

Terrestrial Ecology Scoping

Camden 1 Wind Energy Facility near
Ermelo in Mpumalanga Province



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

Location:

South of Ermelo in Mpumalanga Province

for

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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 accreditation	and 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).



Dr David Hoare

30 November 2021

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. the impact on species composition and structure of vegetation with an indication of the extent of clearing activities in proportion to the remaining extent of the ecosystem type(s);
 - 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;
- SWSAs including:
 - 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) the impacts of the proposed development on habitat condition and
 - 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 compensate 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 in 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 Wind Energy Facility is summarised as follows:

Facility Name	Camden I Wind Energy Facility
Applicant	Camden I Wind Energy Facility (RF) Propriety Limited
Municipalities	Msukaligwa Local Municipality of the Gert Sibande District Municipality
Affected Farms¹	<ul style="list-style-type: none"> o Portion 0 of Klipfontein Farm No. 442 o Portion 1 of Welgelegen Farm No. 322 o Portion 1 of Klipfontein Farm No. 442 o Portion 2 of Uitkomst Farm No. 292 o Portion 2 of Welgelegen Farm No. 322 o Portion 3 of Langverwatch Farm No. 293 o Portion 3 of Klipbank Farm No. 295 o Portion 3 of Klipfontein Farm No. 442 o Portion 10 of Uitkomst Farm No. 292 o Portion 14 of Mooiplaats Farm No. 290
Extent	6000 ha
Buildable area	Approximately 200 ha
Capacity	Up to 250MW
Number of turbines	Up to 47
Turbine hub height:	Up to 200m
Rotor Diameter:	Up to 200m
Foundation	Approximately 25m2 diameter x 3m deep – 500 – 650m3 concrete.

¹ Based on the current conceptual layout.

	Excavation approximately 1000m ² , in sandy soils due to access requirements and safe slop stability requirements.
Operations and Maintenance (O&M) building footprint:	<p>Located in close proximity to the substation. Septic tanks with portable toilets Typical areas include:</p> <ul style="list-style-type: none"> - Operations building – 20m x 10m = 200m² - Workshop – 15m x 10m = 150m² <p>Stores - 15m x 10m = 150m²</p>
Construction camp laydown	<p>Typical area 100m x 50m = 5000m². Sewage: Septic tanks and portable toilets</p>
Temporary laydown or staging area:	Typical area 220m x 100m = 22000m ² . Laydown area could increase to 30000m ² for concrete towers, should they be required.
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.
Internal Roads:	Width of internal road – Between 5m and 6m, this can be increased to 8m on bends. Length of internal road – Approximately 60km.
Cables:	The medium voltage collector system will comprise of cables up to and include 33kV that run underground, except where a technical assessment suggest that overhead lines are required, in the facility connecting the turbines to the onsite substation.
Independent Power Producer (IPP) site substation and battery energy storage system (BESS):	<p>Total footprint will be up to 10ha 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.</p> <p>The associated BESS storage capacity will be up to 200MW/800MWh with up to four hours of storage. It is proposed that Lithium Battery Technologies, such as Lithium Iron Phosphate, Lithium Nickel Manganese Cobalt oxides or Vanadium Redox flow technologies will be considered as the preferred battery technology. The main components of the BESS include the batteries, power conversion system and transformer which will all be stored in various rows of containers.</p>

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 there is high confidence that many of the 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”. Biodiversity offsets should be considered to remedy residual negative impacts on biodiversity of ‘medium’ to ‘high’ significance. Residual impacts of ‘very high’ significance are a fatal flaw for development and residual biodiversity impacts of ‘low’ significance would usually not require offsets. The Policy indicates that impacts should preferably be avoided in protected areas, 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 queried in relation to the following infrastructure:

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

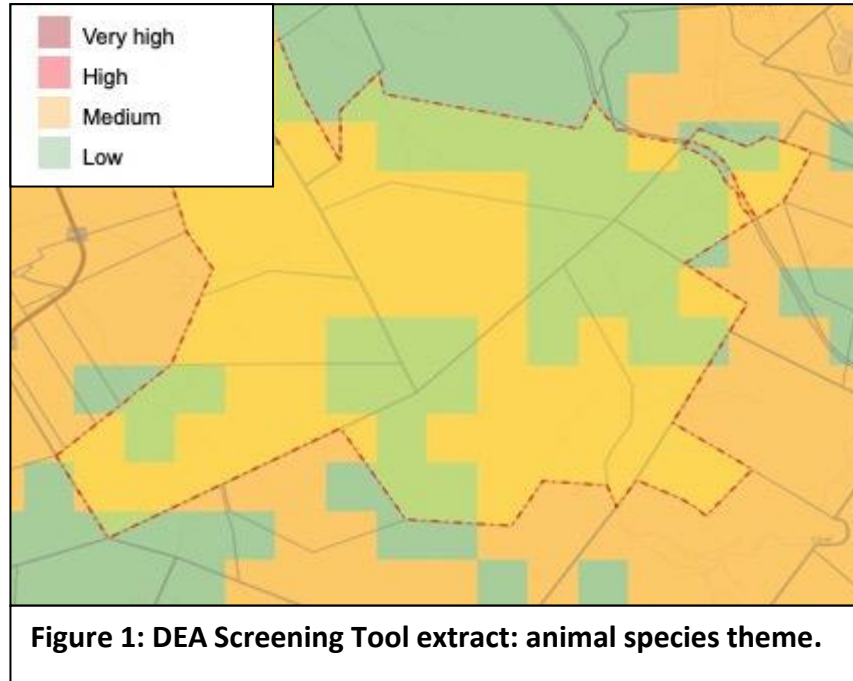
The features identified from the Screening Tool in the section below are only those that relate to Terrestrial Biodiversity and are in relation to the following themes:

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.



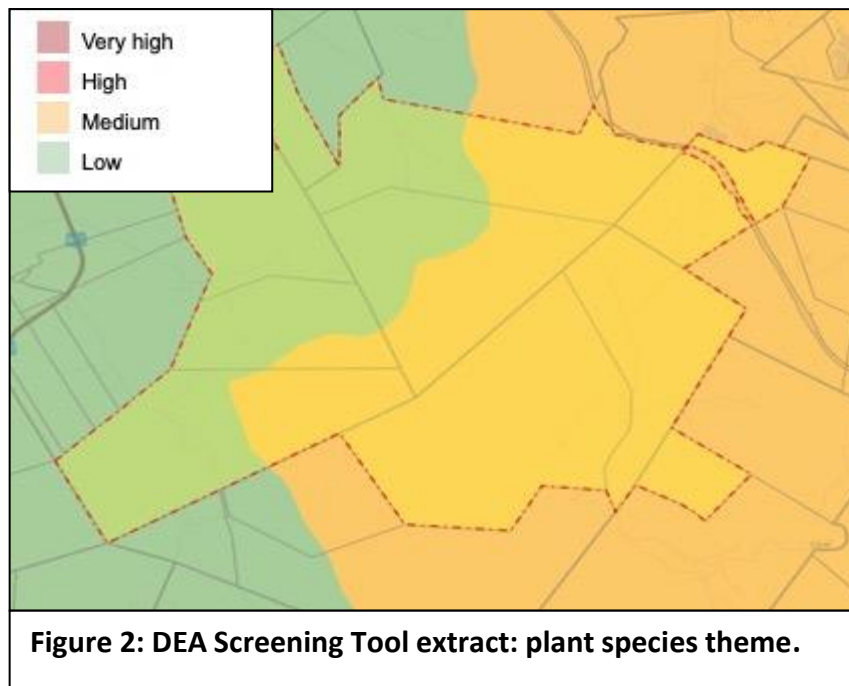
According to the “PROCEDURES TO BE FOLLOWED FOR THE ASSESSMENT AND MINIMUM CRITERIA FOR REPORTING OF IDENTIFIED ENVIRONMENTAL THEMES IN TERMS OF SECTION 24(5)(a) AND (h) OF THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998, WHEN APPLYING FOR ENVIRONMENTAL AUTHORISATION”, the sensitivity ratings for animal 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.
 - c. The two species highlighted in the on-line tool are *Ourebia ourebi* (Oribi) and *Hydrictis maculicollis* (Spotted-necked Otter). A full list for the site is assessed in Appendix 4 and from page 38 to 43.
2. 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 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.



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 ENVIRONMENTAL 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 six plant species listed for the site, according to the on-line tool, three 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.

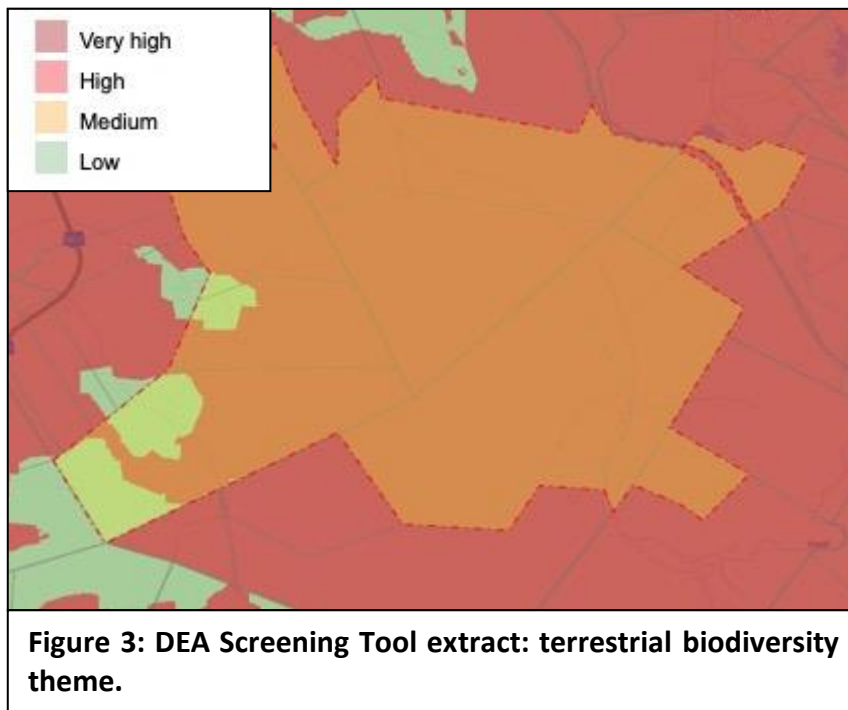
Terrestrial biodiversity theme

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 (not assessed here);
2. CBA1 (see Figure 8, page 33)
3. Endangered Ecosystem (Eastern Highveld Grassland, listed as Vulnerable – see Figure 6, page 27, Chrissiesmeer Panveld is listed as Endangered – see Figure 7, page 32);
4. South African Protected Areas (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).
5. Focus Areas Protected Area Expansion (according to SANBI BGIS data, does not apply to this site).



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 ten (10) 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. There are various secondary roads leading from the main access roads, and a number of homestead complexes. There are groves of exotic trees scattered throughout the study area, but mostly clustered around homesteads and farm infrastructure, where they act as shelter and wind-breaks, and there are also characteristic wind-rows of oak trees along both sides of the road in the south-central half of the study area. The vegetation in the study area is used primarily for livestock grazing and is affected to some degree by this usage, but not to the extent that any severe degradation was noted on site. With the exception of cultivated



Figure 4: Location of the study area.

areas 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 are three regional vegetation type occurring in the study area, namely Eastern Highveld Grassland, Amersfoort Highveld Clay Grassland and Eastern Temperate Freshwater Wetlands (Figure 6). Another vegetation type, Wakkerstroom Montane Grassland occurs nearby to the south-east of the site. It is probable that terrestrial vegetation patterns reflect the major vegetation types, namely Eastern Highveld Grassland and Amersfoort Highveld Clay 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

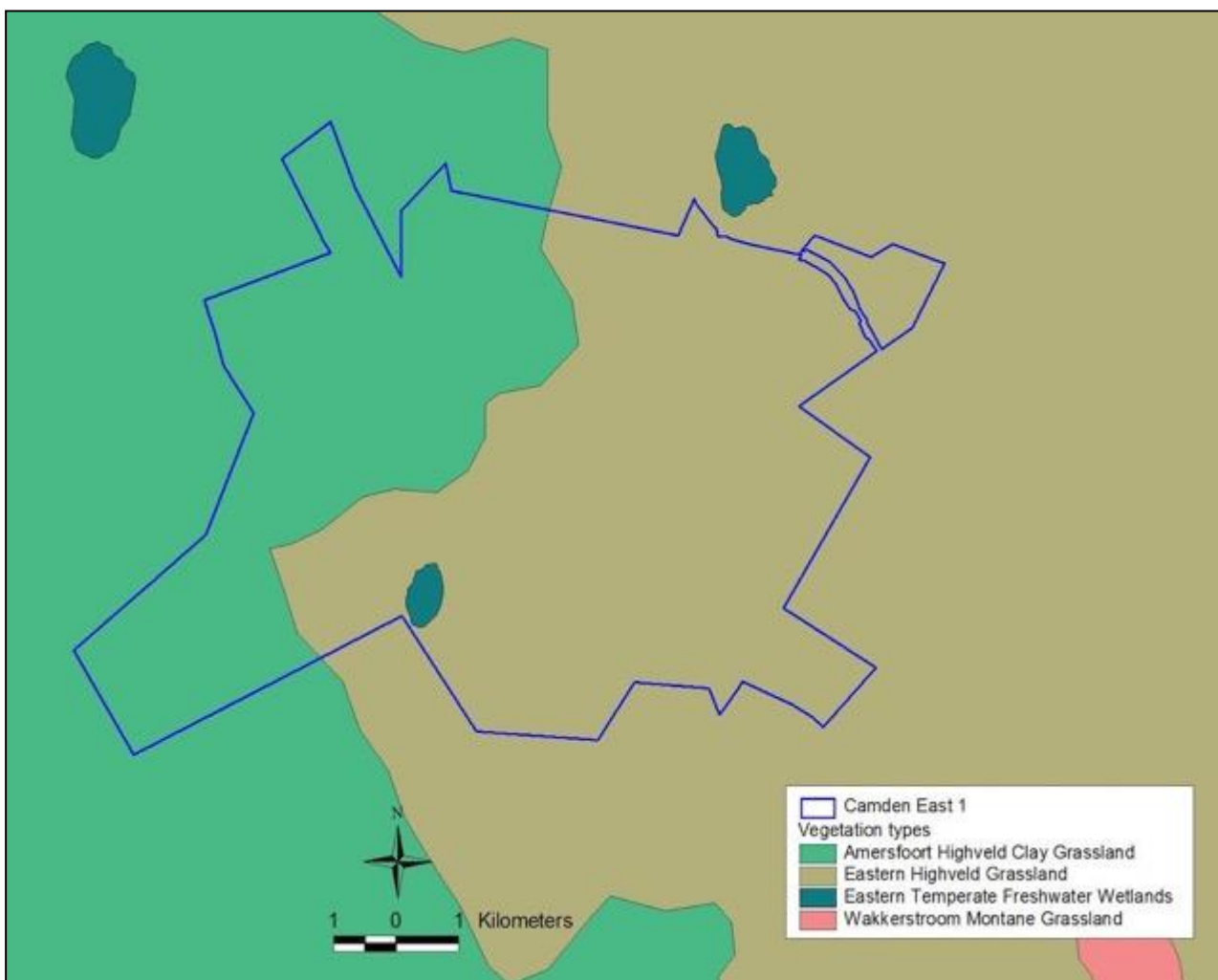


Figure 6: Regional vegetation types of the study area.

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

Climate

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

Important Taxa

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

Amersfoort Highveld Clay Grassland

Distribution

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

Vegetation & Landscape Features

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

Geology & Soils

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

Climate

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

Important Taxa

Graminoids	<i>Andropogon appendiculatus</i> (d), <i>Brachiaria serrata</i> (d), <i>Digitaria monodactyla</i> (d), <i>D. tricholaenoides</i> (d), <i>Elionurus muticus</i> (d), <i>Eragrostis capensis</i> (d), <i>E. chloromelas</i> (d), <i>E. plana</i> (d), <i>E. racemosa</i> (d), <i>Harpochloa falx</i> (d), <i>Heteropogon contortus</i> (d), <i>Microchloa caffra</i> (d), <i>Panicum natalense</i> (d), <i>Setaria nigrirostris</i> (d), <i>S. sphacelata</i> (d), <i>Themeda triandra</i> (d), <i>Trichoneura grandiglumis</i> (d), <i>Tristachya leucothrix</i> (d), <i>Abildgaardia ovata</i> , <i>Andropogon schirensis</i> , <i>Aristida bipartita</i> , <i>A. congesta</i> , <i>A. junciformis</i> subsp. <i>galpinii</i> , <i>A. stipitata</i> subsp. <i>graciliflora</i> , <i>Bulbostylis contexta</i> , <i>Chloris virgata</i> , <i>Cymbopogon caesius</i> , <i>C. pospischilii</i> , <i>Cynodon dactylon</i> , <i>Digitaria diagonalis</i> , <i>D. ternata</i> , <i>Diheteropogon amplexens</i> , <i>Eragrostis curvula</i> , <i>Koeleria capensis</i> , <i>Panicum coloratum</i> , <i>Setaria incrassata</i> .
Herbs	<i>Berkheya setifera</i> (d), <i>Vernonia natalensis</i> , <i>V. oligocephala</i> (d), <i>Acalypha peduncularis</i> , <i>A. wilmsii</i> , <i>Berkheya insignis</i> , <i>B. pinnatifida</i> , <i>Crabbea acaulis</i> , <i>Cynoglossum hispidum</i> , <i>Dicoma</i>

	<i>anomala</i> , <i>Haplocarpha scaposa</i> , <i>Helichrysum caespitium</i> , <i>H. rugulosum</i> , <i>Hermannia coccocarpa</i> , <i>H. depressa</i> , <i>H. transvaalensis</i> , <i>Ipomoea crassipes</i> , <i>I. oblongata</i> , <i>Jamesbrittenia silenoides</i> , <i>Pelargonium luridum</i> , <i>Pentanisia prunelloides</i> subsp. <i>latifolia</i> , <i>Peucedanum magalismontanum</i> , <i>Pseudognaphalium luteo-album</i> , <i>Rhynchosia effusa</i> , <i>Salvia repens</i> , <i>Schistostephium crataegifolium</i> , <i>Sonchus nanus</i> , <i>Wahlenbergia undulata</i> .
Herbaceous climber	<i>Rhynchosia totta</i> .
Geophytic Herbs	<i>Boophone disticha</i> , <i>Eucomis autumnalis</i> subsp. <i>clavata</i> , <i>Hypoxis villosa</i> var. <i>obliqua</i> , <i>Zantedeschia albomaculata</i> subsp. <i>macrocarpa</i> .
Tall Shrubs	<i>Diospyros austro-africana</i> , <i>D. lycioides</i> subsp. <i>guerkei</i> .
Low shrubs	<i>Anthospermum rigidum</i> subsp. <i>pumilum</i> (d), <i>Helichrysum melanacme</i> (d), <i>Chaetacanthus costatus</i> , <i>Euphorbia striata</i> var. <i>cuspidata</i> , <i>Gnidia burchellii</i> , <i>G. capitata</i> , <i>Polygala uncinata</i> , <i>Rhus discolor</i> .
Succulent shrubs	<i>Euphorbia clavarioides</i> var. <i>truncata</i> .

Remarks

1. Overgrazing leads to increase in cover of *Seriphium plumosum* (an indigenous species that has low grazing value).
2. Parts of this unit were once cultivated and now lie fallow and have been left to re-vegetate with pioneer species. These transformed areas are not picked up by satellite for transformation coverage and the percentage of grasslands still in a natural state may be underestimated.

Eastern Temperate Freshwater Wetlands

Distribution

Northern Cape, Eastern Cape, Free State, North-West, Gauteng, Mpumalanga and KwaZulu-Natal Provinces as well as in neighbouring Lesotho and Swaziland: Around water bodies with stagnant water (lakes, pans, periodically flooded vleis, edges of calmly flowing rivers) and embedded within the Grassland Biome. Altitude ranging from 750–2 000 m.

Vegetation & Landscape Features

Flat landscape or shallow depressions filled with (temporary) water bodies supporting zoned systems of aquatic and hygrophilous vegetation of temporarily flooded grasslands and ephemeral herblands.

Geology & Soils

Found on younger Pleistocene to recent sediments overlying fine-grained sedimentary rocks of the Karoo Supergroup (on sediments of both Ecca and Beaufort Groups due to the large extent of the area of occurrence) as well as of the much older dolomites of the Malmani Subgroup of the Transvaal Supergroup in the northwest. Especially the areas built by Karoo Supergroup sediments are associated with the occurrence of Jurassic Karoo dolerite dykes having a profound influence on run-off. Soils are peaty (Champagne soil form) to vertic (Rensberg soil form). The vleis form where flow of water is impeded by impermeable soils and/or by erosion resistant features, such as dolerite intrusions. Many vleis and pans of this type of freshwater wetlands are inundated and/or saturated only during the summer rainfall season, and for some months after this into the middle of the dry winter season, but they may remain saturated all year round. Surface water inundation may be present at any point while the wetland is saturated and some plant species will be present only under inundated conditions, or under permanently saturated conditions. The presence of standing water should not be taken as a sign of permanent wet conditions.

Climate

Exclusively summer-rainfall region (MAP range 421–915 mm). Cool-temperate pattern with MAT ranging between 12.6°C and 16.7°C. Due to high elevation, frost is a frequent phenomenon

Important Taxa

Megagraminoids	<i>Cyperus congestus</i> (d), <i>Phragmites australis</i> (d), <i>Schoenoplectus corymbosus</i> (d), <i>Typha capensis</i> (d), <i>Cyperus immensus</i> ..
Graminoids	<i>Agrostis lachnantha</i> (d), <i>Carex acutiformis</i> (d), <i>Eleocharis palustris</i> (d), <i>Eragrostis plana</i> (d), <i>E. planiculmis</i> (d), <i>Fuirena pubescens</i> (d), <i>Helictotrichon turgidulum</i> (d), <i>Hemarthria altissima</i> (d), <i>Imperata cylindrica</i> (d), <i>Leersia hexandra</i> (d), <i>Paspalum dilatatum</i> (d), <i>P. urvillei</i> (d), <i>Pennisetum thunbergii</i> (d), <i>Schoenoplectus decipiens</i> (d), <i>Scleria dieterlenii</i> (d), <i>Setaria sphacelata</i> (d), <i>Andropogon appendiculatus</i> , <i>A. eucomus</i> , <i>Aristida aequiglumis</i> , <i>Ascolepis capensis</i> , <i>Carex austro-africana</i> , <i>Carex cernua</i> , <i>C. schlechteri</i> , <i>Cyperus cyperoides</i> , <i>C. distans</i> , <i>C. longus</i> , <i>C. marginatus</i> , <i>Echinochloa holubii</i> , <i>Eragrostis micrantha</i> , <i>Ficinia acuminata</i> , <i>Fimbristylis complanata</i> , <i>F.</i>

	<i>ferruginea</i> , <i>Hyparrhenia dregeana</i> , <i>H. quarrei</i> , <i>Ischaemum fasciculatum</i> , <i>Kyllinga erecta</i> , <i>Panicum schinzii</i> , <i>Pennisetum sphacelatum</i> , <i>Pycreus macranthus</i> , <i>P. nitidus</i> , <i>Setaria pallide-fusca</i> , <i>Xyris gerrardii</i> .
Herbs	<i>Centella asiatica</i> (d), <i>Ranunculus multifidus</i> (d), <i>Berkheya radula</i> , <i>B. speciosa</i> , <i>Berula erecta</i> subsp. <i>thunbergii</i> , <i>Centella coriacea</i> , <i>Chironia palustris</i> , <i>Equisetum ramosissimum</i> , <i>Falckia oblonga</i> , <i>Haplocarpha lyrata</i> , <i>Helichrysum difficile</i> , <i>H. dregeanum</i> , <i>H. mundtii</i> , <i>Hydrocotyle sibthorpioides</i> , <i>H. verticillata</i> , <i>Lindernia conferta</i> , <i>Lobelia angolensis</i> , <i>L. flaccida</i> , <i>Marsilea farinosa</i> subsp. <i>farinosa</i> , <i>Mentha aquatica</i> , <i>Monopsis decipiens</i> , <i>Pulicaria scabra</i> , <i>Pycnostachys reticulata</i> , <i>Rorippa fluviatilis</i> var. <i>fluviatilis</i> , <i>Rumex lanceolatus</i> , <i>Senecio inornatus</i> , <i>S. microglossus</i> , <i>Sium repandum</i> , <i>Thelypteris confluens</i> , <i>Wahlenbergia banksiana</i> .
Carnivorous herb	<i>Utricularia inflexa</i> .
Geophytic Herbs	<i>Cordylogyne globosa</i> , <i>Crinum bulbispermum</i> , <i>Gladiolus papilio</i> , <i>Kniphofia ensifolia</i> , <i>K. fluviatilis</i> , <i>K. linearifolia</i> , <i>Neobolusia tysonii</i> , <i>Nerine gibsonii</i> (only in Eastern Cape), <i>Satyrium hallackii</i> subsp. <i>hallackii</i>
Aquatic Herbs	<i>Aponogeton junceus</i> , <i>Ceratophyllum demersum</i> , <i>Lagarosiphon major</i> , <i>L. muscoides</i> , <i>Marsilea capensis</i> , <i>Myriophyllum spicatum</i> , <i>Nymphaea lotus</i> , <i>N. nouchali</i> var. <i>caerulea</i> , <i>Nymphoides thunbergiana</i> , <i>Potamogeton thunbergii</i> .
Endemic Taxa	
Herbs	<i>Disa zuluensis</i> , <i>Kniphofia flammula</i> (northern KwaZulu-Natal), <i>Nerine platypetala</i>
Succulent herb	<i>Crassula tuberella</i>

Remarks

Vegetation patterning in the form of concentric belts ('rings') is often found in pans. Pan size and depth may be a factor limiting vegetation, as large water bodies with shallow water may experience wave action. This limits the presence of species with floating leaves as well as some submerged and marginal macrophytes. The situation is more complex in vleis as these often have variable microtopography and soil types within a single wetland. It is possible for seasonally inundated zones to occur embedded inside the permanently inundated zone of a vlei, if this zone is present.

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

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

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).

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

Vegetation Type	Target (%)	Conserved (%)	Transformed (%)	Conservation status	
				Driver <i>et al.</i> 2005; Mucina <i>et al.</i> , 2006	National Ecosystem List (NEM:BA)
Eastern Highveld Grassland	24	0.3	44	Endangered	Vulnerable
Amersfoort Highveld Clay Grassland	27	0	25	Vulnerable	Not listed
Eastern Temperate Freshwater Wetlands	24	5	15	Least threatened	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, Amersfoort Highveld Clay Grassland as Vulnerable and Eastern Temperate Freshwater Wetlands as Least Threatened.

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 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). Eastern Highveld Grassland covers the eastern two-thirds of the site (Figure 6). Eastern Temperate Freshwater Wetlands are not mapped as occurring on site, but the mapping is at a poor (regional) resolution and all pans and wetlands on site fall within this ecosystem type.

There is an additional listed ecosystem defined under the National Ecosystem List, called Chrissiesmeer Panveld, which is listed as Endangered. This covers more than two-thirds of the site (see Figure 7). It spatially co-incides partially with Eastern Highveld Grassland, but is defined on different criteria.

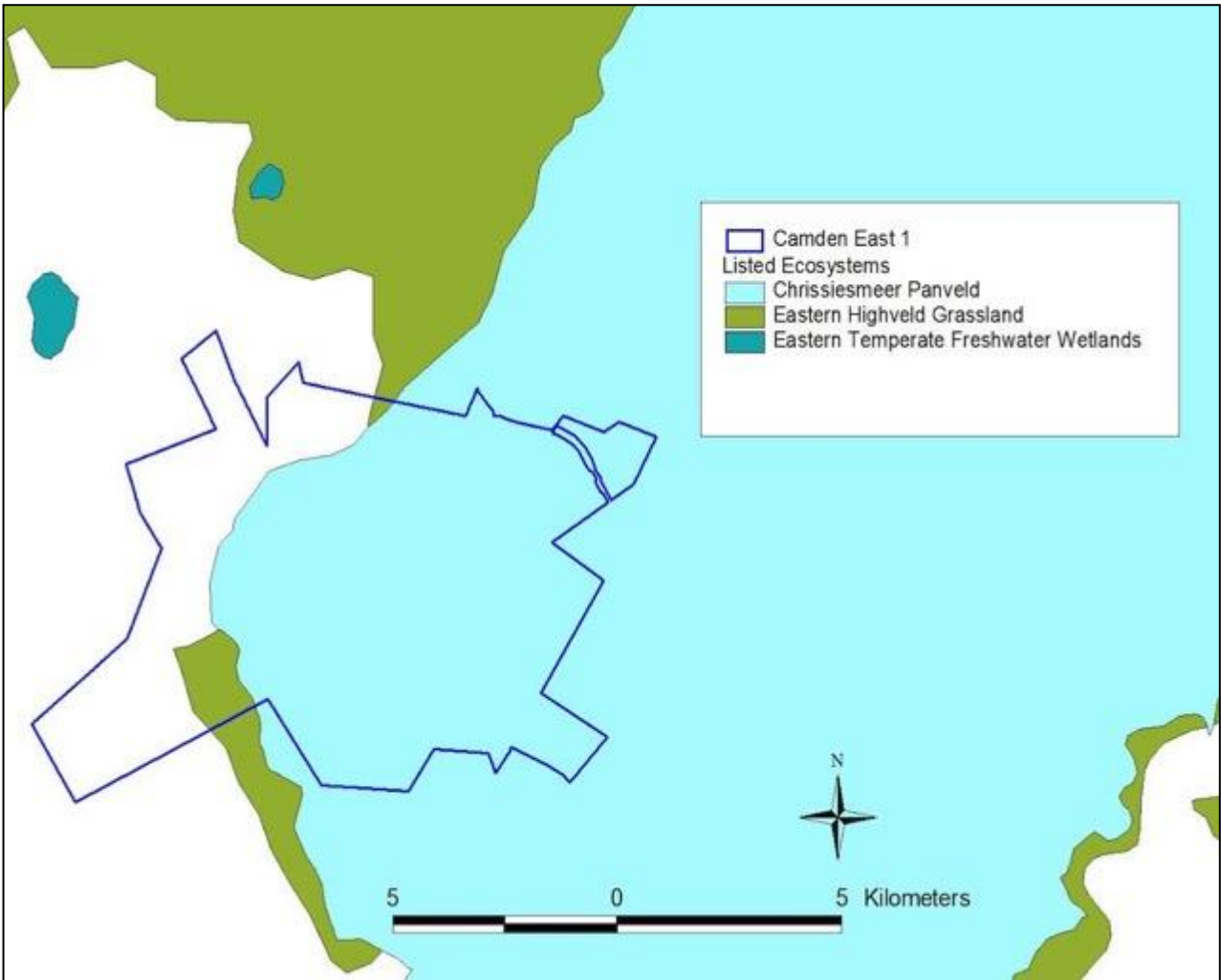


Figure 7: Distribution of listed ecosystems relative to the site.

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.

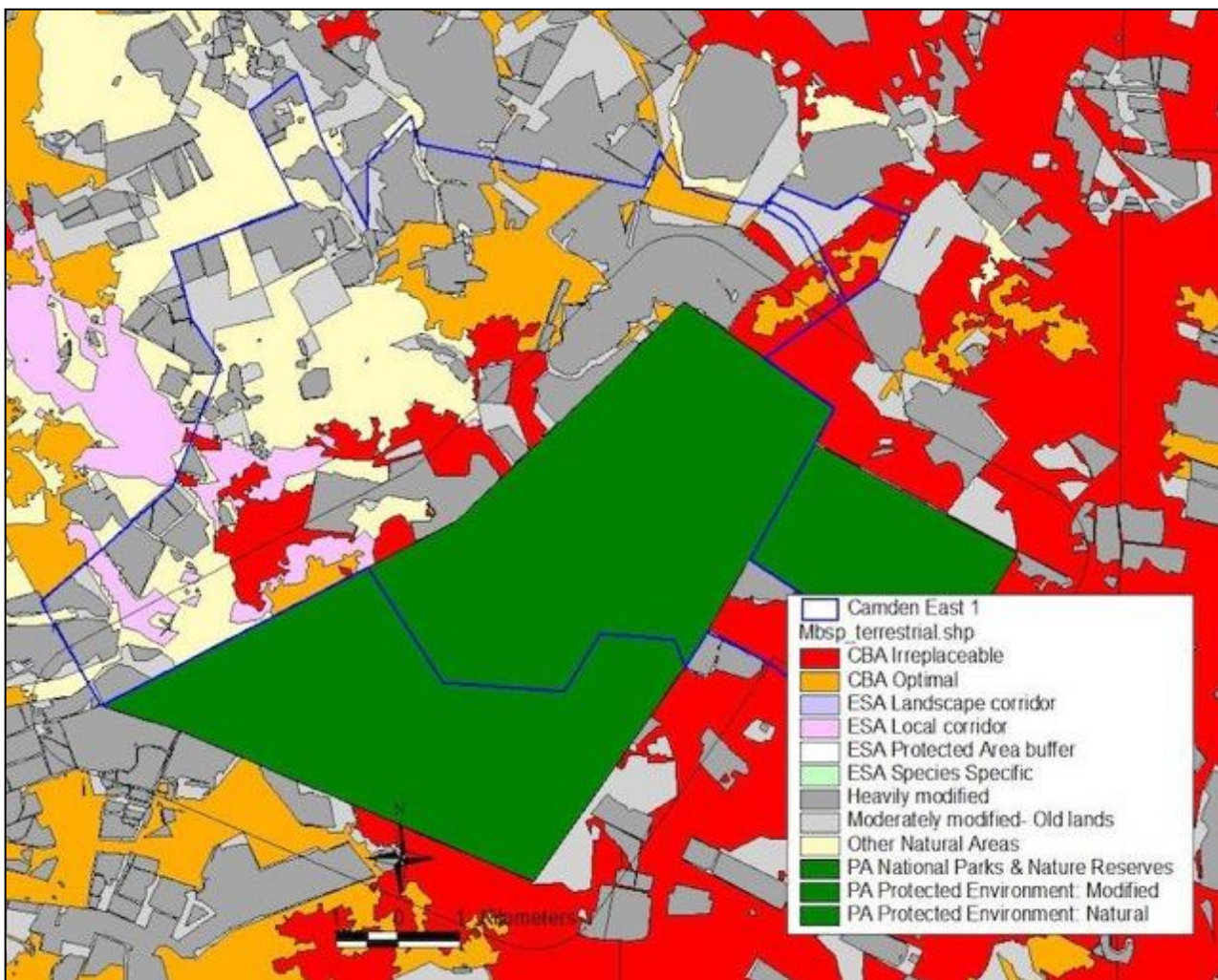


Figure 8: Mpumalanga CBA map for the study area.

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.
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

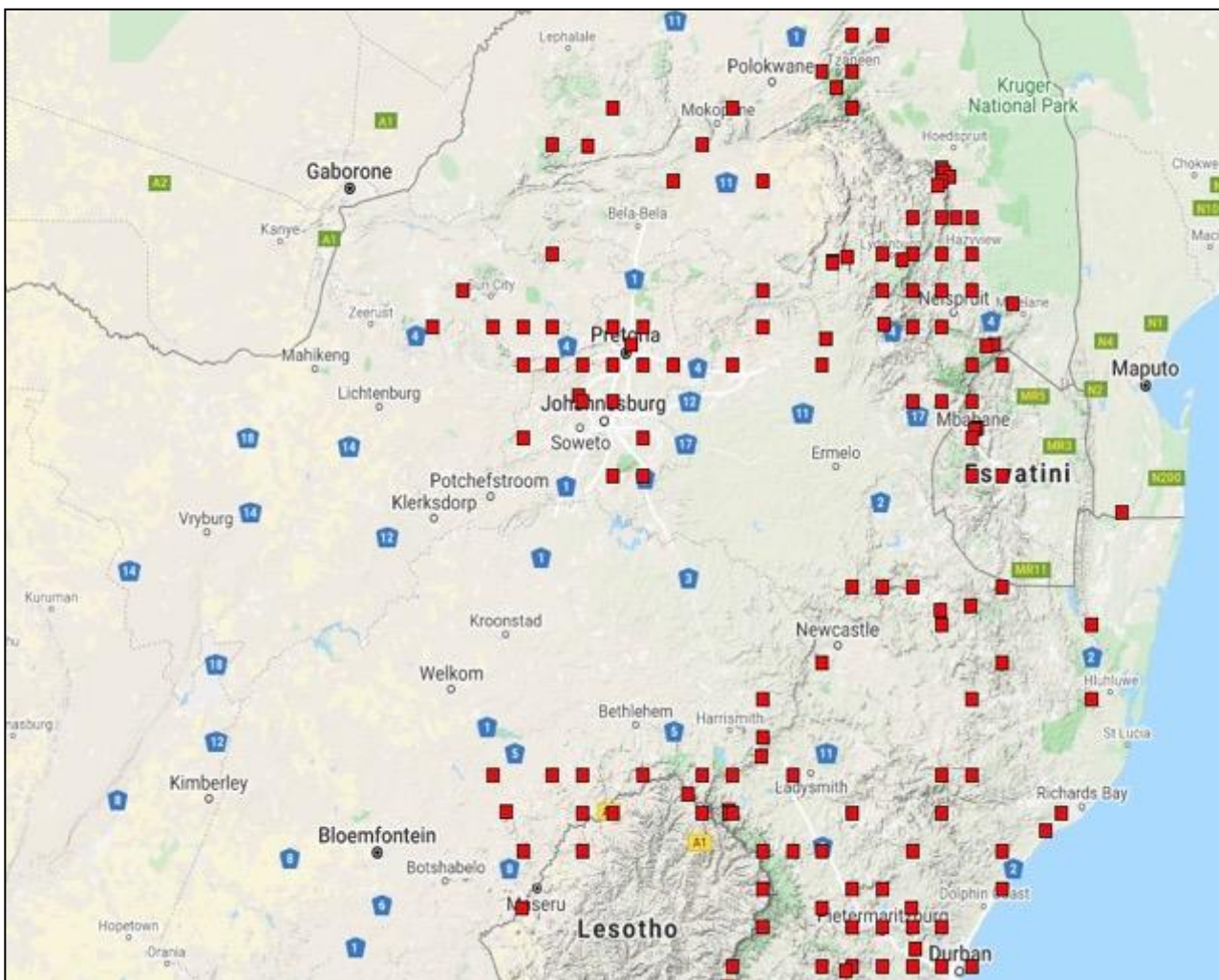


Figure 9: Recorded distribution of *Pittosporum viridiflorum*.

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 occur 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 moist tropical grasslands. They prefer open grassland in good condition containing a mosaic of short grass for feeding and tall grass for feeding and shelter. It has not been recorded in the grid in which the site is located, which is one of a group of grids in south-western Mpumalanga where the species does not appear to occur. Nevertheless, the area is within the overall distribution range of the species. Based on the gap in the distribution of the species, there is a low likelihood that it could occur on site within any suitable habitat. **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 armadillo, 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 km² and females 20 km². 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 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.**

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 east. There are historical records for an adjacent grid to the south-west, but it has not been recorded from the current grid. There is therefore a medium probability of the study area being suitable for this species. **It is considered possible that it could occur on site and individuals could be affected by construction activities, if suitable habitat is damaged.**

White-tailed Rat

The White-tailed Rat (*Mystromys albicaudatus*), listed as Vulnerable, is endemic to South Africa and Lesotho, where it is found primarily in Highveld grasslands, but extending into adjacent Fynbos and Karoo areas. It is terrestrial, but never found in soft, sandy substrates, rocks, wetlands or river banks, and do not occur in transformed habitat. The study area is on the edge of the known distribution of this species, with most of Mpumalanga appearing to be a "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
<i>Ourebia ourebi</i>	Oribi	Endangered	Low
<i>Pelea capreolus</i>	Grey Rhebok	Near Threatened, protected	Medium
<i>Felis nigripes</i>	Black-footed Cat	Vulnerable, protected	High
<i>Panthera pardus</i>	Leopard	Vulnerable, protected	Low
<i>Aonyx capensis</i>	Cape Clawless Otter	Near Threatened, protected	Medium
<i>Hydrictus maculicollis</i>	Spotted-necked Otter	Vulnerable, protected	Medium
<i>Poecilogale albinucha</i>	African Striped Weasel	Near Threatened	Medium
<i>Parahyaena brunnea</i>	Brown hyaena	Near Threatened	Low
<i>Atelerix frontalis</i>	South African Hedgehog	Near Threatened, protected	High
<i>Crocidura maquassiensis</i>	Maquassie Musk Shrew	Vulnerable	Low
<i>Crocidura mariquensis</i>	Swamp Musk Shrew	Near Threatened	High
<i>Amblysomus septentrionalis</i>	Highveld Golden Mole	Near Threatened	Medium
<i>Mystromys albicaudatus</i>	White-tailed Rat	Vulnerable	Low
<i>Otomys auratus</i>	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 north-east, although not from the current grid. There is therefore a moderate to low probability of the study area being suitable for this species, including suitable habitat within the project area. **It is considered a low likelihood that it could occur on site 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	Likelihood of occurrence
<i>Chamaesaura aenea</i>	Coppery grass lizard	Near Threatened	Medium to High
<i>Chamaesaura macrolepis</i>	Large-scaled Grass Lizard	Near Threatened	Low
<i>Tetradactylus breyeri</i>	Breyer's Long-tailed Seps	Vulnerable	Low
<i>Homoroselaps dorsalis</i>	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
<i>Pyxicephalus adspersus</i>	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.

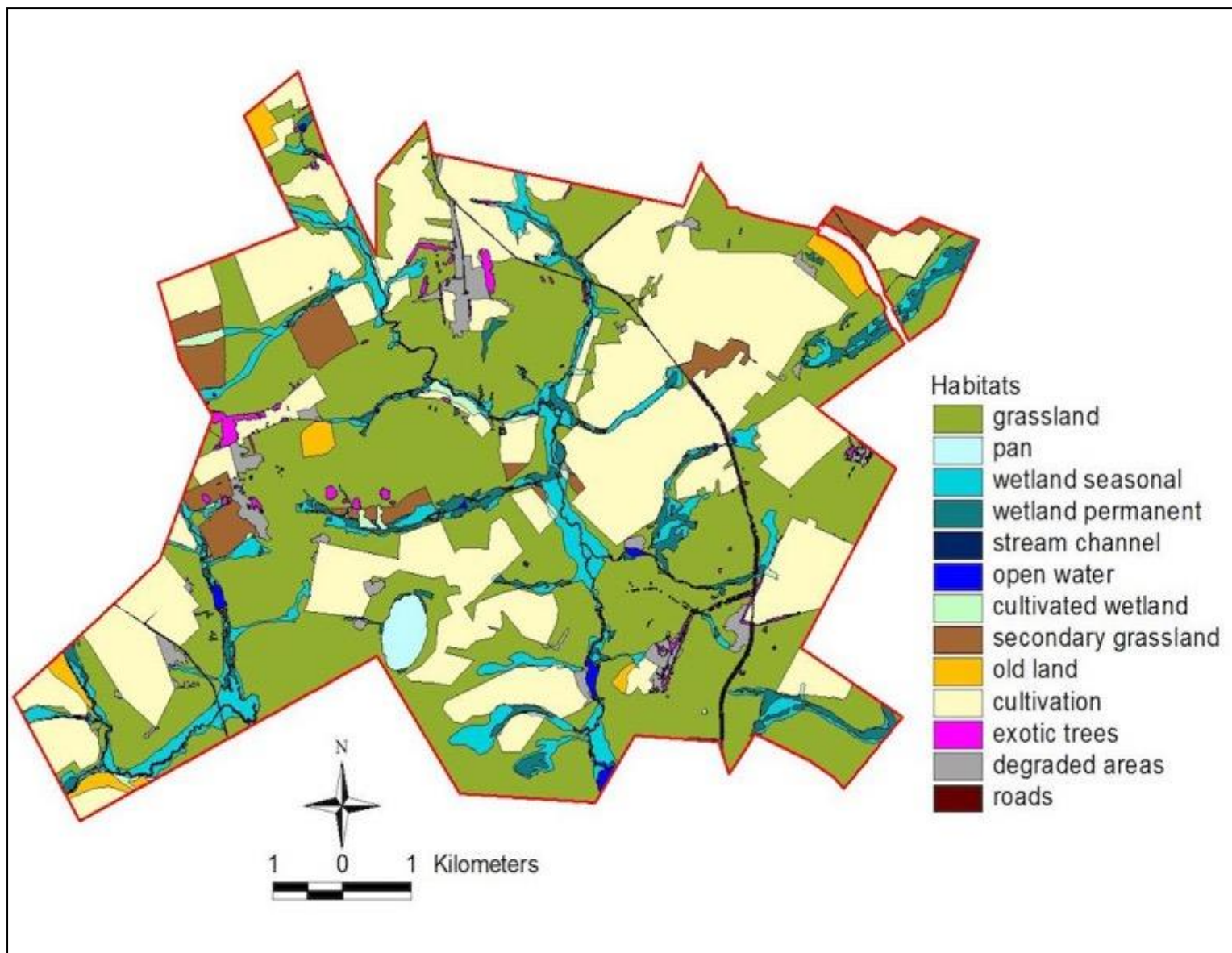


Figure 10: Main habitats of the study area.

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*, *Bewisia biflora*, *Brachiaria serrata*, *Diheteropogon amplexans*, *Elionurus muticus*, *Eragrostis capensis*, *Eragrostis chloromelas*, *Eragrostis plana*, *Eragrostis racemosa*, *Harpochloa falx*, *Heteropogon contortus*, *Microchloa caffra*, *Panicum natalense*, *Setaria sphacelata* var. *torta*, *Themeda triandra*, and *Tristachya leucothrix*, and the forbs, *Acalypha angustata*, *Anthospermum rigidum* subsp. *rigidum*, *Berkheya setifera*, *Chaetacanthus costatus*, *Commelina africana*, *Crabbea acaulis*, *Cucumis hirsutus*, *Cucumis zeyheri*, *Cyanotis speciosa*, *Gerbera viridifolia*, *Haplocarpha scaposa*, *Helichrysum rugulosum*, *Hemizygia pretoriae*, *Hermannia transvaalensis*, *Hibiscus aethiopicus*, *Hypoxis obtusa*, *Hypoxis rigidula*, *Indigofera comosa*, *Ipomoea ommaneyi*, *Justicia anagalloides*, *Kohautia amatymbica*, *Ledebouria ovatifolia*, *Monsonia attenuata*, *Nidorella hottentotta*, *Pentanisia angustifolia*, *Pollichia campestris*, *Scabiosa columbaria*, *Selago densiflora*, *Seriphium plumosum*, *Vernonia galpinii*, *Vernonia oligocephala*, and *Zornia milneana*. Overall diversity in this unit was high and included a full list of over 100 species. Local species richness was also high at 56 species per 400m² 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 hydrological 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 ecological and biodiversity sense, and it is not possible to restore grassland to a natural state after they have been disturbed. They should therefore be treated as sensitive and all efforts made to minimize impacts on any area of grassland. If possible, the footprint of any proposed infrastructure should be kept to a minimum within any 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	Sensitive features	Restrictions
LOW	<ul style="list-style-type: none"> • None 	<ul style="list-style-type: none"> • None
MEDIUM-LOW	<ul style="list-style-type: none"> • None 	<ul style="list-style-type: none"> • None
MEDIUM	<ul style="list-style-type: none"> • Wetlands (disturbed) 	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> Grasslands 	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> CBA areas 	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Wetlands 	<ul style="list-style-type: none"> Avoid, if possible If unavoidable, restrictions according to National Water Act Apply mitigation measures to minimize impacts

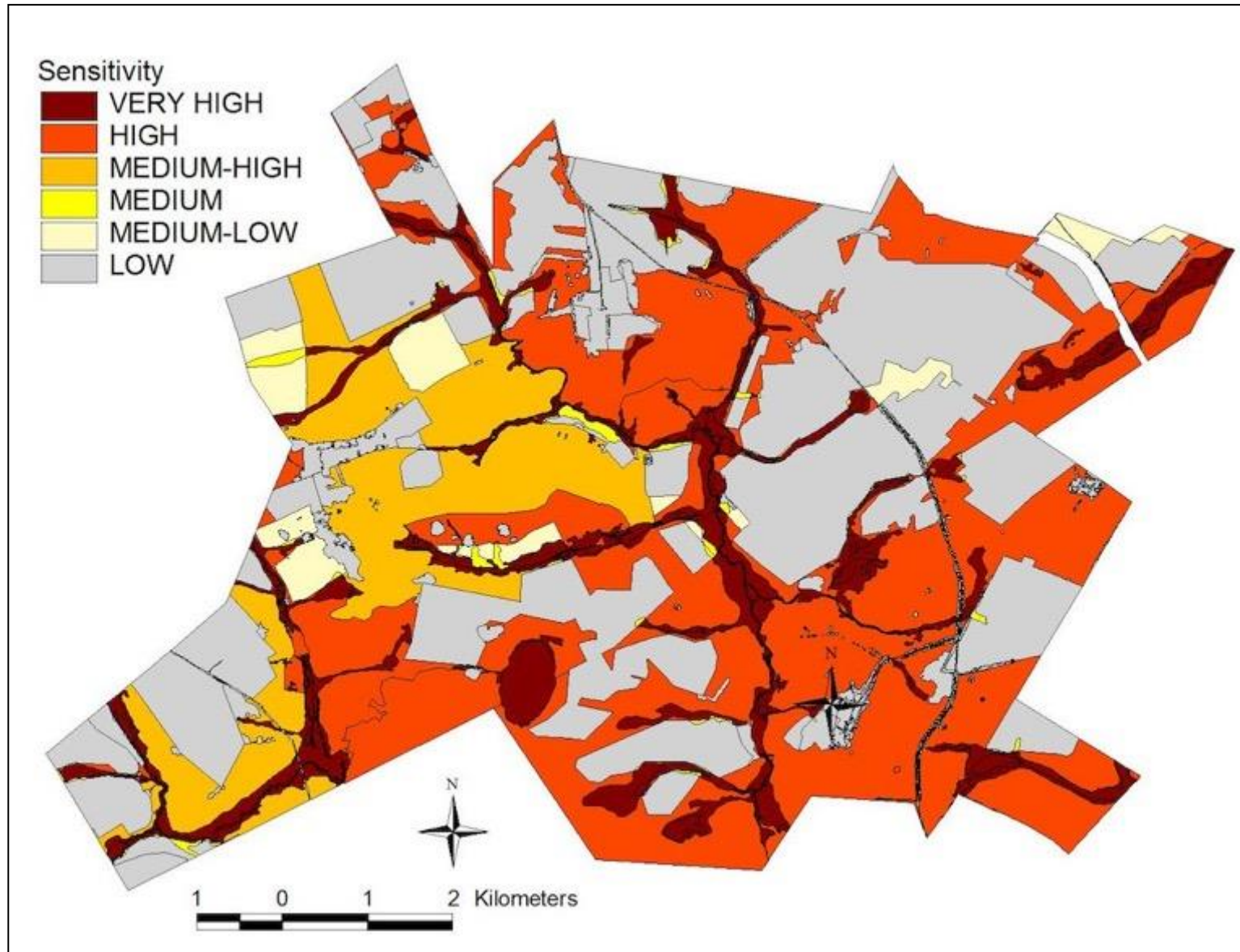


Figure 14: Habitat sensitivity of the study area, including CBAs.

POSSIBLE IMPACTS

Proposed infrastructure in relation to sensitivities

The proposed infrastructure includes the following:

WTGs x 47

These are located within grassland and cultivated areas. They therefore affect areas either with HIGH sensitivity (within CBA1 areas), MEDIUM-HIGH sensitivity (outside CBA1 areas), or areas with LOW sensitivity (within cultivated lands).

Construction camp and batching plants

This is located within a natural grassland area. It therefore affects an area with HIGH sensitivity.

SS & BESS (2 alternative sites)

Both of these alternatives occur within natural grassland areas where there is a small amount of wetland. They therefore both affect areas with HIGH and VERY HIGH sensitivity.

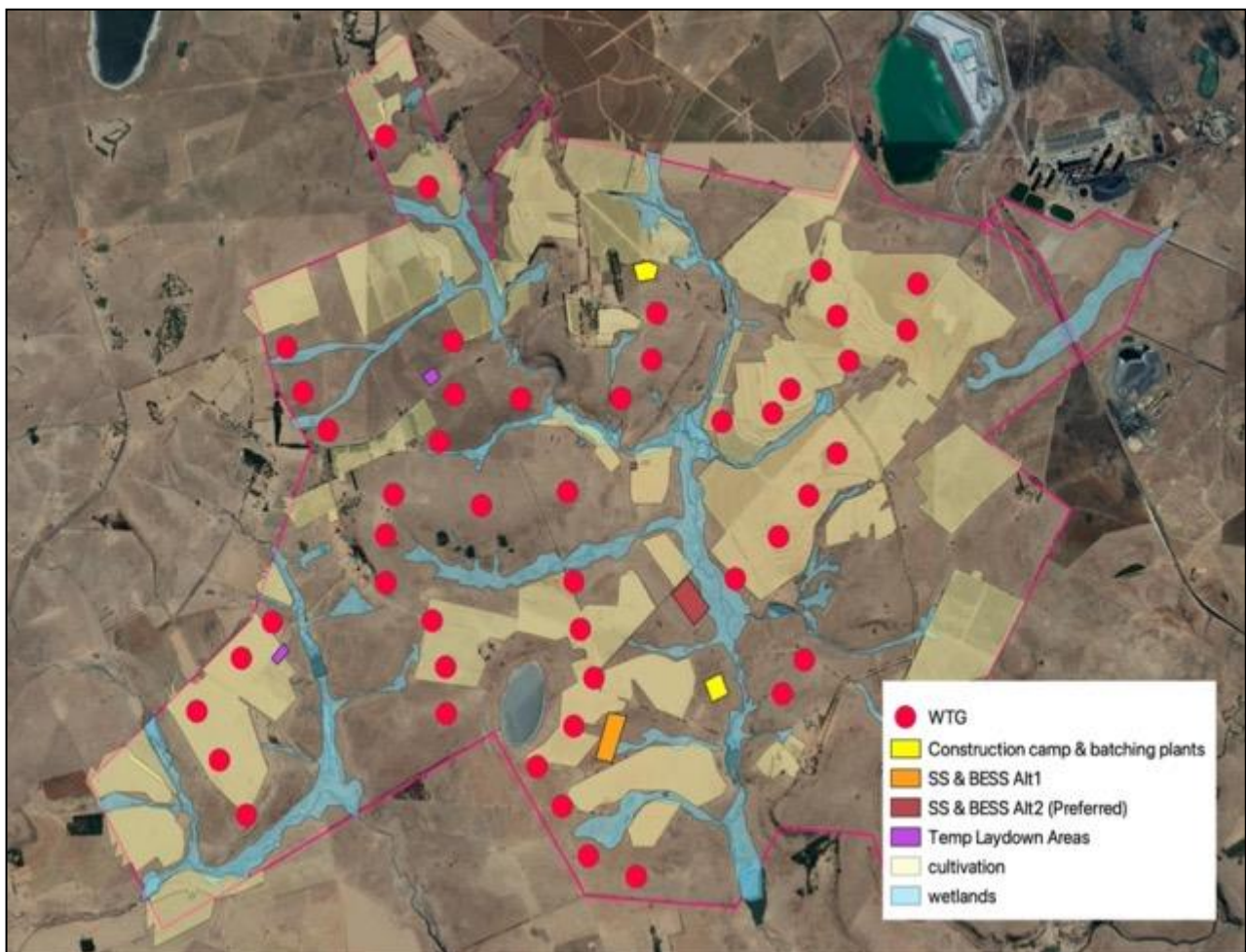


Figure 15: Location of proposed infrastructure relative to wetlands and cultivated areas.

Temporary laydown areas x 2.

The northern temporary laydown area is within a natural grassland area. It therefore affects an area with HIGH sensitivity. The southern temporary laydown area is within a cultivated area and therefore affects an area with LOW sensitivity.

Internal road infrastructure

No internal road infrastructure has been provided, but this is potentially the infrastructure component with the largest footprint, in terms of effects on natural habitat. Based on the location of WTGs, these roads are likely to traverse habitat in HIGH and VERY HIGH sensitivity classes.

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. Two of the three regional vegetation types that occur on site, Eastern Highveld Grassland and Eastern Temperate Freshwater Wetlands, are listed as Vulnerable in the National List of Ecosystems that are Threatened and need of protection (GN1002 of 2011), published under the National Environmental Management: Biodiversity Act (Act No. 10, 2004). The third vegetation type that occurs on site, Amersfoort Highveld Clay Grassland, is not listed. 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 part of the 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 some 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 the proposed location of infrastructure.** It is therefore important that the infrastructure be located to minimise impacts on sensitive receptors and 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 scree, 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.		
<i>Merwillia plumbea</i> 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
<i>Miraglossum davyi</i> APOCYNACEAE	Vulnerable	Dullstroom, Middelburg and Standerton. Grassland (Lydenburg Montane Grassland, Soweto Highveld Grassland, Eastern Highveld Grassland).		HIGH
<i>Nerine gracilis</i> AMARYLLIDACEAE	Vulnerable	Free State, Gauteng, Mpumalanga, North West. Belfast and Ermelo to Wolmaransstad. Undulating grasslands in damp areas.		HIGH
<i>Pachycarpus suaveolens</i> 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
<i>Riocreuxia aberrans</i> 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	Azelia quanzensis
Balanites subsp. maughamii	Barringtonia racemosa
Boscia albitrunca	Brachystegia spiciformis
Breonadia salicina	Bruguiera gymnorhiza
Cassipourea swaziensis	Catha edulis
Ceriops tagal	Cleistanthus schlechteri var. schlechteri
Colubrina nicholsonii	Combretum imberbe
Curtisia dentata	Elaeodendron (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 observations verified by an online community.

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

Acanthaceae

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

Achariaceae

Ceratiosicyos laevis
Kiggelaria africana

Agapanthaceae

Agapanthus inapertus subsp. *intermedius*

Agavaceae

Chlorophytum comosum
Chlorophytum cooperi
Chlorophytum fasciculatum
Chlorophytum galpinii

Aizoaceae

Delosperma sutherlandii
Khadia carolinensis
Mossia intervallaris
Ruschia sp.

Alliaceae

Tulbaghia acutiloba
Tulbaghia cernua
Tulbaghia leucantha
Tulbaghia ludwigiana

Amaranthaceae

Amaranthus hybridus subsp. *cruentus*; *Naturalised*
Amaranthus hybridus subsp. *hybridus* var. *hybridus*; *Naturalised*
Amaranthus thunbergii
Chenopodium album; *Naturalised*
Cyathula cylindrica var. *cylindrica*
Cyathula uncinulata
Gomphrena celosioides; *Naturalised*

Guilleminea densa; Naturalised; Invasive

Amaryllidaceae

Boophone disticha

Brunsvigia natalensis

Brunsvigia radulosa

Crinum bulbispermum

Cyrtanthus breviflorus

Cyrtanthus stenanthus var. *major*

Cyrtanthus tuckii var. *transvaalensis*

Cyrtanthus tuckii var. *tuckii*

Haemanthus humilis subsp. *hirsutus*

Haemanthus montanus

Nerine angustifolia

Nerine gracilis

Nerine krigei

Nerine rehmannii

Scadoxus puniceus

Anacardiaceae

Ozoroa engleri

Searsia dentata

Searsia discolor

Searsia magalismontana subsp. *magalismontana*

Searsia rigida var. *rigida*

Searsia tumulicola var. *tumulicola*

Apiaceae

Afroscidium 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 carnosus
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 arabis

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 parvinox
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.
Merwillia 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

Crocasmia 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 ocyimifolia var. *raineriana*

Mentha aquatica
Ocimum obovatum subsp. *obovatum* var. *obovatum*
Platostoma rotundifolium
Pycnostachys reticulata
Rothea hirsuta
Salvia aurita var. *galpinii*
Salvia repens var. *repens*
Salvia runcinata
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*

Melanthaceae

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 amplexans var. *amplexans*
Echinochloa crus-galli
Ehrharta erecta var. *natalensis*
Eleusine coracana subsp. *africana*
Elionurus muticus
Enneapogon scoparius
Eragrostis caesia
Eragrostis capensis
Eragrostis chloromelas
Eragrostis cilianensis
Eragrostis curvula
Eragrostis gummiflua
Eragrostis lappula
Eragrostis lehmanniana var. *chaunantha*
Eragrostis lehmanniana var. *lehmanniana*
Eragrostis mexicana subsp. *virescens*; *Naturalised*
Eragrostis obtusa
Eragrostis patentissima
Eragrostis plana
Eragrostis planiculmis
Eragrostis racemosa
Eragrostis remotiflora
Eragrostis sclerantha subsp. *sclerantha*
Eragrostis 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*
Hypparrhenia anamesa
Hypparrhenia dregeana
Hypparrhenia hirta
Hypparrhenia 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 gracilentata
Polygala hottentotta
Polygala krumanina
Polygala ohlendorffiana
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 elaeagnifolium; Naturalised; Invasive, NEMBA Category 1b
Solanum humile
Solanum lichtensteinii
Solanum panduriforme
Solanum retroflexum
Solanum sisymbriifolium; Naturalised; Invasive, NEMBA Category 1b

Thymelaeaceae

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

Typhaceae

Typha capensis

Valerianaceae

Valeriana capensis var. *capensis*

Verbenaceae

Chascanum latifolium var. *transvaalense*
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

^NBlack wildebeest

Blue wildebeest

Blesbok

Plains zebra

Klipspringer

^NOribi EN

Grey rhebok NT

Warthog

Bushpig

Steenbok

Mountain reedbuck

Common duiker

Eland

Bushbuck

PERRISODACTYLA:

Rhinocerotidae:

^NWhite rhinoceros

HYRACOIDEA:

Procaviidae:

Rock hyrax

CARNIVORA:

Felidae:

Caracal

^NBlack-footed cat VU

African wild cat

^NServal

^NLeopard VU

Mustelidae:

^NCape clawless otter NT

Striped polecat

^NSpotted-necked otter NT

^NHoney badger

African striped weasel NT

Herpestidae:

Water mongoose

Yellow mongoose

Slender mongoose

Dwarf mongoose

Banded mongoose

White-tailed mongoose

Suricate

Canidae:

Black-backed jackal

^NCape fox

Viveridae:

Small-spotted genet

Large-spotted genet

Hyaenidae:

^NBrown hyaena NT

Aardwolf

INSECTIVORA:

Eulipotyphla:

^NSouth 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
^NGiant 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	<i>Loxodonta africana</i>
All species of rhinoceros	All species of the Family Rhinocerotidae

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

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

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

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

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

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

All species of impala lilies	All species of the Genus 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
Diaphanathe 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
Merwillia 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.

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

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

1 February 1998 – 30 November 2004, Researcher, Agricultural Research Council, Range and Forage Institute, Private Bag X05, Lynn East, 0039. Duties: project management, general vegetation ecology, remote sensing image processing.

Experience as consultant

Ecological consultant since 1995. Author of over 380 specialist ecological consulting reports. Wide experience in ecological studies within grassland, savanna and fynbos, as well as riparian, coastal and wetland vegetation.

Publication record:

Refereed scientific articles (in chronological order):

Journal articles:

- HOARE, D.B.** & BREDEKAMP, 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, BREDEKAMP, 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.** & BREDEKAMP, 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., BREDEKAMP, 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., BREDEKAMP, 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 palaeontological hypotheses on vegetation distributions*; Paper presentation, Randse Afrikaanse Universiteit postgraduate symposium, 1997
- HOARE, D.B., VICTOR, J.E. & BREDENKAMP, G.J. *Historical and ecological links between grassy fynbos and afro-montane fynbos in the Eastern Cape*; Paper presentation, South African Association of Botanists Annual Congress, Cape Town, January 1998
- LUBKE, R.A., HOARE, D.B., VICTOR, J.E. & KETELAAR, R. *The habitat of the Brenton Blue Butterfly*. Paper presentation, South African Association of Botanists Annual Congress, Cape Town, January 1998
- HOARE, D.B. & PANAGOS, M.D. *Satellite stratification of vegetation – structure or floristic composition?* Poster presentation at the 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, VIth International Rangeland Congress, 26 July – 1 August 2003, Durban South Africa.
- VIIth International Rangeland Congress, 26 July – 1 August 2003, Durban South Africa.
- BioMap workshop, Stellenbosch, March 2002 to develop strategies for studying vegetation dynamics of Namaqualand using remote sensing techniques
- South African Association of Botanists Annual Congress, Grahamstown, January 2002.
- 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.