar. 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 sp.
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 sp.
Asparagus virgatus

Asphodelaceae
Aloe bergeriana
Aloe boylei
Aloe davyana
Aloe ecklonis
Aloe graciliflora
Aloe hlangapies
Aloe jeppeae
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
Dicoma sp.
Didelta carnosa var. carnosa
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
Gazania sp.
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
Macledium 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 sp.
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 carnosa
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 sp.
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 parvinux
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
Pycreus betschuanus
Pycreus chrysanthus
Pycreus cooperi
Pycreus macranthus
Pycreus nitidus
Pycreus pumilus
Pycreus 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 sp.
Acalypha wilmsii
Euphorbia gueinzii
Euphorbia inaequilatera
Euphorbia natalensis
Euphorbia sp.
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 sp.
Crotalaria sphaerocarpa subsp. sphaerocarpa
Dichilus strictus
Dolichos angustifolius
Dolichos falciformis
Elephantorrhiza elephantina
Elephantorrhiza praetermissa
Eriosema cordatum
Eriosema kraussianum
Eriosema salignum
Eriosema simulans
Eriosema sp.
Erythrina zeyheri
Indigastrum 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 sp.
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 Baker
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 sp.
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 pentherianus

Haloragaceae
Laurembergia repens subsp. *brachypoda*

Hyacinthaceae
Albuca baurii
Albuca setosa
Albuca shawii
Albuca sp.
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
Ledebouria sp.
Merwilla plumbea
Ornithogalum candicans
Ornithogalum capillare
Ornithogalum esterhuyseniae
Ornithogalum flexuosum
Ornithogalum juncifolium var. juncifolium
Schizocarphus 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*
Hypoxis sp.

Iridaceae
Aristea torulosa
Babiana bainesii
Crocosmia paniculata
Dierama insigne
Dierama mossii
Dierama sp.
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 sp.
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
Rotheca hirsuta
Salvia aurita var. galpinii
Salvia repens var. repens
Salvia runcinata
Salvia sp.
Stachys hyssopoides
Stachys kuntzei
Stachys natalensis var. natalensis
Stachys nigricans
Stachys sp.
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 sp.
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
Eulophia sp.
Habenaria barbertoni
Habenaria clavata
Habenaria dives
Habenaria epipactidea
Habenaria falcicornis subsp*. caffra*
Habenaria lithophila
Neobolusia tysonii
Orthochilus foliosus
Orthochilus leontoglossus

Orthochilus sp.
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
Buchnera sp.
Cycnium adonense
Cycnium tubulosum subsp. tubulosum
Harveya speciosa
Melasma scabrum var. scabrum
Sopubia cana var. cana
Sopubia simplex
Sopubia sp.
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
Clutia hirsuta var. hirsuta
Clutia monticola var*. monticola*
Clutia natalensis
Clutia sp.
Clutia 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
Agrostis sp.
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 sp.
Aristida vestita
Arundinella nepalensis
Avena sativa; Naturalised; Invasive
Avena sp.
Bothriochloa insculpta
Brachiaria eruciformis
Brachiaria humidicola
Brachiaria serrata
Briza minor; Naturalised; Invasive
Bromus catharticus; Naturalised; Invasive
Bromus leptoclados
Bromus sp.
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 sp.

Digitaria ternata
Digitaria tricholaenoides
Diheteropogon amplectens var. amplectens
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 sp.
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
Hyparrhenia sp.
Imperata cylindrica
Koeleria capensis
Leersia hexandra
Lolium multiflorum; Naturalised; Invasive
Lolium temulentum; Naturalised; Invasive
Lophacme digitata
Loudetia densispica
Loudetia simplex
Melinis nerviglumis
Melinis sp.
Microchloa caffra
Monocymbium ceresiiforme
Panicum ecklonii
Panicum natalense
Panicum schinzii
Panicum sp.

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 sp.
Setaria sphacelata var. sphacelata
Setaria sphacelata var. torta
Sorghum bicolor subsp. arundinaceum
Sporobolus albicans
Sporobolus centrifugus
Sporobolus discosporus
Sporobolus fimbriatus
Sporobolus sp.
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 gracilenta
Polygala hottentotta
Polygala krumanina
Polygala ohlendorfiana
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 sp.
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
Eriospermum sp*.*

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 sp*.*
Jamesbrittenia stricta
Limosella longiflora
Limosella maior
Limosella sp*.*
Manulea bellidifolia
Manulea rhodantha subsp*. aurantiaca*
Melanospermum rupestre
Melanospermum sp.
Melanospermum transvaalense

Nemesia fruticans
Nemesia sp.
Selago capitellata
Selago densiflora
Selago galpinii
Selago sp.
Teedia lucida
Tetraselago longituba
Zaluzianskya elongata
Zaluzianskya rubrostellata
Zaluzianskya sp.
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 elaegnifolium; 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*
Chascanum sp.
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 4: 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) (see Appendix 6) marked with "N"

Mammals:

ARTIODACTYLA:

Bovidae:

Red hartebeest
Springbok
[N]Black wildebeest
Blue wildebeest
Blesbok
Plains zebra
Klipspringer
[N]Oribi EN
Grey rhebok NT
Warthog
Bushpig
Steenbok
Mountain reedbuck
Common duiker
Eland
Bushbuck

PERRISODACTYLA:

Rhinocerotidae:

[N]White rhinoceros

HYRACOIDEA:

Procavidae:

Rock hyrax

CARNIVORA:

Felidae:

Caracal
[N]Black-footed cat VU
African wild cat
[N]Serval
[N]Leopard VU

Mustelidae:

[N]Cape clawless otter NT
Striped polecat
[N]Spotted-necked otter NT
[N]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
[N]Cape fox

Viveridae:

Small-spotted genet
Large-spotted genet

Hyaenidae:

[N]Brown hyaena NT
Aardwolf

INSECTIVORA:

Eulipotyphla:

[N]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
Hystricidae:
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
[N]Giant bullfrog
Striped stream frog
Clicking stream frog
Tremolo sand frog
Natal sand frog
Tandy's sand frog

Appendix 5: Flora and 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	Loxodonta africana
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	Pyxicephalus adspersus
All species of reptiles excluding the water leguaan, rock leguaan and all species of snakes	All species of the Class Reptilia excluding Varanus niloticus, Varanus exanthematicus and all species of the Sub Order Serpentes
Riverine rabbit	Bungolagus monticularis
hedgehog	Atelerix frontalis
Samango monkey	Cercopithecus mitis
bushbaby	Otolemur crassicaudatus
Lesser bushbaby	Galago moholi
Honey-badger	Mellivora capensis
pangolin	Manis temminckii
aardwolf	Proteles cristatus
Cape hunting dog	Lycaon pictus
Brown hyaena	Hyaena brunnea
antbear	Orycteropus afer
Mountain zebra	Equus zebra zebra
Hartmann's zebra	Equus zebra hartmannae
hippopotamus	Hippopotamus amphibius
giraffe	Girrafa camelopardalis
nyala	Tragelaphus angasi
Red duiker	Cepalophus natalensis
Blue duiker	Philantomba monticola
reedbuck	Redunca arundinum
Mountain reedbuck	Redunca fulvorufula
Sable antelope	Hippotragus niger
Roan antelope	Hippotragus equinus
Black wildebeest	Connochaetes gnou
tsessebe	Damaliscus lanatus
Lichtenstein's hartebeest	Alcelaphus lichtensteinii
klipspringer	Oreotragus oreotragus
oribi	Ourebia ourebi
steenbok	Raphicerus campestris
Sharpe's grysbok	Raphicerus sharper
suni	Neotragus moschatus
Grey rhebok	Pelea capreolus
eland	Taurotragus oryx
waterbuck	Kobus ellipsiprymnus
Cape clawless otter	Aonyx capensis
Spotted necked otter	Lutra maculicollis

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

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

All species of impala lilies	All species of the Genus Adenium
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 6: Flora and vertebrate animal species protected under the National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004)

(as updated in R. 1187, 14 December 2007)

CRITICALLY ENDANGERED SPECIES

Flora

Adenium swazicum
Aloidendron pillansii
Diaphananthe millarii
Dioscorea ebutsniorum (no such species!!)
Encephalartos aemulans
Encephalartos brevifoliolatus
Encephalartos cerinus
Encephalartos dolomiticus
Encephalartos heenanii
Encephalartos hirsutus
Encephalartos inopinus
Encephalartos latifrons
Encephalartos middelburgensis
Encephalartos nubimontanus
Encephalartos woodii

Reptilia

Loggerhead sea turtle
Leatherback sea turtle
Hawksbill sea turtle

Aves

Wattled crane
Blue swallow
Egyptian vulture
Cape parrot

Mammalia

Riverine rabbit
Rough-haired golden mole

ENDANGERED SPECIES

Flora

Angraecum stella-africae
Encephalartos arenarius
Encephalartos cupidus
Encephalartos horridus
Encephalartos laevifolius
Encephalartos lebomboensis
Encephalartos msinganus
Jubaeopsis caffra
Siphonochilus aethiopicus
Warburgia salutaris
Newtonia hildebrandtii

Reptilia

Green turtle
Giant girdled lizard
Olive ridley turtle
Geometric tortoise

Aves

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

Mammalia

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

VULNERABLE SPECIES

Flora

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

Aves

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

Bald ibis
Ludwig's bustard
Martial eagle
Bataleur
Grass owl

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

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

Amphibia
Giant bullfrog
African bullfrog

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

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

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

Appendix 7: 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.
1January 2009 – 30 June 2009, Lecturer, University of Pretoria, Botany Dept.
1January 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., 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. http://www.biodiversityhotspots.org/xp/hotspots/maputaland/.

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

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

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

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

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

Conference Presentations:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Unpublished technical reports:

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

HOARE, D.B. 1999. The classification and mapping of the savanna biome of South Africa: methodology for mapping the vegetation communities of the South African savanna at a scale of 1:250 000. Report to the National Department of Agriculture (Directorate Resource Conservation). ARC Range and Forage Institute, Pretoria.

HOARE, D.B. 1999. The classification and mapping of the savanna biome of South Africa: size and coverage of field data that exists on the database of vegetation data for South African savanna. Report to the National Department of Agriculture (Directorate Resource Conservation). ARC Range and Forage Institute, Pretoria.

THOMPSON, M.W., VAN DEN BERG, H.M., NEWBY, T.S. & HOARE, D.B. 2001. Guideline procedures for national land-cover mapping and change monitoring. Report no. ENV/P/C 2001-006 produced for Department of Water Affairs and Forestry, National Department of Agriculture and Department of Environment Affairs and Tourism. Copyright: Council for Scientific and Industrial Research (CSIR) and Agricultural Research Council (ARC).

HOARE, D.B. 2003. Natural resource survey of node O R Tambo, using remote sensing techniques, Unpublished report and database of field data for ARC Institute for Soil, Climate & Water, ARC Range and Forage Institute, Grahamstown.

HOARE, D.B. 2003. Short-term changes in vegetation of Suikerbosrand Nature Reserve, South Africa, on the basis of resampled vegetation sites. Gauteng Department of Agriculture, Conservation, Environment and Land Affairs, Conservation Division.

BRITTON, D., SILBERBAUER, L., ROBERTSON, H., LUBKE, R., HOARE, D., VICTOR, J., EDGE, D. & BALL, J. 1997. The Life-history, ecology and conservation of the Brenton Blue Butterfly (*Orachrysops niobe*) (Trimen)(*Lycaenidea*) at Brenton-on-Sea. Unpublished report for the Endangered Wildlife Trust of Southern Africa, Johannesburg. 38pp.

HOARE, D.B., VICTOR, J.E. & MARNEWIC, G. 2005. Vegetation and flora of the wetlands of Nylsvley River catchment as component of a project to develop a framework for the sustainable management of wetlands in Limpopo Province.

Consulting reports:

Total of over 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, VIIth International Rangeland Congress, 26 July – 1 August 2003, Durban South Africa.

VIIth International Rangeland Congress, 26 July – 1 August 2003, Durban South Africa.

BioMap workshop, Stellenbosch, March 2002 to develop strategies for studying vegetation dynamics of Namaqualand using remote sensing techniques

South African Association of Botanists Annual Congress, Grahamstown, January 2002.

28th International Symposium on Remote Sensing of Environment, Somerset West, 27-31 March 2000.

Workshop on Vegetation Structural Characterisation: Tree Cover, Height and Biomass, 28th International Symposium on Remote Sensing of Environment, Strand, 26 March 2000.

South African Association of Botanists Annual Congress, Potchefstroom, January 2000

National Botanical Institute Vegmap Workshop, Kirstenbosch, Cape Town, 30 September-1 October 1999.

Sustainable Land Management – Guidelines for Impact Monitoring, Orientation Workshop: Sharing Impact Monitoring Experience, Zithabiseni, 27-29 September 1999.

WWF Macro Economic Reforms and Sustainable Development in Southern Africa, Environmental Economic Training Workshop, development Bank, Midrand, 13-14 September 1999.

34th Annual Congress of the Grassland Society of South Africa, Warmbaths, 1-4 February 1999

Expert Workshop on National Indicators of Environmental Sustainable Development, Dept. of Environmental Affairs and Tourism, Roodevallei Country Lodge, Roodeplaat Dam, Pretoria, 20-21 October 1998.

South African Association of Botanists Annual Congress, Cape Town, January 1998

Randse Afriakaanse Universiteit postgraduate symposium, 1997.

South African Association of Botanists Annual Congress, Bloemfontein, January 1995.