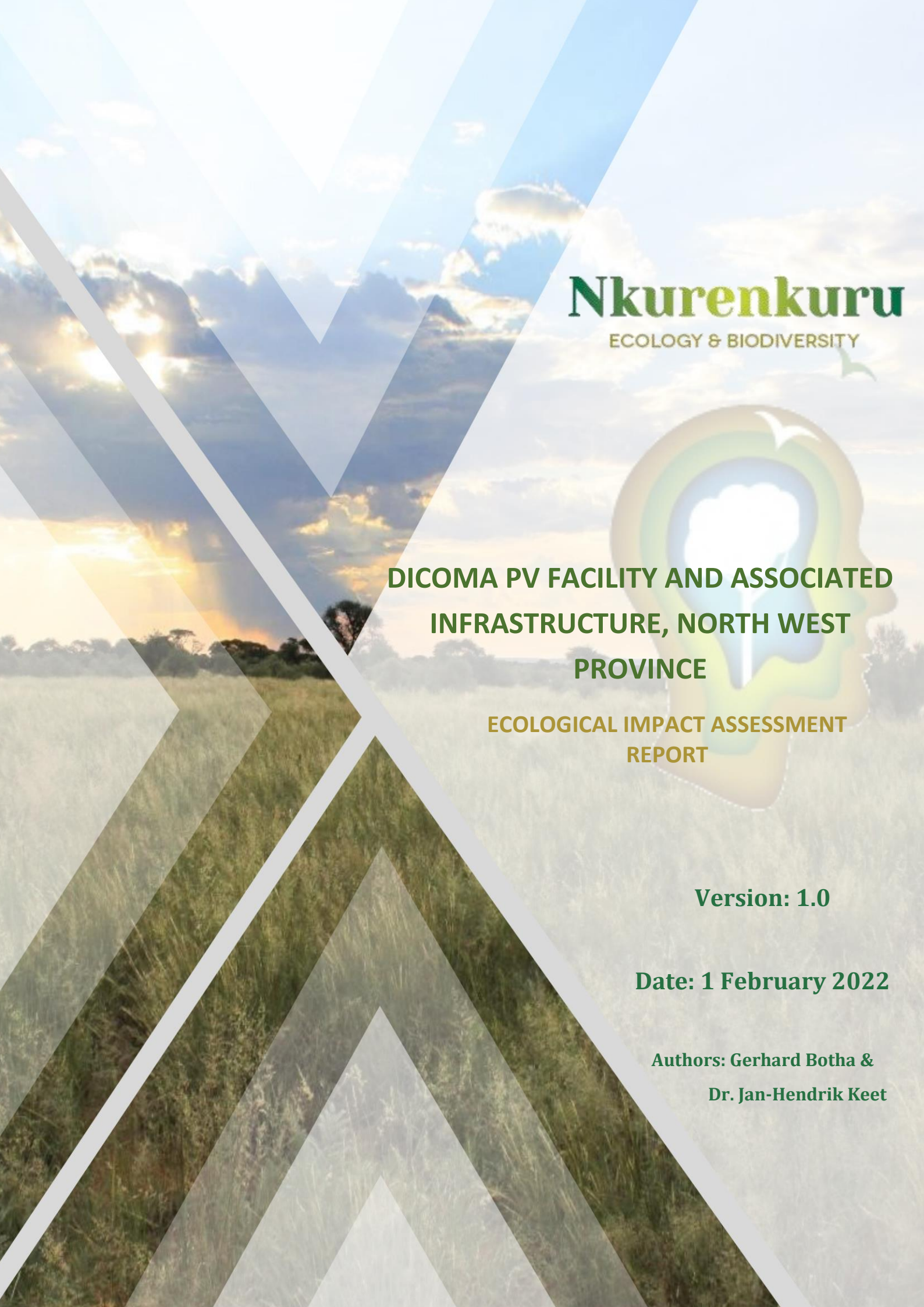

Nkurenkuru
ECOLOGY & BIODIVERSITY

DICOMA PV FACILITY AND ASSOCIATED INFRASTRUCTURE, NORTH WEST PROVINCE

ECOLOGICAL IMPACT ASSESSMENT REPORT

Version: 1.0

Date: 1 February 2022

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Report Title: Dicoma PV facility and associated infrastructure, North West Province.

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I. DECLARATION OF CONSULTANT INDEPENDENCE

The consultants hereby declare that they:

- act/ed as the independent specialists in this application;
- regard the information contained in this report as it relates to specialist input/study to be true and correct at the time of publication;
- do not, and will not, have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA Environmental Impact Assessment Regulations, 2014, and any specific environmental management Act;
- do not, and will not, have any vested interest(s) in the proceedings of the proposed activities;
- have disclosed, to the applicant, EAP, and competent authority(-ies), any information that have, or may have, the potential to influence the decision of the competent authority(-ies) or the objectivity of any report, plan, or document required in terms of the NEMA Environmental Impact Assessment Regulations 2014, and any specific environmental management Act;
- are fully aware of, and meet, the responsibilities in terms of the NEMA Environmental Impact Assessment Regulations 2014 (specifically in terms of regulation 13 of GN No. R. 326), and any specific environmental management Act, and that failure to comply with these requirements may result in disqualification;
- have provided the competent authority(-ies) with access to all necessary information at their disposal at the time of publication regarding the application, whether such information is favourable to the applicant or not; and
- are aware that a false declaration is an offense in terms of regulation 48 of GN No. R. 326.

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February 2022

II. STATEMENT OF WORK

» This study has been executed in accordance with and meet the responsibilities in terms of:
  - NEMA, the Environmental Impact Assessment Regulations, 2014 (specifically in terms of regulation 13 of GN No. R. 326);
  - 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:
    - 3(c): Protocol for the assessment and reporting of environmental impacts on terrestrial animal species.
    - 3(d): Protocol for the assessment and reporting of environmental impacts on terrestrial plant species.

REPORT AUTHORS:

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February 2022

Jan-Hendrik Keet

February 2022

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1. INTRODUCTION

1.1. Applicant

Dicoma PV (Pty) Ltd.

1.2. Project

Savannah Environmental (Pty) Ltd. on behalf of Dicoma PV (Pty) Ltd.

1.3. Proposed Activity

The Applicant, Dicoma PV (Pty) Ltd, is proposing the construction of a photovoltaic (PV) solar energy facility (known as the Dicoma PV facility) located on a site approximately 5km north west of the town of Lichtenburg in the North West Province (Figure 1). The solar PV facility will comprise several arrays of PV panels and associated infrastructure and will have a contracted capacity of up to 75MW. The development area is situated within the Ditsobotla Local Municipality within the Ngaka Modiri Molema District Municipality. The site is accessible via an existing gravel road which provides access to the development area off the R505, located east of the development area.

The development area for the PV facility will be located on the following properties:

- Portion 1 of the Farm Houthaalboomen 31;
- Portion 9 of the Farm Houthaalboomen 31; and
- Portion 10 of the Farm Houthaalboomen 31

Two additional 75MW PV facilities (Barleria PV and Setaria PV) are concurrently being considered on the project site (within Portion 1, Portion 9, and Portion 10 of the Farm Houthaalboomen 31) and are assessed through separate Environmental Impact Assessment (EIA) processes.

A facility development area (approximately 180ha) as well as two alternative grid connection solutions (within a 100m wide corridor) have been considered in the Scoping phase.

The infrastructure associated with this 75MW PV facility includes:

- PV modules and mounting structures
- Inverters and transformers
- Battery Energy Storage System (BESS)
- Site and internal access roads (up to 8m wide)

- » Site offices and maintenance buildings, including workshop areas for maintenance and storage.
- » Temporary and permanent laydown area
- » Grid connection solution (two alternative locations assessed) within a 100m wide corridor, including:

    - 33kV cabling between the project components and the facility substation
    - A 132kV facility substation
    - A 132kV Eskom switching station
    - A Loop-in-Loop out (LILO) overhead 132kV power line between the Eskom switching station and the existing Delareyville Munic–Watershed 1 88kV power line.

The alternative grid connection configurations assessed include (Figure 1):

Grid Connection Alternative 1: 33kV MV cabling will connect the Dicoma PV solar array to the 132kV facility substation. The 132kV Eskom switching station is located directly adjacent to the development footprint of the facility substation. The facility substation and Eskom switching station are located approximately 1.3km east of the Dicoma PV facility on Portion 1 of the Farm Houthaalboomen 31. A 132kV Loop-in-Loop Out power line from the Eskom switching station will connect into the Delareyville Munic–Watershed 1 88kV. The grid connection infrastructure is located within an assessment corridor of 100m wide.

Grid Connection Alternative 2: 33kV MV cabling will connect the Dicoma PV solar array to the 132kV facility substation. The 132kV Eskom switching station is located directly adjacent to the development footprint of the facility substation. The facility substation and Eskom switching station are located within the development footprint of the Dicoma PV facility on Portion 1 of the Farm Houthaalboomen 31. A 132kV Loop-in-Loop Out power line from the Eskom switching station will connect into the Delareyville Munic–Watershed 1 88kV. The grid connection infrastructure is located within an assessment corridor of 100m wide.

The grid connection infrastructure is proposed on the following properties:

- » Portion 1 of the Farm Houthaalboomen 31;
- » Portion 0 of Farm Talene 25; and
- » Portion 7 of Farm Elandsfontein 34

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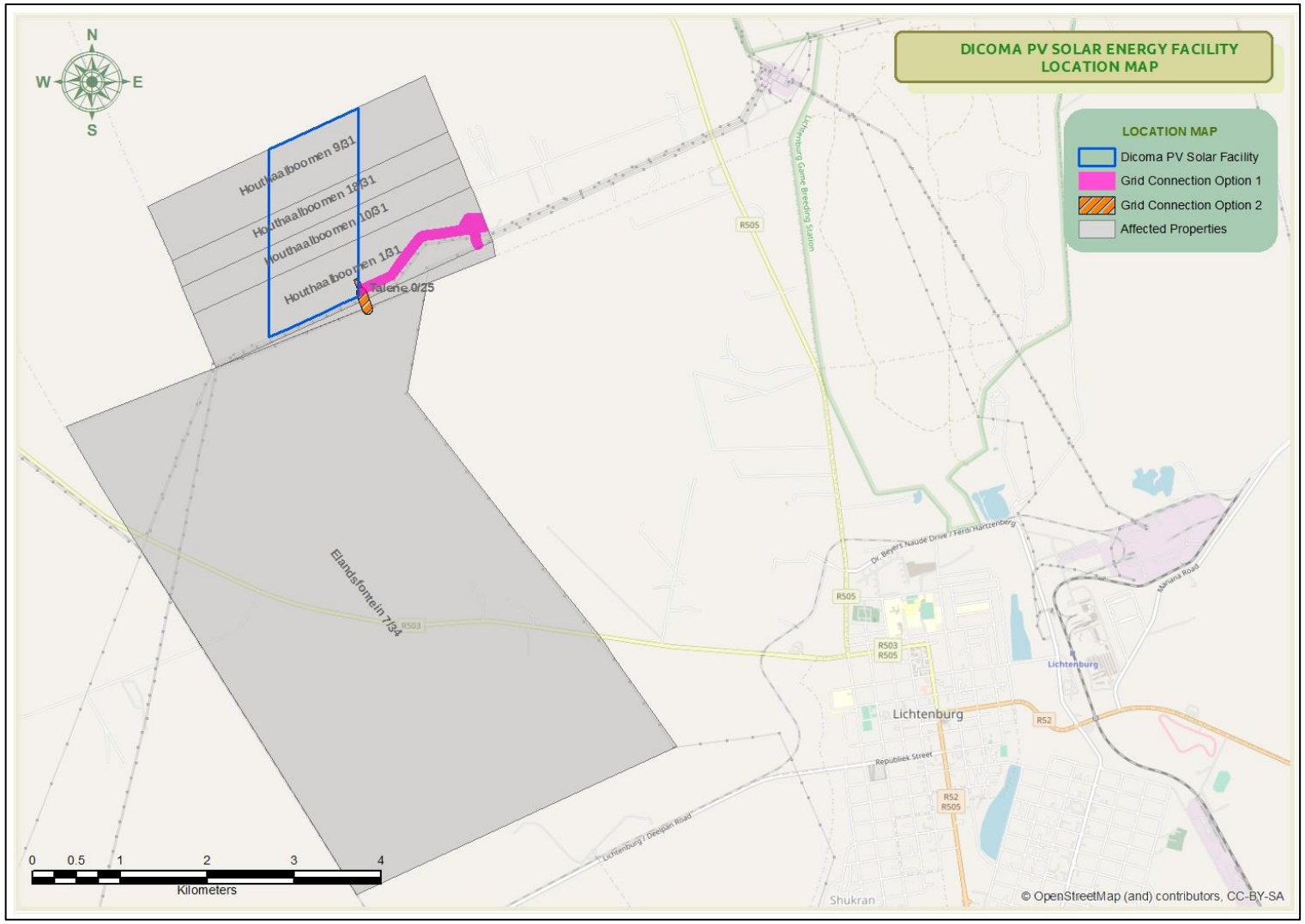

Figure 1: Proposed location of the Dicoma PV Solar Energy Facility.

1.4. Terms of Reference (ToR)

To conduct a detailed site terrestrial biodiversity sensitivity and impact assessment, including the following:

- Desktop analysis;
- On-site investigation;
- Detailed compilation of an ecological impact assessment report which adheres to the following (this list is not exhaustive):

    - An Ecological Sensitivity and Impact report meeting the requirements for environmental themes in terms of section 24(5)(a) and (h) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA, 2020)[1];
    - Identification of any discrepancies with the environmental sensitivity as identified on the national web based environmental screening tool;
    - Refine / confirm the delineation of the CBA;
    - Identification of sensitive areas to be avoided (including corresponding spatial data);
    - Identification of sensitive species (Species of Conservation Concern and Protected Species) that occur on site;
    - An assessment of all potential impacts associated with the development, including impact significance ratings;
    - Recommendations regarding potential development areas for solar PV within the project site (including acceptable footprint limit); and
    - Recommendations regarding the scope and timeframe for further assessment.

1.5. Conditions of this Report

Findings, recommendations and conclusions provided in this report are based on the authors' best scientific and professional knowledge and information available at the time of compilation. No form of this report may be amended or extended without the prior written consent of the author. Any recommendations, statements or conclusions drawn from or based on this report must clearly cite or make reference to this report. Whenever such recommendations, statements or conclusions form part of a main report relating to the current investigation, this report must be included in its entirety.

[1] During a pre-screening site visit/survey, it determined that no wetland/aquatic features were present within 500m of the development footprint, and subsequently no such features will be impacted by the development. As such there are no need for a Freshwater Resource Study and Assessment during the EIA phase. All other ecological features that may potentially be impacted by the proposed development have been addressed within this report.

1.6. Relevant Legislation

The following legislation was taken into account whilst compiling this report:

1.6.1. Provincial

The Transvaal Nature Conservation Ordinance (No. 12 of 1983) in its entirety, with special reference to:

- Schedule 2: Protected Game
- Schedule 3: Specially Protected Game
- Schedule 4: Protected Wild Animals
- Schedule 5: Wild Animals
- Schedule 7: Invertebrates
- Schedule 11: Protected Plants
- Schedule 12: Specially Protected Plants

The Bophuthatswana Nature Conservation Act (Act 3 of 1973) in its entirety, with special reference to:

- Schedule 1: Protected Game
- Schedule 1A: Specially Protected Game
- Schedule 2: Ordinary Game
- Schedule 3: Wild Animals in Respect Of Which The Provision Of Section 3 (a) (ii) Apply
- Schedule 4: Wild Animals To Which The Provisions Of Section 4 (1) (b) Do Not Apply
- Schedule 7: Protected Plants
- Schedule 7: Specially Protected Plants

The above-mentioned Nature Conservation Acts are regarded by North West Provincial Legislature, as the legally binding provincial document, providing regulations, guidelines, and procedures for the sustainable utilisation of wild animals, aquatic biota and plants, the implementation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, and also, the general conservation of flora and fauna, and the destruction of problematic (vermin and invasive) species.

1.6.2. National

» National Environmental Management Act / NEMA (Act No 107 of 1998), and all amendments and supplementary listings and/or regulations.
» Environment Conservation Act (ECA) (No 73 of 1989) and amendments.
» National Environmental Management Act: Biodiversity Act / NEMA:BA (Act No. 10 of 2004) and amendments.

- National Forest Act 1998 / NFA (No 84 of 1998).
- National Veld and Forest Fire Act (Act No. 101 of 1998).
- Conservation of Agricultural Resources Act / CARA (Act No. 43 of 1983) and amendments.

1.6.3. International

- Convention on International Trade in Endangered Species of Fauna and Flora (CITES; https://cites.org/eng).
- The Convention on Biological Diversity (CBD; https://www.cbd.int/).
- The Convention on the Conservation of Migratory Species of Wild Animals (CMS; https://www.cms.int/).

2. METHODOLOGY

2.1. Assessment Approach and Philosophy

The assessment was conducted according to the 2014 EIA Regulations, as amended 7 April 2017, as well as within the best-practice guidelines and principles for biodiversity assessment (Brownlie, et al., 2006) and (de Villiers, et al., 2005).

This includes adherence to the following broad principles:

- That a precautionary and risk-averse approach be adopted towards projects which may result in substantial detrimental impacts on biodiversity and ecosystems, especially the irreversible loss of habitat and ecological functioning in threatened ecosystems or designated sensitive areas: i.e., Critical Biodiversity Areas (as identified by systematic conservation plans, Biodiversity Sector Plans or Bioregional Plans), and Freshwater Ecosystem Priority Areas.
- Demonstrate how the proponent intends on complying with the principles contained in section 2 of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended (NEMA), which, amongst other things, indicates that environmental management should, in order of priority aim to:
    - Avoid, minimise or remedy disturbance of ecosystems and loss of biodiversity;
    - Avoid degradation of the environment;
    - Avoid jeopardising ecosystem integrity;
    - Pursue the best practicable environmental option by means of integrated environmental management;
    - Protect the environment as the people's common heritage;
    - Control and minimise environmental damage; and
    - Pay specific attention to management and planning procedures pertaining to sensitive, vulnerable, highly dynamic, or stressed ecosystems.

These principles serve as guidelines for all decision-making concerning matters that may affect the environment. As such, it is incumbent upon the proponent to show how proposed activities would comply with these principles and thereby contribute towards the achievement of sustainable development as defined by NEMA.

In order to adhere to the above principles and best-practice guidelines, the basis for the study approach and assessment philosophy included baseline data collection, desktop studies, and site walkovers/field surveys of the property, describing:

- The broad botanical characteristics of the site and its surrounds in terms of any mapped spatial components of ecological processes and/or patchiness, patch size, relative isolation of patches, connectivity, corridors, disturbance regimes, ecotones, buffering, viability, etc.

In terms of pattern, the following was studied:

Community and ecosystem level:

» The main vegetation types and plant communities (Dayaram et al., 2018; Mucina and Rutherford, 2006), their aerial extents, and interaction with neighbouring types, soils, or topography.
» Threatened or Vulnerable ecosystems (cf. new South African vegetation map/National Spatial Biodiversity Assessment1, fine-scale systematic conservation plans, etc) (South African National Biodiversity Institute, 2019).

Species-level:

» Species of Conservation Concern (SoCC: Red List and protected species), giving GPS location, if possible (Raimondo et al., 2009).
» Estimated population sizes and viabilities of SoCC present on site (including the degree of confidence in prediction based on availability of information and specialist knowledge; i.e., High = 70 – 100% confident, Medium = 40 – 70% confident, Low = 0 – 40% confident).
» Probability of other SoCC occurring in the region of the site (include degree of confidence).

Other pattern issues:

» Any significant landscape features, or rare or important vegetation associations, such as seasonal wetlands, alluvium, seeps, sandstone outcroppings, steep southern aspects, drainage lines etc. in the vicinity.
» The extent of alien plant cover within the site, and whether any infestations are the result of prior soil disturbance, such as ploughing or quarrying (alien cover resulting from disturbance is generally more difficult to restore than an infestation of undisturbed sites).
» The condition of the site in terms of current or previous land uses.

In terms of process, the following was studied:

» The key ecological "drivers" of ecosystems on the site and in the vicinity.
» Any mapped spatial components of ecological processes that may occur on site or in the vicinity (i.e., corridors such as watercourses, upland-lowland gradients, migration routes, coastal linkages or inland-trending dunes, and vegetation boundaries such as edaphic interfaces, upland-lowland interfaces, or biome boundaries).
» Any possible changes in key processes e.g., increased fire frequency or drainage/artificial recharge of aquatic systems.

Any further studies that may be required during or after the EIA process will be outlined, together with all relevant legislation, permits, and standards that would apply to the development.

The opportunities and constraints for development is described and shown graphically on an aerial photograph, satellite image, or map delineated at an appropriate level of spatial accuracy.

2.2. Data Exploration and Review

Data sources from the literature and GIS spatial information was consulted and used where necessary in the study.

A National Aeronautics and Space Administration (NASA) Shuttle Radar Topography Mission (SRTM) (V3.0, 1 arcsec resolution) Digital Elevation Model (DEM) have been obtained from the United States Geological Survey (USGS) Earth Explorer website. Basic desktop terrain analysis has been performed on this DEM using ArcGis (10.4.1) software that encompassed a slope, landforms and channel network analyses in order to detect potential outcrops, ridges, landscape depressions and drainage networks.

The above-mentioned spatial data along with Google Earth Imagery (Google Earth ©) have been utilized to identify and delineate habitat/ecosystem features/units.

Vegetation:

- South African National Vegetation Map (Mucina and Rutherford, 2006) and National List of Threatened Ecosystems (2011): vegetation types and their respective conservation statuses. The latest version of the National Vegetation Map was also consulted to check for any updates of the respective regions (Dayaram et al., 2018; South African National Biodiversity Institute, 2018).
- Botanical Database of Southern Africa (BODATSA), hosted by the South African National Biodiversity Institute (SANBI; https://posa.sanbi.org; also referred as POSA: Plants of Southern Africa): information on plant species recorded for the Quarter Degree Squares 3019CB and 3019DA (Figure 2). This is a larger area than required and is a conservative approach that ensures all species possibly occurring within the site have been represented. It also accounts for the fact that the site itself might not be well represented in national databases.
- Threatened Species Programme, Red List of South African Plants (Version 2017.1; http://redlist.sanbi.org/): The IUCN conservation statuses of all listed species were extracted from this database and include the following (see 2 for the area used to compile a plant species list, and Table 1 for a summary):

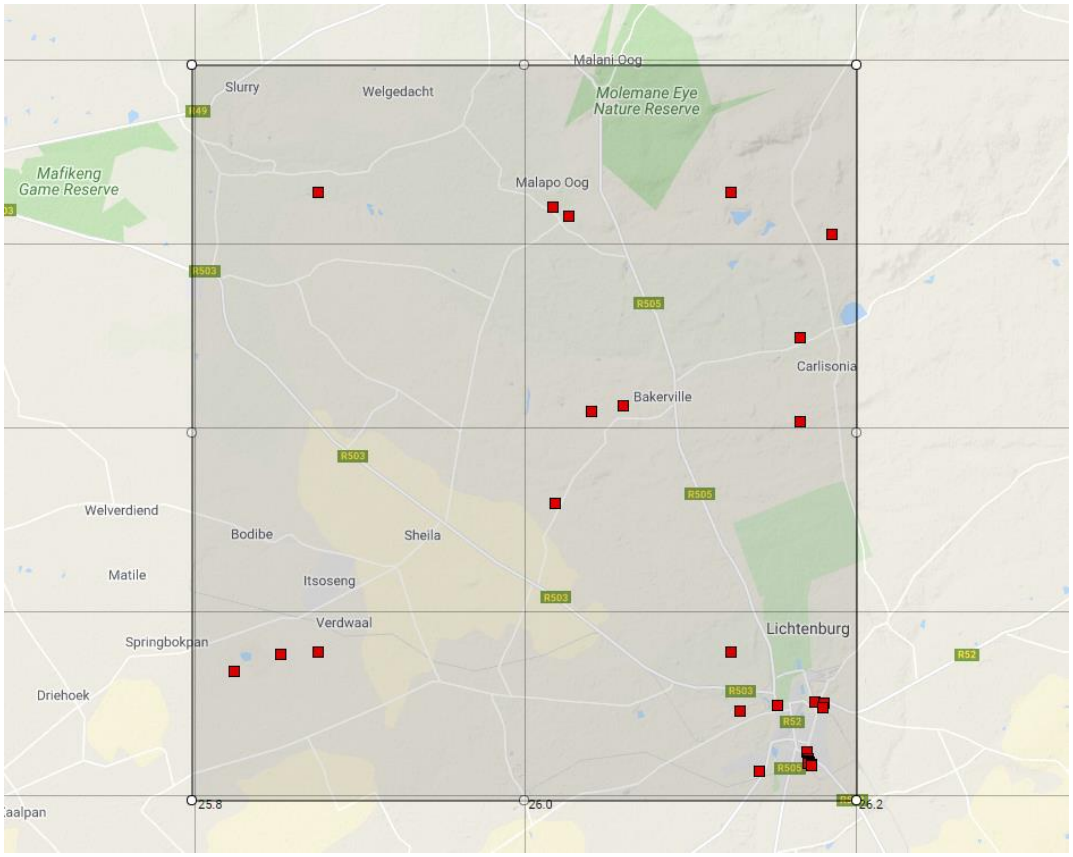

Figure 2: Site locality (red) and area indicating the extent of data extraction from POSA. Extracted data was used to compile a list of plant species that may potentially occur within the site, as well is the surrounding area, and provide an indication of potential Species of Conservation Concern that may be found within this area

Ecosystem:

- » Freshwater and wetland information was extracted from the National Freshwater Ecosystem Priority Areas assessment (NFEPA; Nel et al., 2011). This includes rivers, wetlands, and catchments defined in the study area.
- » Important catchments and protected areas expansion areas were extracted from the National Protected Areas Expansion Strategy 2008 (NPAES; Government of South Africa, 2008).
- » Critical Biodiversity Areas for the site and surroundings (CBA Map for Northern Cape; obtained from SANBI Biodiversity GIS (BGIS), specifically http://bgis.sanbi.org/Projects/Detail/203.

Fauna:

The list of mammal and herpetofauna species predicted to occur in the region and their respective likelihood of occurrence within the study area was generated based on known distributions and habitat suitability, based on online and literature sources such as MammalMap, ReptileMap, FrogMap and the ReptileAtlas as well as field guides such as, Skinner & Chimimba (2005), Apps (ed. 2012), Stuart & Stuart (1998), Bates *et al* (2014),

Minter *et al*. (2004), Branch (2009) and Du Preez and Carruthers (2009). The literature study focussed on querying the online database to generate species lists for the relevant Quarter Degree Squares (QDS).

The predicted list is typically heavily influenced by factors other than just distribution or biome type. Factors such as habitat suitability, current land use, current levels of disturbance and structural integrity of the habitats all influence the potential for predicted species to occur in the vicinity of the study area. There is a high likelihood that not all mammal species known to occur within the region will be located within the study area and surrounding areas. Therefore, a 'Likelihood of Occurrence' (LOO) and a 'Species of Conservation Concern' review will be applied to any potential omissions in the data set. For the LOO analysis, a full summary of Red List faunal species (IUCN, 2017), as well as other SCC will be tabulated, with a LOO applied.

Likelihood of Occurrences will be based upon available spatial imagery and will be based on:

- Habitat suitability;
- Overlap with known distributions;
- Rarity of the species; and
- Current Impacts.

Mammal distribution data were obtained from the following sources:

- The Mammals of the Southern African Subregion (Skinner & Chimimba, 2005);
- The 2016 Red List of Mammals of South Africa, Lesotho and Swaziland (www.ewt.org.za) (EWT, 2016);
- Animal Demography Unit (ADU) - MammalMap Category (MammalMap, 2017) (mammalmap.adu.org.za);
- Stuarts' Field Guide to Mammals of Southern Africa – Including Angola, Zambia & Malawi (Suart & Stuart, 2015)
- A Field Guide to the Tracks and Signs of Southern, Central and East African Wildlife (Stuart & Stuart, 2013).
- Smither's Mammals of Southern Africa (Apps, ed. 2012)

Herpetofauna distribution and species data were obtained from the following sources:

- South African Reptile Conservation Assessment (SARCA) (sarca.adu.org);
- A Guide to the Reptiles of Southern Africa (Alexander & Marais, 2007);
- Field guide to Snakes and other Reptiles of Southern Africa (Branch, 1998);
- Atlas and Red list of Reptiles of South Africa, Lesotho and Swaziland (Bates et al.,
- 2014);
- A Complete Guide to the Frogs of Southern Africa (du Preez & Carruthers, 2009);
- Animal Demography Unit (ADU) - FrogMAP (frogmap.adu.org.za);

» Atlas and Red Data Book of Frogs of South Africa, Lesotho and Swaziland (Mintner et al., 2004); and
» Ensuring a future for South Africa's frogs (Measey, 2011).

Table 1: Information and data coverages used to inform the ecological assessment.

	Data/Coverage Type	Relevance	Source
Biophysical Context	**1:50 000 Relief Line** (5m Elevation Contours GIS Coverage)	Desktop mapping of terrain and habitat features as well as drainage network.	National Geo-Spatial Information (NGI)
	1:50 000 River Line (GIS Coverage)	Highlight potential on-site and local rivers and wetlands and map local drainage network.	CSIR (2011)
	South African Vegetation Map (GIS Coverage)	Classify vegetation types and determination of reference primary vegetation.	Mucina *et al.* (2018)
	NFEPA: river and wetland inventories (GIS Coverage)	Highlight potential on-site and local rivers and wetlands.	CSIR (2011)
	NBA 2018 National Wetland Map 5 (GIS Coverage)	Highlight potential on-site and local wetlands	SANBI (2018)
	NBA 2018 Artificial Wetlands (GIS Coverage)	Highlight potential on-site and local artificial wetlands	SANBI (2018)
Conservation and Distribution Context	**NFEPA: River, wetland and estuarine FEPAs** (GIS Coverage)	Shows location of national aquatic ecosystems conservation priorities.	CSIR (2011)
	National Biodiversity Assessment – Threatened Ecosystems (GIS Coverage)	Determination of national threat status of local vegetation types.	SANBI (2011)
	Terrestrial Critical Biodiversity Areas of the Fee State (GIS Coverage)	Determination of provincial terrestrial conservation priorities and biodiversity buffers.	DESTEA (2015)
	SAPAD – South Africa Protected Areas Database (GIS Coverage)	Shows the location of protected areas within the region	http://egis.environment.gov.za DEA (2020)
	SACAD – South Africa Conservation Areas Database (GIS Coverage)	Shows the location of conservation areas within the region	http://egis.environment.gov.za DEA (2020)

2.3. Botany: Methods followed during Field Sampling and Assessment

The sites were inspected over the course of 10 – 12 June 2021 (winter) and 26 – 27 November (summer and active growing season). During the inspections the vegetation was in an optimal survey condition, with the majority of plants being easily identifiable, even during the winter assessment.

Prior to the site visit, the vegetation was delineated into homogenous units using satellite imagery, existing land cover maps and a SRTM DEM. Sampling of floristic (Flora SCC) and habitat data was done simultaneously by combining to scientifically recognised methods,

namely the plot method and the timed random meanders, wherein a timed meander will be conducted and at a specified time plot sampling (all floristic data including cover-abundance) will be conducted.

The timed random meander method is a highly efficient method for conducting floristic analysis specifically in detecting flora SCC and maximising floristic coverage. In addition, the method is time and cost effective and highly suited for compiling flora species lists and therefore gives a rapid indication of flora diversity. The timed meander search was performed based on, as mentioned a slight adaptation (addition of plots) of the original technique described by Goff et al. (1982). Suitable habitat for SCC were identified according to Raimondo et al. (2009) and targeted as part of the timed meanders.

In terms of plot/relevè sampling the guidelines for phytosociological classifications and descriptions of vegetation in southern Africa (Brown et al., 2013) was followed. At several sites (plots) within each homogeneous unit, a survey of total visible floristic composition and the relative cover percentage of each species were recorded, following established vegetation survey techniques (Mueller-Dombois & Ellenberg 1974; Westhoff & Van der Maarel 1978). These vegetation survey methods have been used as the basis of a national vegetation survey of South Africa (Mucina et al. 2000) and are considered an efficient method of describing vegetation and capturing species information. Notes were additionally made of the general habitat and any other features, biotic and abiotic, that might have an influence on the composition of landscape components and functioning of the landscape. All floristic and environmental data was captured using Braun-Blanquet Data Sheets.

Phytosociological analysis was carried out using the standard TurboVeg phytosociological database (Hennekens and Schaminée 2001) and TWINSPAN classification techniques with JUICE (Tichý 2002). The assessment did not cover an extensive area necessary to fully describe plant communities; hence, the vegetation is simply described in terms of 'vegetation units', which may be associations within plant communities. Extrapolation of vegetation units from survey sites to entire sample area was done by traversing the larger area without doing additional surveys as such and mapping this on Google Earth satellite data.

Plant species nomenclature follows Germishuizen and Meyer (2003), Henderson (2001) and Bromilow (2010).

2.4. Fauna: Methods followed during Field Sampling and Assessment

The sites were inspected over the course of 10 – 12 June 2021 (winter) and 26 – 27 November (summer and active growing season). Conditions for a faunal survey regarded as optimal during the summer survey and acceptable for the winter survey.

Mammal Assessment:

Likelihood of Occurrence

There is a high likelihood that not all mammal species known to occur within the study area and surrounding areas will be located during the survey. Therefore, a 'Likelihood of Occurrence' (LOO) and a 'Species of Special Consideration (SCC)' review was applied to any potential omissions in the data set. For the LOO analysis, a full summary of Red List mammals (IUCN, 2017), as well as other SCC was tabulated, with a LOO applied. The relevant species of special consideration were addressed separately based on the data collected during the fieldwork, in context to the development and the effects on the species (both ecologically and spatially).

Likelihood of Occurrences are based upon:

- Habitat suitability;
- Overlap with known distributions;
- Rarity of the species; and
- Current Impacts.

Spoor Tracking

Spoor tracking enabled detailed sampling of mammalian species without the need for trapping or direct observation. All spoor, including footprints, den sites, burrows, hairs, scrapings and diggings were recorded and documented by detailed geo-referenced photography. Spoor tracking took place during general fieldwork, during specific timed spoor tracking drives/transects and at carefully chosen locations such as roads and other areas with highly trackable substrates. In addition, all camera trap sites (see below) were subjected to spoor tracking.

Camera trapping

The use of camera trapping has long been considered as a valuable ecological census tool in the field of African Mammalogy and this method was a primary focus of the field study. Baited cameras were deployed during survey. Bait stations were chosen based on available cover around the area, the presence of any promising signs (e.g. tracks, scats, tree scrapings) and the likelihood of possible habitat for important species. The baits used consisted of a mixture of pilchards and oats that was pureed to a fine pulp. Cameras were set to record 3 images, with a 40 second delay between events. Four cameras were deployed.

Nocturnal surveys and daytime observations

Nocturnal Surveys: This technique is an essential tool in mammalian sampling, simply because most of the target species are only active after dark. A high-powered spotlight was used from the vehicle to illuminate nocturnal species. Some mammal species were located from vocalisations. Two, night drives of 2 hours each was carried out during the study (one during the winter survey and one during the summer survey).

Direct Observations: All mammals observed during the sampling period, their geographic coordinates and the surrounding habitat were recorded. This data was used to supplement the overall habitat analysis to give context to the area. Animals were encountered through driving, normal routine movement through the study area, active searching of refugia and finally, through spotlighting at night.

Sherman Trapping

Sherman trapping was done for three trap nights. Four trap lines were deployed and traps were placed on the ground and baited with a mixture of peanut butter, olive oil, oats and marmite. Two trap lines comprised of 20 traps each whilst the second and forth trap line comprised of 15 traps. The distance between each trap varied between 15 and 25 meters and was dependent on the transition between habitats. Each trap line was situated within a single habitat type. Captured animals were moved from the traps into clear plastic bags, identified, photographed and then released unharmed. The specific period of sampling is regarded as a moderately acceptable period for sampling.

Herpetofaunal Assessment:

Due to the limited time available for the field survey, no trapping was performed in order to maximise prime active searching time by eliminating the need to install, service and dismantle the traps. Instead, the survey aimed to focus on intensive active searching.

Active Searching

Reptiles were searched for on foot within the study area during the day and night. Specific habitat types were selected, beforehand, where active sampling was focused intently (point samples). The habitat of these point samples was described and photographs were taken. Active searching for reptiles occurred for approximately 30 minutes per point sample and involved:

- Photographing active reptiles from a distance with a telephoto lens (300m telephoto lens);
- Lifting up and searching under debris, rocks or logs (rocks and logs were always returned to their original positions);

» Scanning for any signs of reptiles such as shed skins, the positive identification of which was taken as an observation of that species; and
» Catching observed reptiles by hand. All captured reptiles were photographed and released unharmed.

Nocturnal herpetofauna were searched for by driving slowly on the roads during a single night. Amphibians (frogs and toads) are nocturnal and were searched for by torchlight during a single night at and around the ephemeral watercourses. Each amphibian encountered at a particular site was identified and photographed where possible. Positive identification of acoustic signals (males call to attract females) was also used as a means of identifying amphibians.

Opportunistic Sampling

Reptiles, especially snakes, are incredibly elusive and difficult to observe. Consequently, all possible opportunities to observe reptiles were taken in order to augment the standard sampling procedures described above. As a result, the other participating biodiversity specialists assisted through opportunistically taking photographs of reptiles and amphibians within the study area. These images were copied for proper identification and added to the list of random observations unless a specific location of the observation was provided.

2.5. Assessing Species of Conservation Concern

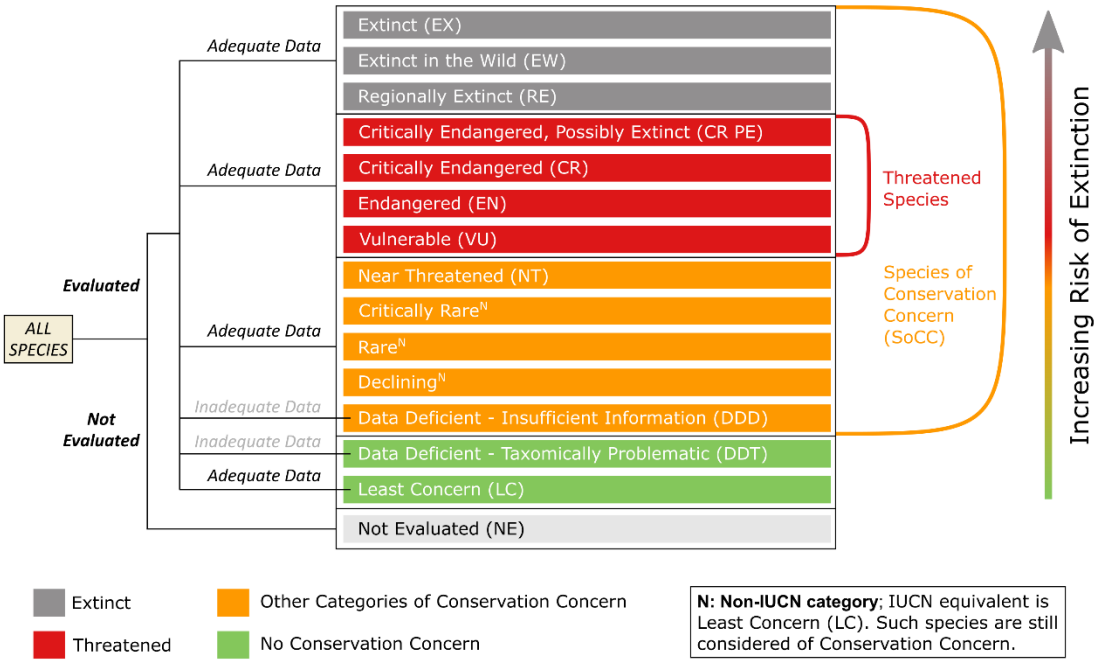

Figure 3: Red List categories used in this report, delineated according to SANBI's Red List of South African Plants (version 2020; http://redlist.sanbi.org/redcat.php).

Species of Conservation Concern (SoCC) are taxa (plants or animals) that have a significant conservation importance in terms of preserving South Africa's high biological diversity. They include threatened species — i.e., Red List species — that have been classified as "at high risk of extinction in the wild" (i.e., Critically Endangered [CR], Endangered [EN], Vulnerable [VU]), as well as those classified in the categories Near Threatened (NT), Critically Rare, Rare, Declining, and Data Deficient (Figure 3). SoCC also include protected species listed in international conventions, national acts, and provincial ordinances that regulate activities such as the hunting, collecting, and trading of such species. A population of an SoCC occurring on a proposed development site serves to indicate that the proposed activities could result in significant loss of biodiversity, knowing that the loss of such subpopulations will either increase the species' extinction risk, or may even contribute to its extinction. A description of the different SANBI Red List categories (http://redlist.sanbi.org/) is provided, below (Table 2).

Table 2: South African Red List Categories for species of conservation significance (adapted from http://redlist.sanbi.org/redcat.php).

Present State			
Species of Conservation Concern (SoCC)		Extinct (EX)	A species is Extinct when there is no reasonable doubt that the last individual has died. Species are classified as Extinct only after exhaustive surveys throughout the species' known range have failed to record an individual.
		Extinct in the Wild (EW)	A species is Extinct in the Wild when it is known to survive only in cultivation or as a naturalized population (or populations) well outside of its natural and historical range.
		Regionally Extinct (RE)	A species is Regionally Extinct when it is extinct within the region assessed (in this case South Africa), but wild populations can still be found in areas outside the region.
	Threatened Species	Critically Endangered, Possibly Extinct (CR PE)	Possibly Extinct is a special tag associated with the category Critically Endangered, for species that are highly likely to be extinct, but exhaustive surveys required for classifying the species as Extinct have not yet been completed. A small chance remains that such species may still be rediscovered.
		Critically Endangered (CR)	A species is Critically Endangered when the best available evidence indicates that it meets at least one of the five IUCN criteria for Critically Endangered, indicating that the species is facing an extremely high risk of extinction.
		Endangered (EN)	A species is Endangered when the best available evidence indicates that it meets at least one of the five IUCN criteria for Endangered, indicating that the species is facing a very high risk of extinction.
		Vulnerable (VU)	A species is Vulnerable when the best available evidence indicates that it meets at least one of the five IUCN criteria for Vulnerable, indicating that the species is facing a high risk of extinction.
		Near Threatened (NT)	A species is Near Threatened when available evidence indicates that it almost meets any one of the IUCN criteria for Vulnerable, and is, therefore, likely to become at risk of extinction in the near future.
		Critically Rare [non-IUCN]	A species is Critically Rare when it is known to occur at a single site, but is not exposed to any direct or plausible potential threat and does not otherwise qualify for a category of threat according to one of the five IUCN criteria.
		Rare [non-IUCN]	A species is Rare when it meets at least one of four South African criteria for rarity, but is not exposed to any direct or plausible potential threat, and does not qualify for a category of threat according to one of the five IUCN criteria.
		Declining	A species is Declining when it does not meet or almost meet any one of the five IUCN criteria, and does not qualify for Critically Endangered, Endangered,

			Vulnerable, or Near Threatened, but there are threatening processes causing a continuing decline of the species.
		Data Deficient – Insufficient Information (DDD)	A species is DDD when there is inadequate information to make an assessment of its extinction risk, but the species is well defined. Listing of species in this category indicates that more information is required and that future research could show that a threatened classification is appropriate.
Other		Data Deficient – Taxonomically Problematic (DDT)	A species is DDT when taxonomic problems hinder its distribution range and habitat from being well defined so that an assessment of risk of extinction is not possible.
		Least Concern (LC)	A species is Least Concern when it has been evaluated against the IUCN criteria and does not qualify for any of the above categories. Species classified as Least Concern are considered at low risk of extinction. Widespread and abundant species are typically classified in this category.
		Not Evaluated (NE)	A species is Not Evaluated when it has not been evaluated against the criteria. The national Red List of South African plants is a comprehensive assessment of all South African indigenous plants, and therefore all species are assessed and given a national Red List status. However, some species included in Plants of southern Africa: an Online Checklist, are species that do not qualify for national listing because they are naturalized aliens, hybrids (natural or cultivated), or synonyms. These species are given the status Not Evaluated and the reasons why they have not been assessed are included in the assessment justification.

SoCC likely to occur in the various habitats of the study area were assessed at a desktop level using the outputs of BODATSA, hosted by the South African National Biodiversity Institute (SANBI; https://posa.sanbi.org). This information was used to identify potential habitats in the project area that could support these species. Special attention was given to the identification of any Red List species and suitable habitats for Red List species observed during field investigations.

2.6. Ecological Mapping

Mapping was done by comparing georeferenced ground survey data to available Google-Earth Satellite Imagery, thus extrapolating survey reference points to the entire study area. Due to the intricate mosaics and often gradual mergers of vegetation units, generalisations were made and delineations are therefore approximate. Mapped units thus indicate dominant vegetation, but smaller vegetation types invariably exist within dominant units, and could not be mapped separately. The latter would require a supervised classification of georeferenced raw SPOT or similar satellite imagery (with full reflectance data), which was not available for this project due to a limited budget. Maps were created with QGIS (version 3.20).

2.7. Sensitivity Analysis and Criteria

Aspects of biodiversity that were used to guide the interpretation and assessment of the study area are summarized below (Table 3).

Table 3: Summary of the different aspects of biodiversity considered in the assessment of the study site.

Intrinsic / Ecological Values
Species-Level Aspects of Biodiversity
» Protected flora and fauna; » Threatened Species (Red List); » Keystone species performing a key ecological role; » Large or congregatory species populations; » Endemic species or species with restricted ranges; » Previously unknown species.
Community and Ecosystem-Level Aspects of Biodiversity
» Distinct or diverse communities or ecosystems; » Unique ecosystems; » Locally adapted communities or assemblages; » Species-rich or diverse ecosystems; » Communities with a high proportion of endemic species or species with restricted ranges; » Communities with a high proportion of threatened and/or declining species; » The main uses and users of the area and its ecosystem goods and services: important ecosystem services, valued ecosystem goods, valued cultural areas.
Landscape-Level Aspects of Biodiversity
» Key ecological processes (e.g., seed dispersal, pollination, primary production, carbon sequestration); » Areas with large congregations or species and/or breeding grounds; » Migration routes/corridors; » Importance as a link or corridor to other fragments of the same habitat, to protected or threatened or valued biodiversity areas; » Importance and role in the landscape with regards to arrangement of spatial components of ecological processes, comprising processes tied to fixed physical features (e.g., soil or vegetation interfaces, river or sand movement corridors, upland-lowland interfaces) and flexible processes (e.g., upland-lowland gradients and macro-climatic gradients), as well as important movement or migration corridor for species.

The determination of specific ecosystem services and the sensitivity of ecosystem components, both biotic and abiotic, is complex and no single overarching criterion applies to all habitats studied. The main aspects of an ecosystem that require incorporation into a sensitivity analysis, however, include the following (see Kremen 2005):

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

This implies that, in a sensitivity analysis, aspects that currently prevail in the project area should be taken into consideration. The possibility of fully restoring the original

environment and its biota, or at least rehabilitating ecosystem services, after significant disturbance, as close as possible to the original state, should also be considered.

According to the above, sensitivity classes are summarised as follows:

Table 4: Explanation of sensitivity rating

Sensitivity	Factors contributing to sensitivity	Examples of qualifying features
VERY HIGH	Indigenous natural areas that are highly positive for any of the following: » Critical habitat for range restricted species of conservation concern that have a distribution range of less than 10 km^2 » Presence of species of conservation concern listed on 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 or listed as Nationally Rare » Habitats/Vegetation types with high conservation status (low proportion remaining intact, highly fragmented, habitat for species that are at risk). » Protected habitats (areas protected according to national/provincial legislation, e.g. National Forests Act, Draft Ecosystem List of NEM:BA, Integrated Coastal Zone Management Act, Mountain Catchment Areas, Lake Areas Development Act). These areas/habitats are irreplaceable in terms of species of conservation concern May also be positive for the following: » High intrinsic biodiversity value (high species richness and/or turnover, unique ecosystems) » High value ecological goods and services (e.g. water supply, erosion control, soil formation, carbon storage, pollination, refugia, food production, raw materials, genetic resources, cultural value) » Low ability to respond to disturbance (low resilience, dominant species very old).	» CBA 1 areas » Remaining areas of vegetation type listed in Draft Ecosystem List of NEM:BA as Critically Endangered, Endangered, or Vulnerable. » Protected forest patches. » Confirmed presence of populations of species of conservation concern (Critically Endangered, Endangered, Vulnerable & Rare)
HIGH	Indigenous natural areas that are positive for any of the following: » High intrinsic biodiversity value (moderate/high species richness and/or turnover). » Confirmed habitat highly suitable for species of conservation concern (Those species listed on the IUCN Red List of Threatened Species or	» CBA 2 "critical biodiversity areas". » Confirmed habitat where species of conservation concern could potentially occur (habitat is suitable, but no confirmed records).

Sensitivity	Factors contributing to sensitivity	Examples of qualifying features
	South Africa's National Red List website as Critically Endangered, Endangered or Vulnerable according to the IUCN Red List 3.1. Categories and Criteria). » Moderate ability to respond to disturbance (moderate resilience, dominant species of intermediate age). » Moderate conservation status (moderate proportion remaining intact, moderately fragmented, habitat for species that are at risk). » Moderate to high value ecological goods & services (e.g. water supply, erosion control, soil formation, carbon storage, pollination, refugia, food production, raw materials, genetic resources, cultural value). These areas/habitats are unsuitable for development due to a very likely impact on species of conservation concern May also be positive for the following: » Protected habitats (areas protected according to national/provincial legislation, e.g. National Forests Act, Draft Coastal Zone Management Act, Mountain Catchment Areas Act, Lake Areas Development Act)	» Habitat containing individuals of extreme age. » Habitat with low ability to recover from disturbance. » Habitat with exceptionally high diversity (richness or turnover). » Habitat with unique species composition and narrow distribution. » Ecosystem providing high value ecosystem goods and services.
Medium	Indigenous natural areas that are positive for: » Suspected habitat for species of conservation concern based either on there being records for this species collected I the past prior to 2002 or being a natural area included in a habitat suitability model (Those species listed on 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). Indigenous natural areas that are positive for one or two of the factors listed below, » Moderate intrinsic biodiversity value (moderate species richness and/or turnover). » Moderate to moderate low ability to respond to disturbance (moderate resilience, dominant species of intermediate age). » Moderate conservation status (moderate proportion remaining intact, moderately fragmented, habitat for species that are at risk). » Moderate value ecological goods & services (e.g. water supply, erosion control, soil formation, carbon storage, pollination, refugia,	» CBA 2 "corridor areas", ESA 1 and ESA2. » Habitat with moderate diversity (richness or turnover). » Suspected habitat for species of conservation concern.

Sensitivity	Factors contributing to sensitivity	Examples of qualifying features
	food production, raw materials, genetic resources, cultural value).	
Low	Degraded or disturbed indigenous natural vegetation No Natural habitat remaining	

2.8. Impact Assessment and Criteria

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

» The **nature**, which includes a description of what causes the effect, what will be affected and how it will be affected.

» The **extent**, wherein it is indicated whether the impact will be local (limited to the immediate area or site of development) or regional,

Immediate area	1
Whole site (entire surface right)	2
Neighboring areas	3
Regional	4
Global (Impact beyond provincial boundary and even beyond SA boundary)	5

» The **duration**, wherein it was indicated whether:

Lifetime of the impact will be of a very short duration (0 – 1 year)	1
The lifetime of the impact will be of a short duration (2 – 5 years)	2
Medium-term (5 -15 years)	3
Long term (> 15 years)	4
Permanent	5

» The **magnitude**, quantified on a scale from 0 – 10,

small and will have no effect on the environment	2
minor and will not result in an impact on processes	4
moderate and will result in processes continuing but in a modified way	6
high (processes are altered to the extent that they temporarily cease)	8
very high and results in complete destruction of patterns and permanent cessation of processes	10

» The **probability of occurrence**, which describes the likelihood of the impact actually occurring. Probability was estimated on a scale of 1 -5,

very improbable (probably will not happen)	1
improbable (some possibility, but low likelihood)	2
probable (distinct possibility)	3
highly probable (most likely)	4
definite (impact will occur regardless of any prevention measures)	5

» The **significance**, was determined through a synthesis of the characteristics described above and can be assessed as;
  - **LOW,**
  - **MEDIUM or**
  - **HIGH;**

» the status, which was described as either positive, negative or neutral.
» the degree of which the impact can be reversed,
» the degree to which the impact may cause irreplaceable loss of resources,
» the degree to which the impact can be mitigated.

The significance was calculated by combining the criteria in the following formula:

S=(E+D+M)P where;

» S = Significance weighting
» E = Extent
» D = Duration
» M = Magnitude
» P = Probability

The significance weightings for each potential impact are as follows;

Table 5: Rating table used to rate level of significance.

RATING	CLASS	MANAGEMENT DESCRIPTION
< 30	**Low (L)**	Where the impact would not have a direct influence on the decision to develop the area.
30 - 60	**Medium (M)**	Where the impact could influence the decision to develop in the area unless it is effectively mitigated.
> High	**High (H)**	Where the impact must have an influence on the decision process to develop in the area.

2.9. Assumptions and Limitations

This report deals exclusively with a specifically defined area, and the impacts upon plant biodiversity and natural ecosystems in that area. As such:

- » All relevant project information provided by the applicant and engineering design team to the ecological specialist was correct and valid at the time that it was provided.
- » Probably the most significant potential limitation associated with such a sampling approach is the narrow temporal window of sampling.

Temporal variation plays an important role in the structure and patterns of plant biodiversity, communities, and species occurrences. One site visit might, therefore, not fully catalogue plant species diversity in an area (for example, due to seasonal variation of vegetation). The site was surveyed in the dry (winter) period as well as the wet and active growing period (summer) and furthermore the conditions during both surveys can be described as optimal and acceptable. Thus, the biodiversity of the area has most likely been well documented.

Nevertheless, some annual, short-lived, ephemeral (plants surviving unfavourable conditions as seeds), geophytic (species with underground storage organs), or other cryptic species might not have been observed/detected. For example, some plant species of the families Amaryllidaceae, Colchicaceae, Eriospermaceae, Hyacinthaceae, Hypoxidaceae, Iridaceae, and Orchidaceae, among others, are known to completely die back during certain times of the year, depending on respective life strategies. Thus, such species remain unobservable/undetectable and survive only as dormant bulbs, corms, tubers, or rhizomes below the soil surface. Moreover, rare and threatened plant species are generally uncommon and/or localised, and can easily be overlooked. Even multiple site visits might therefore fail to locate such species.

Furthermore, flowers and fruits are crucial for the complete and accurate identification of plant species, and any absence of such flowers and fruits might prevent the complete and accurate identification of such plant species. Flowering and fruiting times are species specific and there would invariably have been some plant species that were not flowering and/or fruiting during surveying.

Finally, in principle, it is impossible to survey any site to its full extent, both physically and temporally. The total number of plant species thus recorded on any site is therefore almost always an underestimate of the potential number of species that could occur on site (although, in this instance it is expected that the majority of plant species have been documented).

In light of all of the aforementioned, the authors declare a gap in knowledge as to the potential presence of plant species that might not have been observable/detectable on site as a result of their potential annual, short-lived, dormant, cryptic, or ephemeral nature during the time of surveying, their rare and localised distributions on site, and also the incomplete and inaccurate identification of plant species which lacked flowers and/or fruits and/or other characteristic features during the time of surveying. A list of Species of Conservation Concern known to occur in the area (as per SANBI online databases) was used to supplement the list of species recorded during the site visit(s). This final combined

list is likely to be sufficiently conservative and cautious to account for the aforementioned study limitations.

3. THE IMPORTANCE OF BIODIVERSITY AND CONSERVATION

The term "biodiversity" is used to describe the wide variety (richness and abundance) of plant and animal species occurring in their natural environment or "habitat". Biodiversity not only encompasses all living things but also the series of interactions that sustain them, which are termed "ecological processes". South Africa's biodiversity provides an important basis for economic growth and development; keeping biodiversity intact is thus vital for ensuring the on-going provision of ecosystem services, for example the production of clean water through comprehensive catchment management practices. The role of biodiversity in combating climate change is also well recognised and further emphasises the key role that biodiversity management plays on a global scale (South African National Biodiversity Institute, 2019). Typical pressures that natural ecosystems face from human activities include the loss and degradation of natural habitat, invasive alien species, pollution and waste, and climate change (South African National Biodiversity Institute, 2019). High levels of infrastructural and agricultural development typically restrict the connectivity of natural ecosystems, and maintaining connectivity is considered critical for the long-term persistence of both ecosystems and species, in the face of human development and global climate change. Biodiversity loss places aspects of South Africa's economy and quality of life at risk, and reduces socioeconomic options for future generations. In essence, then, sustainable development is not possible without a healthy biodiversity.

4. DESKTOP ANALYSIS

4.1. Land Use and Land Cover

Refer to Figure 6 for an illustration of the identified and delineated land-cover features located within the affected properties.

Land cover and land-use changes often indicate major impacts on biodiversity, especially if those changes show the loss of natural habitat due to urban sprawl, cultivation, etc.

The affected properties are almost entirely used for grazing with very limited infrastructure, mainly restricted to access roads, powerlines, kraals, water and feeding points for livestock and the occasional homestead. The properties to the north, south and east are mainly small holdings with residential areas and patches of land utilised for small scale subsistence farming. The properties to the west, on the other hand, are larger and utilized mostly for commercial farming practises.

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points for livestock and the occasional homestead. The properties to the north, south and east are mainly small holdings with residential areas and patches of land utilised for small scale subsistence farming. The properties to the west, on the other hand, are larger and utilized mostly for commercial farming practises.

It was confirmed that the entire development site is used for grazing (cattle). Based on historical satellite imagery and the site visit it was found that a little more than 24% of the project site is covered by a secondary grassland (plagioclimax) that has established on historically cultivated areas (> 40 years), with the only evidence, from available spatial data, being feint ploughing contour lines (Figure 5) and stone piles that have been removed from the cultivated areas (Figure 4). Current disturbance within the project site include farm roads/twin tracks, fire breaks, fences, Eskom powerline and very low levels of woody encroachment, kraals, a homestead and small *Eucalyptus* woodlot. These transformed and disturbed areas cover about 10% of the development site. The remaining 60% of the project site is covered by an open savanna type grassland where the taller shrubs and trees tend to be clumped together and are surrounded by a well-developed tufted grassland (natural).

Currently the site can be reached by a larger gravel road off the R505 north of Lichtenburg, and then by smaller farm tracks.

Figure 4: An example of a stone pile/heap.

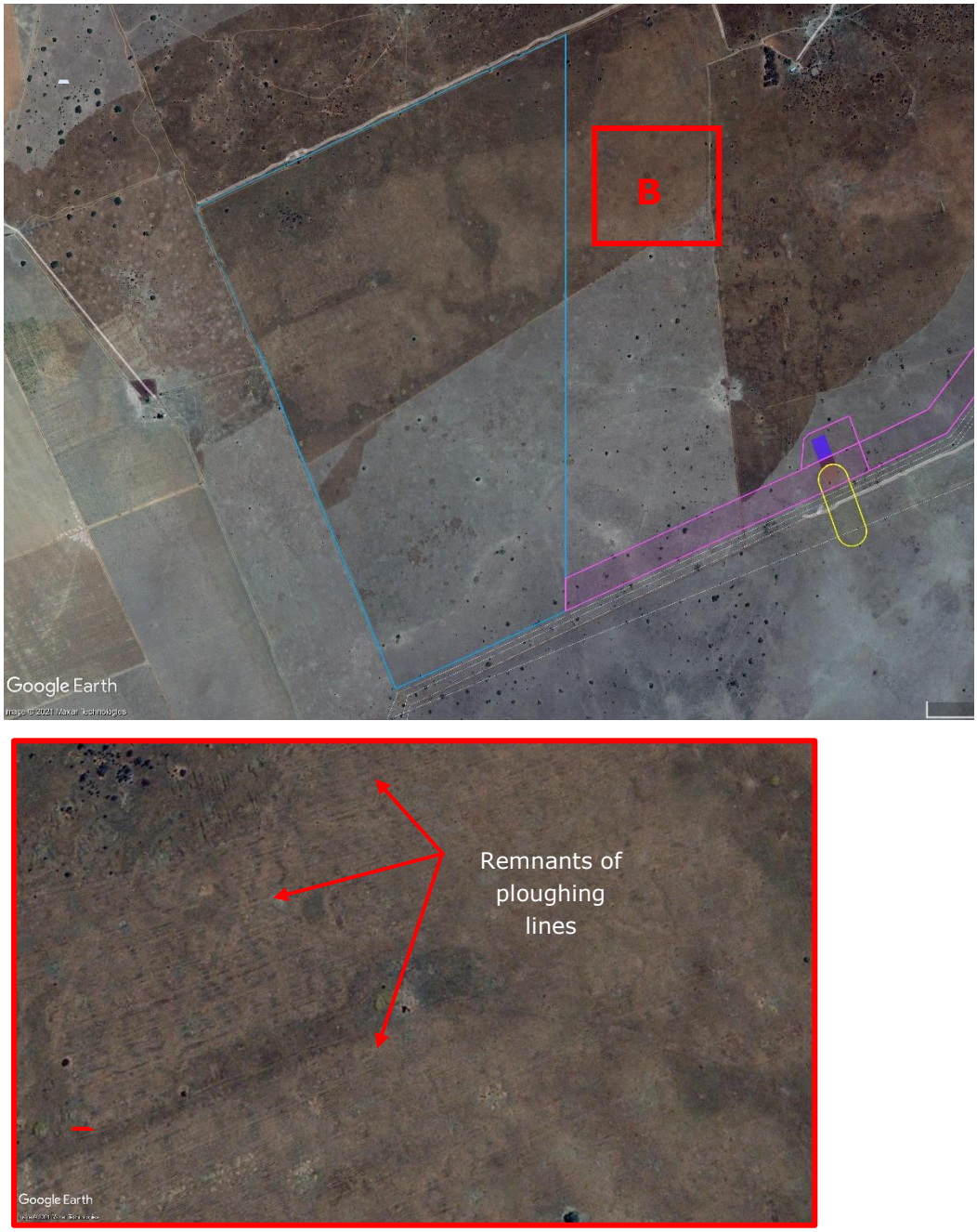

Figure 5 (A-C): Satellite Image taken in 2006 providing evidence of historical cultivation (>45years) within areas that have been mapped as natural grassland within the SANLC dataset as well as within the Critical Biodiversity Area data sets.

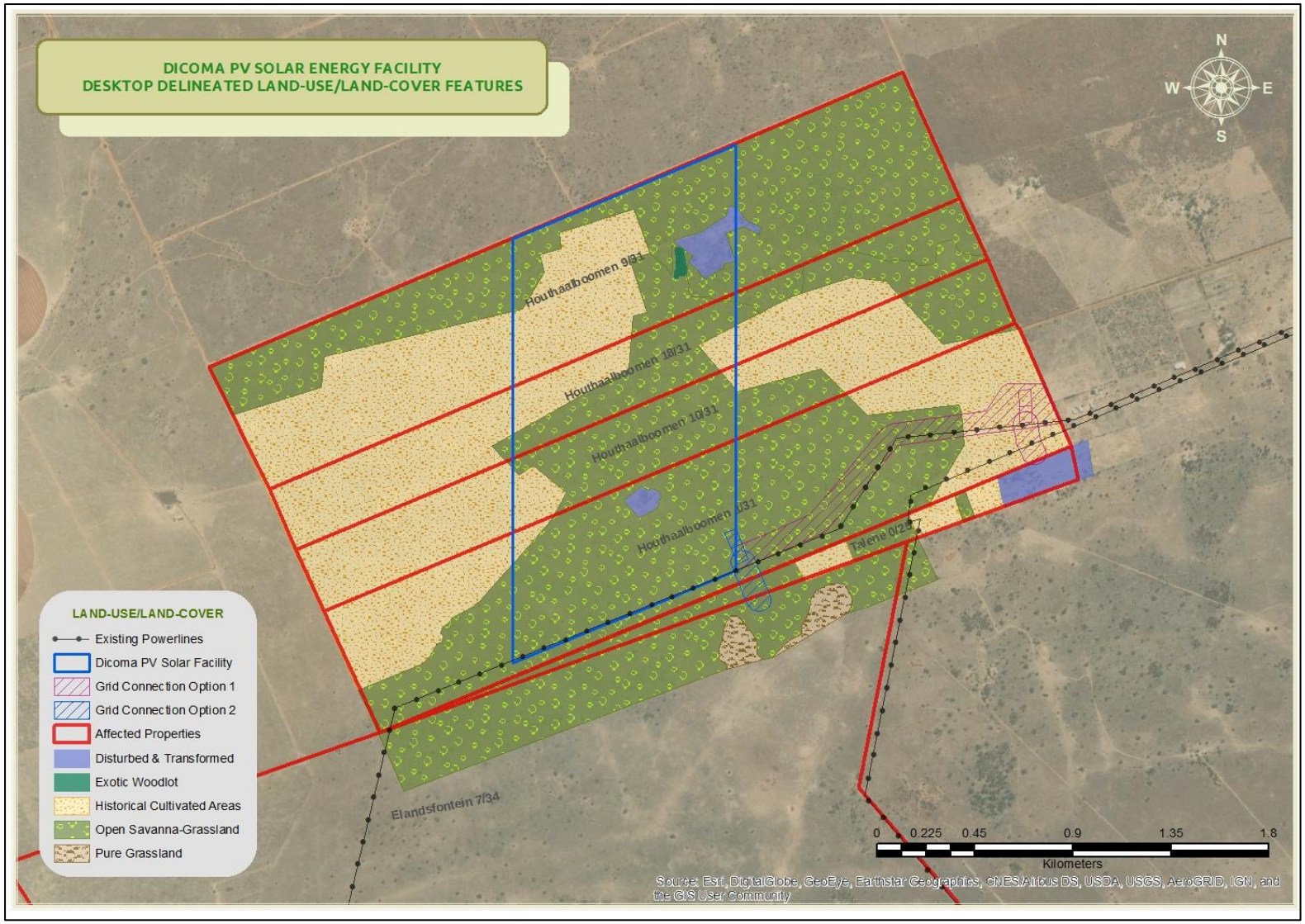

Figure 6: Delineated land-cover features.

4.2. Regional/Local Biophysical Setting

A summary of the biophysical features and the setting of the project site and surroundings are summarised in Table 6.

Table 6: Summary of the biophysical setting of the proposed SEF footprint.

Biophysical Aspect	Desktop Biophysical Details		Source
Physiography			
Landscape Description	A relative flat to gradual sloping plains-dominated landscape with a low dolerite outcrop to the south of the development footprint. As already described, a large portion of the project site has been historically transformed for cultivation purposes but has since been covered by a plagioclimax grassland. The portions to the south and north consist of moderately shallow to shallow, stony and gritty soils, not favourable for ploughing, and as a result has remained largely intact (natural). These natural areas comprise of an open savanna type of grassland characterised by a well-developed tussock grassland, whist the woody component tend to comprise of small trees and shrubs that are clumped together and unevenly spread within the grassland.		Google Earth
Dominant Land Type	Fa11 (small south-western corner falls within Fa10)		ARC
Dominant Terrain Type	Symbol	Description	ARC
	A2	Level plains or plateaus with some relief of between 30 – 90m.	
Geomorphic Province	North-western Highveld		Partridge et al., 2010
Geology	Dolomite and chert belonging to the Chuniespoort Group, supporting mostly shallow Mispah and Glenrosa soil forms. Chert gravels are abundant on midslopes and footslopes including valley bottoms.		ARC & SA Geological Dataset
Soils (General)	Lithosols: Soils with minimal development, usually shallow, on hard or weathering rock, with or without intermittent diverse soils. The soil forms that epitomise these processes are Glenrosa and Mispah which tend to be reddish-brown to brown, structureless to weakly structured. Surface rock may be present. Hillcrest areas in this land type are characterized by rock, Mispah and occasionally shallow Hutton form soils. The upper sideslopes are mainly composed of rock and Mispah soils while the lower sideslopes have more Mispah soils. The valley bottom soils are mainly of the Hutton and Westleigh form soils. Lime is rare or absent in upland soils but may be present in low-lying soils and the soils formation is contributed by dolomite and chert of the Chuniespoort Group.		ARC
Susceptibility to Wind and Water Erosion	Class	Description	ARC
	3c (Wind), & 1 (Water)	Land with low susceptibility to water erosion and moderately susceptible to wind erosion. Generally, level to gently sloping covered by sub-dominant loamy sands	
Climate			

Köppen-Geiger Climate Classification	BSk (Cold semi-arid climate)			Climate-data.org
Mean annual temperature	16.9°C			Climate-data.org
Warmest Month & Av. Temp.	January: 21.7°C			Climate-data.org
Coldest Month & Av. Temp.	July: 9.9°C (±37 frost days per year)			Climate-data.org
Rainfall Seasonality	Mid-summer (December – February)			DWAF, 2007
Mean annual precipitation	570-575 mm			Schulze, 1997
Mean annual runoff	9.5mm			Schulze, 1997
Mean annual evaporation	1 800 – 2 000 mm			Schulze, 1997
Surface Hydrology				
DWA Ecoregions	Level 1	Level 2		DWA, 2005
	Highveld	11.01		
Wetland vegetation group	Dry Highveld Grassland (Group 5)			CSIR, 2011
Water management area	Lower Vaal WMA (10)			DWA
Quaternary catchment	Name (Symbol)			DWA
	C31A			
Main collecting river(s) in the catchment	Small tributaries of the Harts River.			CSIR, 2011
Closest river to the project site	Small seasonal tributary of the Harts River located approximately 7.6km to the south-east of the project site.			Google Earth
Geomorphic Class	Symbol	Description	Slope (%)	CSIR, 2011
	V4	Upper foothill	0.005 - 0.019	
	Description			
	Watercourses within the quaternary catchment corresponds with Upper Foothill systems. » Upper Foothill systems typically have moderately steep, cobble-bed or mixed bedrock cobble bed channels with pain-bed, pool-riffle or pool-rapid reach types. Length of pools and riffles/rapids are typically very similar. Narrow floodplains of sand, gravel or cobbles are often present.			
Vegetation Overview				
Biome	Grassland Biome (Dry Highveld Grassland Bioregion)			Mucina & Rutherford, 2018
Vegetation Types	Carletonville Dolomite Grassland			Mucina & Rutherford, 2018
Vegetation & Landscape Feature	Slightly undulating plains dissected by prominent rocky chert ridges. These undulating plains are characterised by species rich grasslands forming complex mosaic patterns dominated by many species.			Mucina & Rutherford, 2006
BODATSA Data	Regional: Total Species Observed			2021-10-08_093850156-BRAHMSOnlineData
	453			
	Indigenous Flora			
	390			
	Non-indigenous Flora			
	45			
	South African Endemic Flora			
	16			
	Threatened Flora			
	Data Deficient: 1 Species; Near Threatened: 1 Species Vulnerable: 1 Species			

	Not Evaluated: 28 Species	

4.3. Conservation Planning / Context

Understanding the conservation context and importance of the study area and surroundings is important to inform decision making regarding the management of the aquatic resources in the area. In this regard, national, provincial, and regional conservation planning information available and was used to obtain an overview of the study site (Table 7).

Table 7: Summary of the conservation context details for the study area.

Conservation Planning Dataset		Relevant Conservation Feature	Location in Relationship to Project Site	Conservation Planning Status
NATIONAL LEVEL CONSERVATION PLANNING CONTEXT	National Protected Areas Expansion Strategy	Focus Area	Well outside of any NPAES Focus Areas: ±24km south of the closest Focus Area	Not Classified
	Protected Areas and Conservation Areas (PACA) Database	South African Conservation Area (SACA)	Well outside of any SACA: ±68km north east of the closest SACA (Baberspan Nature Reserve)	Not Classified
		South African Protected Area (SAPA)	Well outside of any SAPA: ±15km south west of the closest SAPA (Rall Broers Private Nature Reserve)	Not Classified
	Strategic Water Source Areas for groundwater (SWSA-gw)	Areas with high groundwater availability and of national importance	Located within the Bo-Molopo Karst Belt SWSA-gw	Located within important groundwater recharge area.
	Vegetation Types	Carletonville Dolomite Grassland	Vegetation of Study Area	Least Threatened
	Threatened Ecosystems	Carletonville Dolomite Grassland	Ecosystems of Study Area	Not listed
	National Freshwater Ecosystem Priority Area	River FEPA	According to NFEPA spatial data no watercourses are located within or near the project area, however the project area falls within Quaternary Catchment listed as an Upstream FEPA	Upstream Quaternary Catchment
		Wetland FEPA	No Wetland FEPAs located within or near the project site.	Not Classified

» PROVINCIAL AND REGIONAL LEVEL CONSERVATION PLANNING CONTEXT	NWBSP (2015): Terrestrial Critical Biodiversity Areas	Ecological Support Areas ESA1	Corridors/linkages between the upland (terrestrial) areas and important water resource features such as the Harts River and its tributaries and wetland habitats. Approximately 98% of the PV Solar's footprint is located within ESA1, whilst all of the grid infrastructure options are located within the ESA1	ESA 1
	NWBSP (2015): Aquatic Critical Biodiversity Areas	Ecological Support Areas ESA1	Located within a dolomite recharge area.	ESA1

4.3.1. National Protected Areas Expansion Strategy

Land-based protected area expansion targets include large, intact, and unfragmented areas of high importance for biodiversity representation and ecological persistence, which are suitable for the creation or expansion of large protected areas. Such areas were identified through a systematic biodiversity planning process undertaken as part of the development of the National Protected Area Expansion Strategy 2008 (NPAES). They present the best opportunities for meeting the ecosystem-specific protected area targets set in the NPAES, and were designed with a strong emphasis on climate change resilience and requirements for protecting terrestrial and freshwater ecosystems (FEPA: Freshwater Ecosystem Priority Areas). These areas should not be seen as future boundaries of protected areas, since in many cases only a portion of a particular focus area would be required to meet the protected area targets set in NPAES. They are also not a replacement for fine-scale planning, which may identify a range of different priority sites based on local requirements, constraints, and opportunities.

According to the NPAES spatial data (Holness, 2010), the entire project site is located well outside of any FA with the closest FA (NW/Gauteng Busheveld FA) located approximately 24km to the north (Figure 8). This development will not impact any FAs or impact the future conservation potential of nearby FAs.

The proposed development will won't have an impact on national ecosystem-specific protected area targets.

4.3.2. Protected Areas and Conservation Areas (PACA) database

The South African Protected Areas Database (SAPAD) contains spatial data for the conservation estate of South Africa. It includes spatial and attribute information for both formally protected areas and areas that have less formal protection. Data is collected by parcels which are aggregated to protected area level.

The definition of protected areas used in this document follows the definition of a protected area as defined in the National Environmental Management: Protected Areas Act, (Act 57 of 2003). Chapter 2 of the National Environmental Management: Protected Areas Act, 2003 sets out the "System of Protected Areas", which consists of the following kinds of protected areas –

- Special nature reserves,
- National parks,
- Nature reserves and
- Protected environments (1-4 declared in terms of the National Environmental Management: Protected Areas Act, 2003);
- World heritage sites declared in terms of the World Heritage Convention Act;
- Marine protected areas declared in terms of the Marine Living Resources Act;
- Specially protected forest areas, forest nature reserves, and forest wilderness areas declared in terms of the National Forests Act, 1998 (Act No. 84 of 1998); and
- Mountain catchment areas declared in terms of the Mountain Catchment Areas Act, 1970 (Act No. 63 of 1970).

The types of conservation areas that are currently included in the database are the following:

- Biosphere reserves
- Ramsar sites
- Stewardship agreements (other than nature reserves and protected environments)
- Botanical gardens
- Transfrontier conservation areas
- Transfrontier parks
- Military conservation areas
- Conservancies

Taken together, protected areas and conservation areas make up the conservation estate.

According to the PACA database, no Conservation or Protected Areas are located in close proximity to the project site, with the nearest Conservation Area located approximately 67km to the north east of the closest SACA namely Baberspan Nature Reserve. The closest Protected Area (Rall Broers Private Nature Reserve) is located approximately 15km to the north-west of the project site.

Subsequently this development will not have an impact on any SACAs and SAPAs.

4.3.3. Strategic Water Source Areas (SWSAs)

Strategic Water Source Areas (SWSAs) are defined as areas of land that either:

- » supply a disproportionate (i.e. relatively large) quantity of mean annual surface water runoff in relation to their size and so are considered nationally important;
- » have high groundwater recharge and where the groundwater forms a nationally important resource;
- » areas that meet both criteria mentioned above.

They include transboundary Water Source Areas that extend into Lesotho and Swaziland.

The project site is located outside of any SWSA for surface water but is located within a SWSA for groundwater; namely the Bo-Molopo Karst Belt SWSA-gw (Figure 9).

Surface water is relatively scarce within the Lichtenburg area with very few of the rivers, creeks or pans having perennial water. Most of the farmers of the area largely depend on underground water resources. At present water is drawn from springs, wells, bore-holes, and storage-dams on the surface. South Africa's dolomite aquifers are amongst the highest yielding and most important aquifers in the country (Barnard, 2000). The dolomites of North West Province known as the North West dolomites, hold around 5 000 Mm3 of water and are recharged at a rate of about 300 Mm^3/a (Stephens and Bredenkamp, 2002). The North West dolomites are divided into a number of discrete units/ compartments (known as Ground Water Management Units) by igneous dykes and faults (Meyer, 2012), making them a patchwork of semi-autonomous aquifers rather than a single hydraulic entity. Under natural conditions rainfall recharges these compartments / aquifers, and they drain via springs, seeps and wetlands. Whilst most dolomite groundwater is used for irrigation, hundreds of thousands of people also depend on it for domestic water supply. It also supports many springs, wetlands and associated ecosystems. Bodibe, Lichtenburg, Itsoseng, Ventersdorp, Mahikeng, Ottoshoop and Zeerust, amongst other towns, all rely mainly on dolomite groundwater for municipal water supplies. Over-abstraction in some of the dolomite compartments is a growing problem, threatening domestic supplies, irrigated agriculture and environmental services.

Most of these aquifers are known as Dolomitic Karst Aquifers and are collectively classified as the Karst Belt. Dolomite is a magnesium-rich calcium carbonate rock that can dissolve in the presence of water combined with carbon dioxide (i.e. carbonic acid, H2CO3), which generally happens naturally as part of weathering processes (DWA, 2009). This dissolution weathering can result in subsurface solution cavities/cave systems and surface sinkholes/dolines forming, with the resulting dissolution landscape being known as "karst" terrain (DWA, 2009). Any local or regional fault or fracture systems can further enhance

dissolution and karst development. These subsurface dissolution systems form excellent secondary porosity features along which strong flowing groundwater can occur, often forming high yielding karst aquifer systems (provided sufficient recharge is present). The Malmani Subgroup in the vicinity of the study area forms such a fractured dolomitic karst aquifer, with potential yields of ~5-20 litres/second (l/s) or ~0.15-0.5 million cubic metres per annum (hm^3/a) per borehole, which is significantly higher than most other rock formations. Wetlands, pans, springs, sinkholes and a lack of surface drainage may also be indicative of subsurface groundwater bearing solution cavities (Taylor, 1983). Subsidence above major water conduits results in the accumulation of chert breccia rubble covered by red soil, which is characteristically found adjacent to ENE-WSW trending dykes in the Lichtenburg area (Taylor, 1983). Generally, the dolomite karst aquifers are unconfined to semi-confined, with compartmentalisation by dolerite dykes occurring. Due to partial dissolution of the dolomitic rock material, dolomite aquifers commonly experience surface geotechnical problems such as sinkhole/doline formation.

The study area is situated within this Karst Belt and more specifically within the Lichtenburg Ground Water Management Area (GMA) of the Karst Belt, also classified as the Bo-Molopo Karst Belt. The boundaries of this GMA, covering a total area 873 km2, are formed by the Hendriksdal, Stryd and Elizabeth dykes and the Lichtenburg dyke forms the southern boundary. Other dykes in the GMA include the Vlakplaas (NW-SE), Zamekomst (N-S), Paarl (E-W), Manana (N-S) and Lichtenburg (E-W). Approximately 360 m south of the study area, and approximately 1.8 km north of the Paarl Dyke an un-named dyke runs almost parallel with the Paarl Dyke. Only one significant spring, the Aslaagte spring just to the north of Lichtenburg and about 8km south of the study area, occurs in this GMA. This spring is situated in the Oaktree Formation and appears not to be associated with dyke or geological contact structures. Recent studies state that Lichtenburg obtains its water from the Aslaagte (or Lichtenburg) spring and boreholes in the Oaktree and Monte Christo Formations. The Monte Christo Formation is the more chert-rich and karstified formation of the two, and as such production boreholes located on this formation usually have a higher sustainable yield than those drilled into the Oaktree Formation.

Due to the nature of the Solar PV developments and their associated infrastructure (limited use of chemicals, hazardous and toxic materials), it is unlikely that such a development will have a significant impact on groundwater quality. However, Solar PV developments may slightly influence local infiltration and subsequently ground water recharge. This impact can however, be successfully mitigated through careful planning and with effective mitigation measures in place.

4.3.4. National Level of Conservation Priorities (Threatened Ecosystems)

South Africa's vegetation types have been assigned a conservation status according to their respective degrees of transformation and rates of conservation. The conservation status of a habitat or vegetation type is based on the amount of its original area that currently remains intact relative to various thresholds. On a national scale, these thresholds are arranged from Least Threatened to Critically Endangered (Figure 7), as determined by the best available scientific approaches (Driver et al., 2005; South African

National Biodiversity Institute, 2019). The level at which an ecosystem becomes Critically Endangered depends on biodiversity targets, and therefore differs from one ecosystem to another, varying from 16% to 36%.

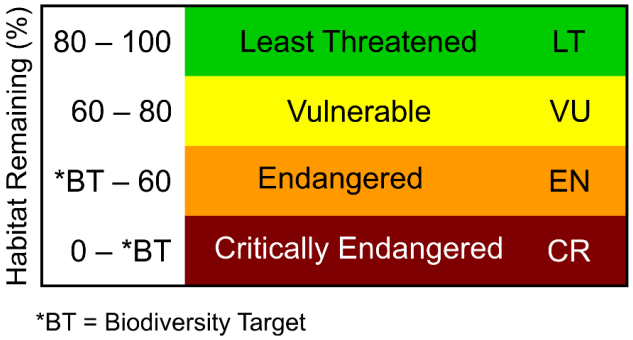

Figure 7: Ecosystem threat status categories (Driver et al., 2005). The biodiversity target represents the minimum conservation requirement.

Nationally, threatened ecosystems that are currently under threat of being transformed by other land uses have been identified and listed. The first national list of threatened terrestrial ecosystems for South Africa was gazetted on 9 December 2011 (NEM:BA National list of ecosystems that are threatened and in need of protection, G 34809, GoN 1002, 9 December 2011). The primary purpose of listing threatened ecosystems is to reduce the rate of ecosystem and species extinction by preventing further degradation and loss of structure, function, and composition of threatened ecosystems (SANBI, 2011). NEM:BA lists threatened or protected ecosystems in one of five categories: Critically Endangered (CR), Endangered (EN), Vulnerable (VU), or protected; Least Threatened ecosystems are not listed. There are four main implications of listing ecosystems:

- Planning related implications which are linked to the requirement in the Biodiversity Act (Act 10 of 2004) for listed ecosystems to be taken into account in municipal IDPs and SDFs;
- Environmental authorisation implications in terms of NEMA and the EIA regulations;
- Proactive management implications in terms of the National Biodiversity Act;
- Monitoring and reporting implications in terms of the Biodiversity Act.

The site is located within one vegetation type (Carletonville Dolomite Grassland) as currently mapped by the National Vegetation Map 2018 (see section 5.1).

Only 1.8% of the vegetation type is protected within formal conservation areas with 23.9% of this unit being transformed, mainly due to cultivation practices (ploughed for commercial crops), by urban sprawl or by mining activity as well as the building of the Boskop and Klerkskraal Dams. The conservation status of this unit is classified as Least Threatened by SANBI (2018) and is furthermore not listed within the National List of Ecosystems that are Threatened and in need of protection (GN1002 of 2011), published

under the National Environment Management: Biodiversity Act (Act No. 10 of 2004) (Table 8 and Figure 8).

Table 8: Conservation status of the vegetation type occurring in and around the study area.

Vegetation Type	**Target (%)**	**Conserved (%)**	**Transformed (%)**	**Conservation Status**	
				SANBI, 2018	National Ecosystem List (NEM:BA)
Carletonville Dolomite Grassland	24%	1.8%	23.9%	Least Concern	Not Listed

It is highly unlikely that this development will have an impact on the status of the Ecosystem as well as Vegetation Type Status due to the extent of the development.

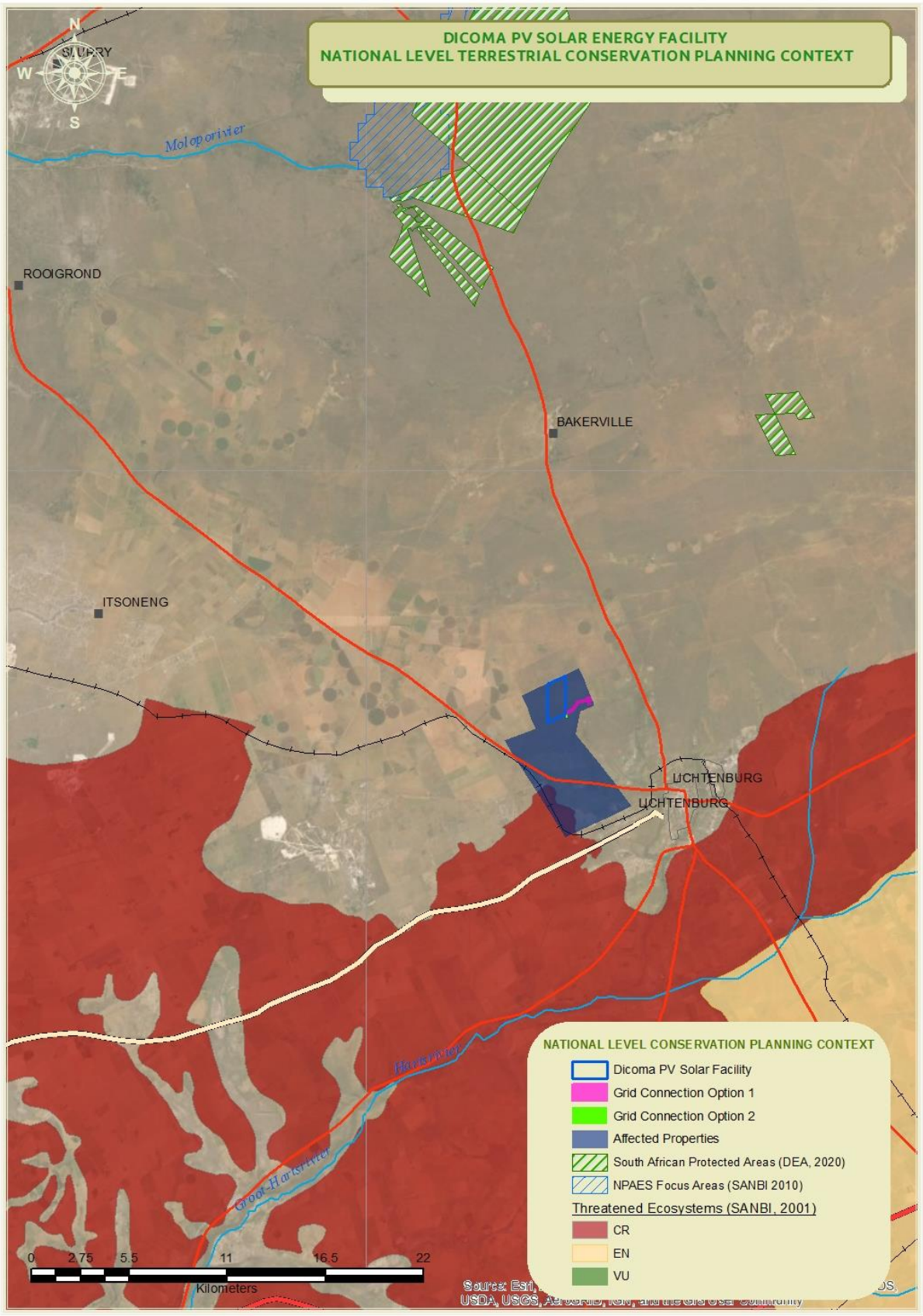

Figure 8: National Level Terrestrial Conservation Planning Context

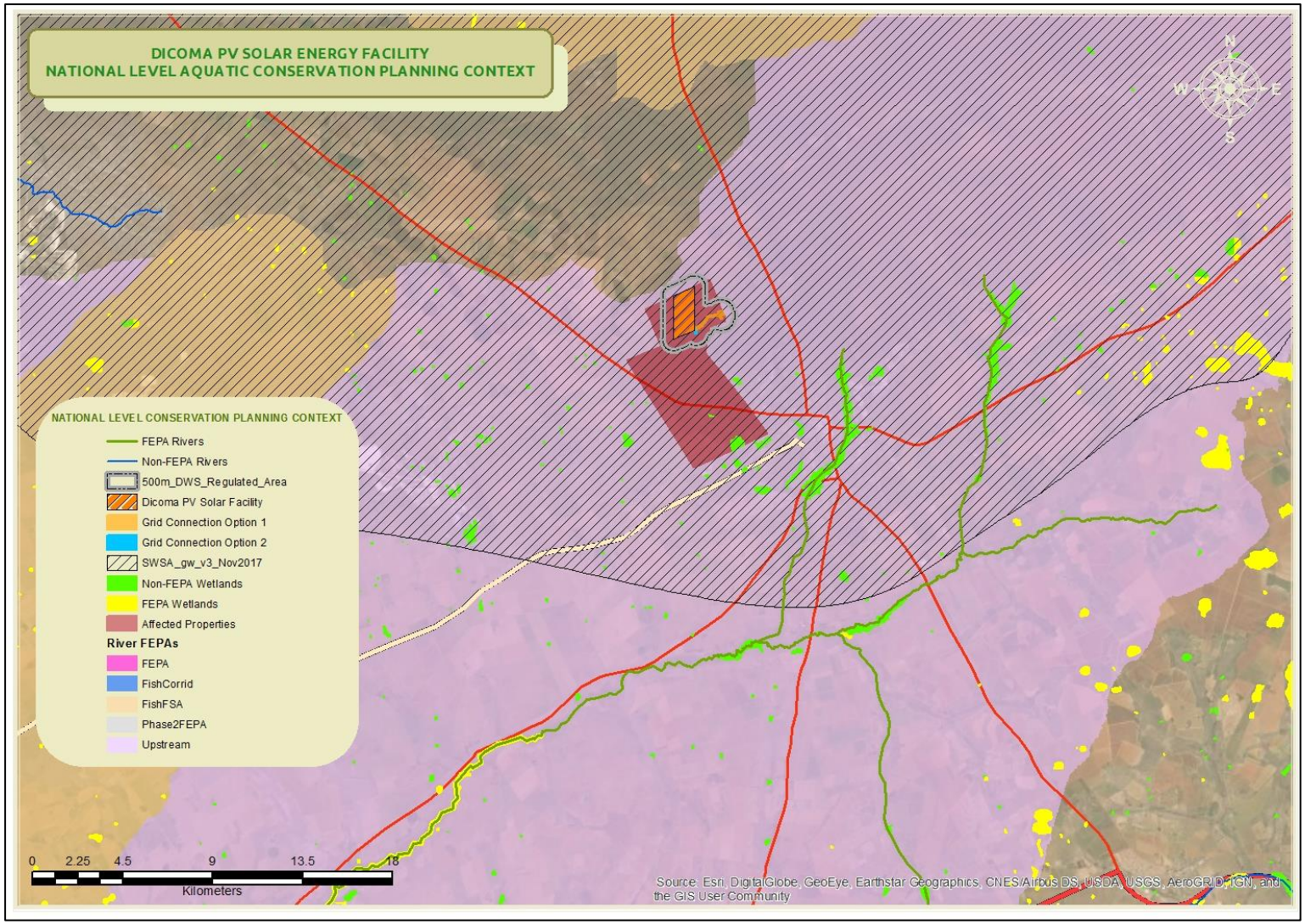

Figure 9: National Level Aquatic Conservation Planning Context.

4.3.5. Critical Biodiversity Areas and Broad Scale Ecological Processes

Critical Biodiversity Areas (CBA) have been identified for the North West Province and are published by SANBI (http://bgis.sanbi.org/). This biodiversity assessment identifies CBAs representing biodiversity priority areas that should be maintained in a natural to near-natural state. CBA maps show the most efficient selection and classification of land portions to be safeguarded so that ecosystem functioning is maintained and national biodiversity objectives are met (see Table 10 for CBA land management objectives).

In terms of Terrestrial CBAs approximately 98% of the PV Solar's footprint is located within a T_ESA1, whilst the entire proposed footprint (all options) for the grid infrastructure is located within the T_ESA1 (Figure 9). In terms of Aquatic CBAs, the entire development footprint (PV Solar and grid connection) is located within an A_ ESA1 (Figure 11).

Definitions and descriptions of Critical Biodiversity Areas of the North West Province

Critical Biodiversity Areas (CBAs) are terrestrial and aquatic features in the landscape that are critical for retaining biodiversity and supporting continued ecosystem functioning and services. These form the key output of a systematic conservation assessment and are the biodiversity sectors inputs into multi-sectoral planning and decision-making tools. The use of CBAs within the North West Province follows the definition laid out in the guideline for publishing bioregional plans (Anon, 2008).

The identification and mapping of CBAs forms part of the biodiversity assessment of the North West Province which will be used to inform the development of the Provincial Biodiversity Sector plans, bioregional plans, and will also be used to inform Spatial Development Frameworks (SDFs), Environmental Management Frameworks (EMFs), Strategic Environmental Assessments (SEAs) and in Environmental Impact Assessment (EIA) processes in the province. Simply put, the purpose of the CBA is to spatially indicate the location of critical or important areas for biodiversity in the landscape. The CBA, through the underlying land management objectives that define the CBA, prescribes the desired ecological state in which the province would like to keep this biodiversity. Therefore, the desired ecological state or land management objective determines which land-use activities are compatible with each CBA category based on the perceived impact of each activity on biodiversity pattern and process.

According to the guidelines for bioregional plans, three basic CBA categories can be identified based on three high-level management objectives (Table 9).

Table 9: Definitions and framework for linking CBAs to land-use planning and decision-making guidelines based on a set of high-level land biodiversity management objectives (Adapted from the guidelines for bioregional plans (Anon 2008).

CBA category	Land Management Objective
Critical Biodiversity Areas (CBAs) Definition: CBAs are areas of the landscape that need to be maintained in a natural or near-natural state in order to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. In other words, if these areas are not maintained in a natural or near-natural state then biodiversity conservation targets cannot be met. Maintaining an area in a natural state can include a variety of biodiversity-compatible land uses and resource uses.	
Protected Areas (PA) & CBA 1	***Natural landscapes:*** » Ecosystems and species are fully intact and undisturbed. » These are areas with high irreplaceability or low flexibility in terms of meeting biodiversity pattern targets. If the biodiversity features targeted in these areas are lost then targets will not be met. » These are landscapes that are at or past their limits of acceptable change.
CBA 2	***Near-natural landscapes:*** » Ecosystems and species largely intact and undisturbed. » Areas with intermediate irreplaceability or some flexibility in terms of the area required to meet biodiversity targets. There are options for loss of some components of biodiversity in these landscapes without compromising the ability to achieve targets. » These are landscapes that are approaching but have not passed their limits of acceptable change.
Ecological Support Areas (ESAs) Definition: ESAs are areas that are not essential for meeting biodiversity representation targets/thresholds but which nevertheless play an important role in supporting the ecological functioning of critical biodiversity areas and/or in delivering ecosystem services that support socio-economic development, such as water and food provision, or carbon sequestration. The degree of restriction on land use and resource use in these areas may be lower than that recommended for critical biodiversity areas.	
ESA	***Functional landscapes:*** » Ecosystem moderately to significantly disturbed but still able to maintain basic functionality. » Individual species or other biodiversity indicators may be severely disturbed or reduced. » These are areas with low irreplaceability with respect to biodiversity pattern targets only.
ONA (Other Natural Areas) and Transformed	Production landscapes: Manage land to optimise sustainable utilisation of natural resources.

The high-level land management objectives (natural, near-natural and functional) can be further unpacked using the three ecosystem integrity indicators namely; ecosystem composition, structure and function. Composition relates to biodiversity pattern, whereas structure and function relate to ecological process and services (Table 10).

Table 10: A summary of the CBA map categories used in relation to the biodiversity-related land management objectives and potential landscape-level biodiversity indicators.

Land Management Objective:	**Land Management Objective Biodiversity Indicators**			
	Component of biodiversity:	Biodiversity Pattern	Ecological Processes and Services	
	Indicator category	Composition	Structure	Functioning

	Specific Indicators	» Habitat types, » Species; » Populations; » Met-populations; » Alien plants	» Transformation; » Fragmentation	» Fire; » Grazing regimes; » Biogeochemical processes; » Hydrological functioning; » Soil formation and erosion; » Biotic processes.
	CBA Category	*Limit of Acceptable Change (LAC): Permitted amount or degree of change in biodiversity indicator.*		
Natural	PA / CA	None	None	None
	CBA 1	None	None	None
Near-Natural	CBA 2	Some	Some	None
Functional	ESA 1	Significant	Some	None
	ESA 2	Significant	Some	Some
	ONA	Significant	Significant	Some
	Transformed	Significant	Significant	Significant

Description/Discussion of Critical Biodiversity Areas within the study area.

Terrestrial Critical Biodiversity Areas: Almost the entire development footprint (gird and PV Solar) is located within an ESA1(>90% of development footprint). The ESA 1 functions as a linkage/corridor (comprising of natural vegetation) between the major freshwater resource features (Harts River and Molopo River watercourses and associated tributaries) and their fringing terrestrial habitats.

This function of forming a corridor for movement (within the potential area of influence) is somewhat influenced, mainly through the highly fractured nature of the landscape (access roads, cultivated areas, boundary and other farm fences). Having said this, the natural to semi-natural areas are still likely to provide habitat for numerous smaller mammals as well as reptile species.

Due to the large extent of this ESA1, and the availability of ample natural to near natural areas still available between the two mentioned valleys the development will unlikely have an impact on this ESA, and its ability to function as an important corridor.

Aquatic Critical Biodiversity Areas: As for the Aquatic Critical Biodiversity Areas, the entire project site is located within an extensive ESA1. This ESA1 is associated with the Bo-Molopo Karst Belt and is regarded as an important recharge area.

As already mentioned, due to the nature of a Solar PV developments and their associated infrastructure (limited use of chemicals, hazardous and toxic materials), it is unlikely that such a development will have a significant impact on groundwater quality. However, Solar PV developments may slightly influence local infiltration and subsequently ground water recharge. This impact can however, be successfully mitigated through careful planning and with effective mitigation measures in place.

As already mentioned, the site has been visited twice during 2021. Part of the purpose of the site visit was to determine the status, condition and capabilities of these ESAs to fulfil their respective ecological functions and to determine whether the proposed development will have a potential detrimental impact on these areas and their functions. The ecological sensitivity and potential classification as no-go areas will be discussed within Section 4.4

The following aspects of the site visit should be taken into account:

» Both site visits were relative high-level visits with the aim of determining wat relating activities will be acceptable within the ESAs and whether the ESA areas within the site should receive any special conservation consideration (e.g. classified as No-Go areas that should be excluded from the project).
» The site visits were conducted during the inactive, dry season as well as the active wet season.

The following observations regarding the CBAs within the study area were made following the site visits:

Terrestrial ESA1: Vegetation of the study area was confirmed to consists of Carletonville Dolomite Grasslands with a relative small-scale plant diversity. Three major vegetation patterns were identified, namely a plagioclimax grassland found on old, historical cultivated areas, a thorny- open savanna grassland to the north-east and an open parkland type of savanna to the east and south. Small variations within these major vegetation units manly due to variations in surface rockiness/soil depth as well as past and current disturbances (e.g. trampled areas). Around man-made watering points, homesteads and closer to the entrance and existing power line, weeds and alien invasives become more prominent.

Both types of open savanna grassland were found to be largely natural and is capable of fulfilling the functions and services that is typical of an ESA1, however the extent of the ESA within the project area is somewhat over calculated as a portion of this ESA1 has been historically cultivated and is now covered by a plagioclimax grassland, which should, according to the definitions of the various ESAs, rather be classified as an ESA2. Furthermore, the affected properties as well as the neighbouring properties comprise of numerous small fenced grazing camps which most likely have had an impact on the connectivity of the landscape thus slightly impacting the integrity of the ESA1.

Furthermore, as already described the development will unlikely have a detrimental impact on this ESA, and its ability to function as an important corridor. Furthermore, with careful planning and the necessary mitigation measures in place, the impact of this development on the greater extent ESA1 corridor can be affectively minimised to an acceptable level.

4.3.6. National Freshwater Ecosystem Priority Areas (2011) Database

The National Freshwater Ecosystems Priority Areas (NFEPA) (2011) database provides strategic spatial priorities for conserving South Africa's freshwater ecosystems and supports the sustainable use of water resources. The spatial priority areas are known as Freshwater Ecosystem Priority Areas (FEPAs).

FEPAs were identified based on:

- Representation of ecosystem types and flagship free-flowing rivers.
- Maintenance of water supply areas in areas with high water yield.
- Identification of connected ecosystems.
- Preferential identification of FEPAs that overlapped with"
    - Any free-flowing river
    - Priority estuaries identified in the National Biodiversity Assessment 2011.
    - Existing protected areas and focus areas for protected area expansion identified in the National Protected Area Expansion Strategy.

FEPA maps show various different categories, each with different management implications. The categories include river FEPAs and associated sub-quaternary catchments, wetland FEPAs, wetland clusters, Fish Support Areas (FSAs) and associated sub-quaternary catchments, fish sanctuaries, phase 2 FEPAs and associated sub-quaternary catchments, and Upstream Management Areas (UMAs).

A review of the NFEPA coverage for the study area (Figure 9) revealed that the entire project site is located within a sub-quaternary catchment classified as an "Upstream Management Area" (UMA). These UMAs represent sub-quaternary catchments in which human activities need to be managed to prevent degradation of downstream river FEPAs and Fish Support Areas but do not include management areas for wetland FEPAs, which need to be determined at a finer scale (Driver et al., 2011). The most important drainage feature within this sub-quaternary catchment is an unnamed tributary of the Harts River, located some 7.4km to the south-east of the project site. No watercourse (FEPA or Non-FEPA) drain the project site or the 500m DWS regulated area, according to available NFEPA (2011) and SANBI (2018) spatial data. This was confirmed during the pre-screening site visit/survey. Based on the analysis of the available spatial data as well as the screening site visit it was determined that this development will not impact any watercourses directly or through significant alteration to their catchments.

Furthermore, no freshwater wetlands have been mapped/listed within the proposed development site or within close proximity to the site (500m regulated DWS area), according to NFEPA (2011) and SANBI (2018) spatial datasets.

This was confirmed during the site visits. Based on the analysis of the available spatial data as well as the site visits it was determined that this development will not impact any wetland features directly or through significant alteration to their catchments.

Subsequently, no freshwater resource features will be impacted by the proposed development and as such further assessments relating freshwater resource features (during the EIA phase) will not be necessary.

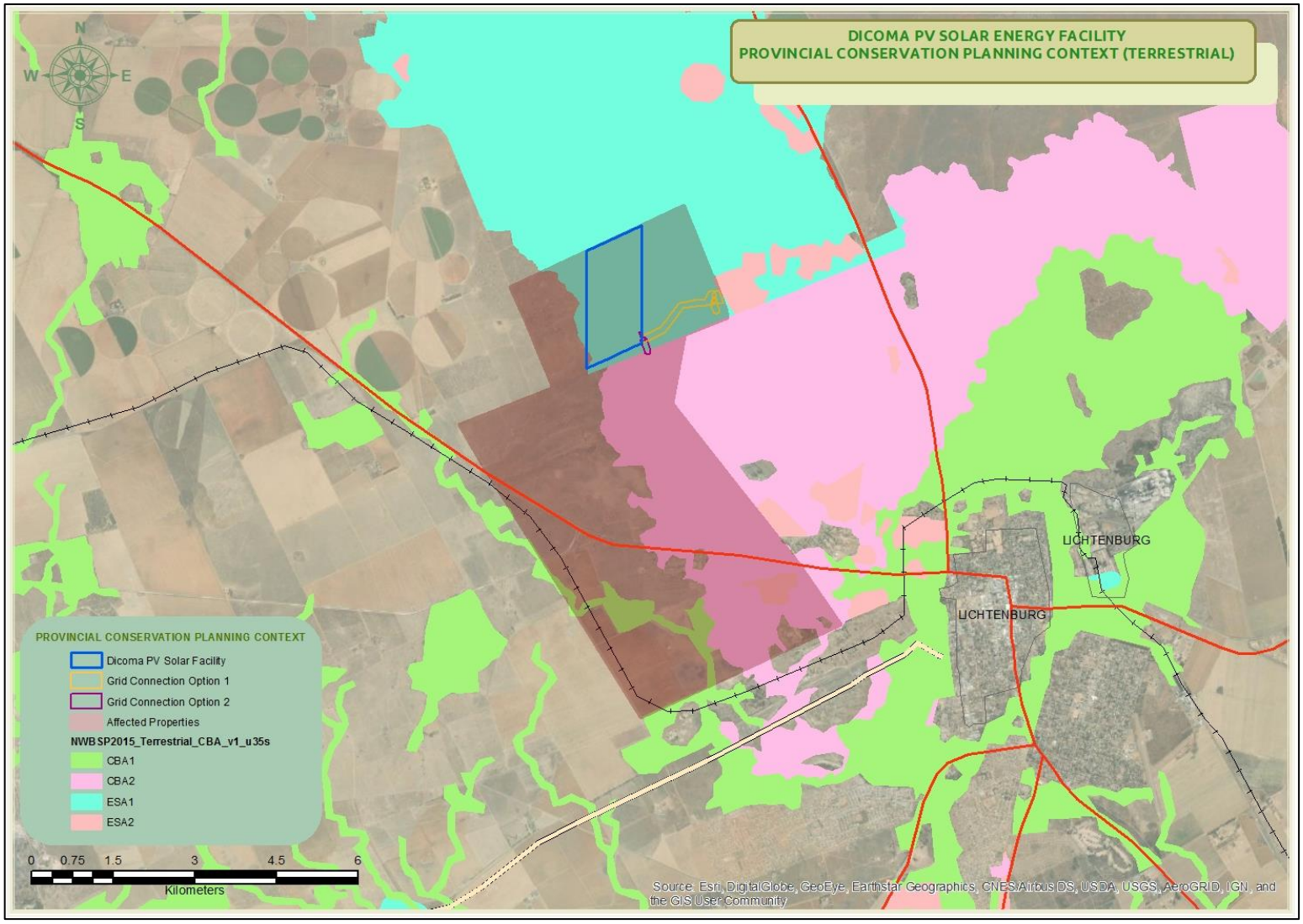

Figure 10: Provincial Level Conservation Planning Context – Terrestrial CBA Map (North West Province Biodiversity Conservation Assessment).

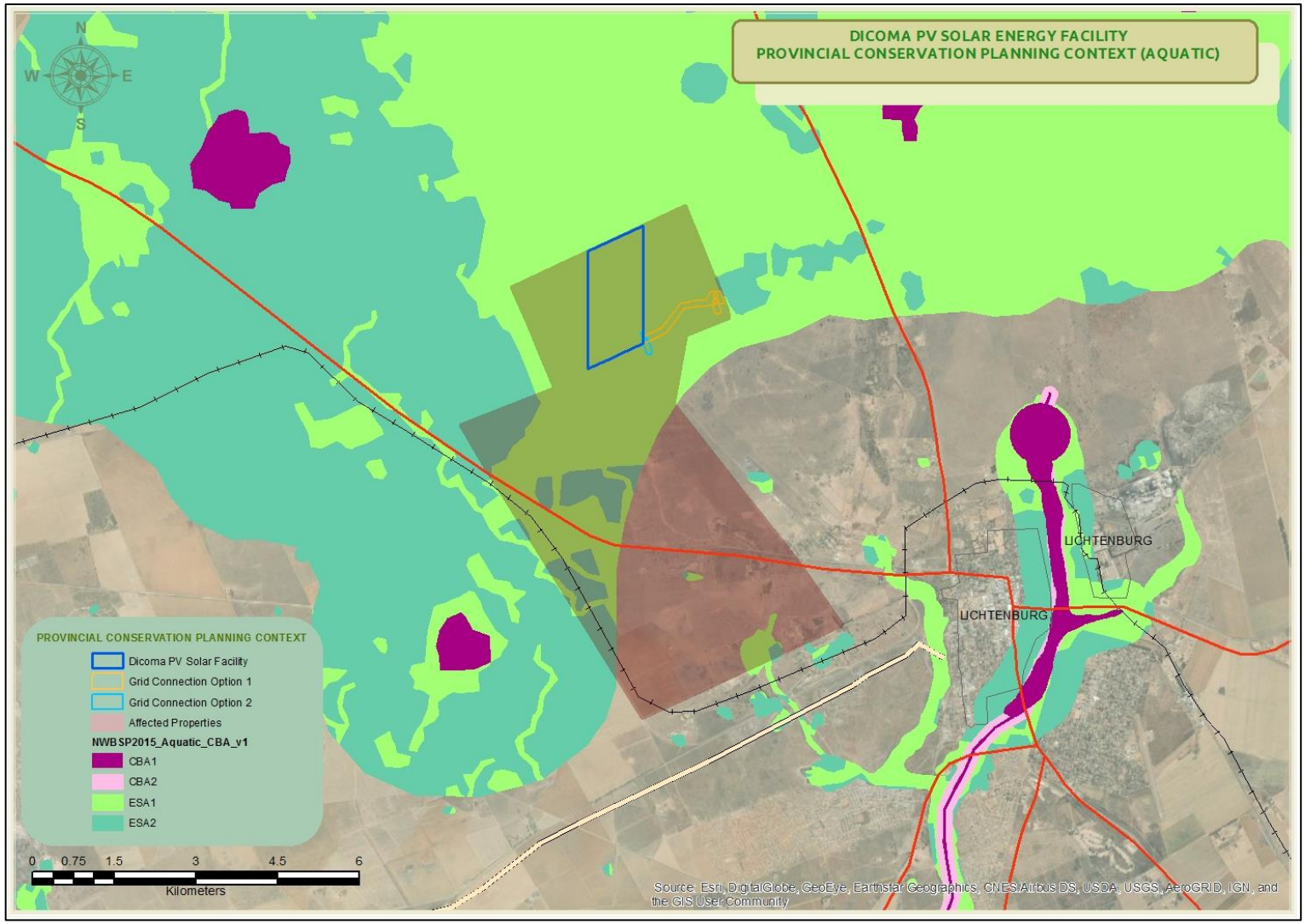

Figure 11: Provincial Level Conservation Planning Context – Aquatic CBA Map (North West Province Biodiversity Conservation Assessment).

5. DESCRIPTION OF THE AFFECTED ENVIRONMENT – BASELINE

5.1. Broad-Scale Vegetation Patterns

5.1.1. National Vegetation Map of Southern Africa

This section deals with vegetation types as described in the National Vegetation Map of Southern Africa, which will be used interchangeably with the term "VegMap" (Dayaram et al., 2018; Mucina and Rutherford, 2006 and SANBI 2018; these references are the rest of this section)

The overall project area is situated within the grassland biome. The grassland biome comprises many different bioregions and vegetation types. The project site is located within the Dry Highveld Grassland Bioregion with the entirety of project site located within a single vegetation type namely; Carletonville Dolomite Grassland (Gh15) (Figure 8 and Figure 10; also see Figure 12).

5.1.1.1. Carletonville Dolomite Grassland (Gh15)

This vegetation unit is moderate in size, covering an area of approximately 9117.8 km^2. Gh15 is mostly found within the North-West Province extending into Gauteng and a small portion of the Free State Province, and is predominantly associated with the Potchefstroom, Ventersdorp and Carletonville regions. This vegetation type extends westwards to the vicinity of Ottoshoop and to the east as far as Centurion and Bapsfontein (Gauteng Province). Gh15 is mainly found between elevations of 1 360 – 1 620 m but mostly between 1 500 – 1 560 m.

This vegetation type has been described by Mucina and Rutherford (2006) as species-rich grasslands forming a complex mosaic pattern across slightly undulating plains dissected by prominent rocky chert ridges. Depending on specific underlying geology and soils, the species composition of plant communities varies in a complex mosaic pattern, and several species may be co-dominant.

Typical plant communities are dominated by the grasses *Brachiaria serrata*, *Cynodon dactylon, Digitaria tricholaenoides, Diheteropogon amplectens, Themeda triandra, Eragrostis chloromelas, Setaria sphacelata*, and *Heteropogon contortus*. Prominent forbs and low shrubs include *Acalypha angustata, Barleria macrostegia, Crabbea angustifolia, Dicoma anomala*, and several *Helichrysum* species.

The diversity of perennial grasses and forbs is typically high for these grasslands.

The typical low grasslands are interspersed with a low density of high shrubs and low trees. Most of these are *Acacia, Ziziphus* and *Searsia* species. Soils are loamy and appear relatively shallow with sections of prominent surface rock (dolomite). Grazing capacity is estimated to be approximately 11 – 15 ha / large livestock unit.

The unit is classified as Least Threatened with a target of protection of 24%. Only a small portion is statutorily conserved. According to Mucina and Rutherford (2006), almost a quarter of this vegetation type has already been transformed for cultivation, by urban sprawl or by mining activities as well as the building of dams. The unit has a very low to low level of erosion.

Table 11: *Key species associated with Hantam Karoo (SKt 2).*

DOMINANT SPECIES	
Growth Form	**Key Species**
Graminoids	*Aristida congesta, Brachiaria serrata, Cynodon dactylon, Digitaria tricholaenoides, Diheteropogon amplectens, Eragrostis chloromelas, E. racemosa, Heteropogon contortus, Loudetia simplex, Schizachyrium sanguineum, Setaria sphacelata, Themeda triandra, Alloteropsis semialata subsp. eckloniana, Andropogon schirensis, Aristida canescens, A. diffusa, Bewsia biflora, Bulbostylis burchellii, Cymbopogon caesius, Elionurus muticus, Eragrostis curvula, E. gummiflua, E. plana, Eustachys paspaloides, Hyparrhenia hirta, Melinis nerviglumis, M. repens subsp. repens, Monocymbium ceresiiforme, Panicum coloratum, Pogonarthria squarrosa, Trichoneura grandiglumis, Triraphis andropogonoides, Tristachya leucothrix, T. rehmannii*
Low shrubs	*Anthospermum rigidum subsp. pumilum, Indigofera comosa, Pygmaeothamnus zeyheri var. rogersii, Searsia magalismontana, Tylosema esculentum, Ziziphus zeyheriana.*
Herbs	*Acalypha angustata, Chamaecrista mimosoides, Euphorbia inaequilatera, Crabbea angustifolia, Dianthus mooiensis, Dicoma anomala, Helichrysum caespititium, H. miconiifolium, H. nudifolium var. nudifolium, Ipomoea ommanneyi, Justicia anagalloides, Kohautia amatymbica, Cyphocarpa angustifolia, Ophrestia oblongifolia, Pollichia campestris, Senecio coronatus, Hilliardia oligocephala*
Geophytic Herbs	*Boophone disticha, Habenaria mossii*
Succulent Herbs	*Tripteris aghillana var. integrifolia*
Geoxylic Suffrutex	*Elephantorrhiza elephantina, Parinari capensis subsp. capensis.*
ENDEMIC SPECIES	
Growth Form	**Key Species**
Succulent Shrubs	*Delosperma davyi*

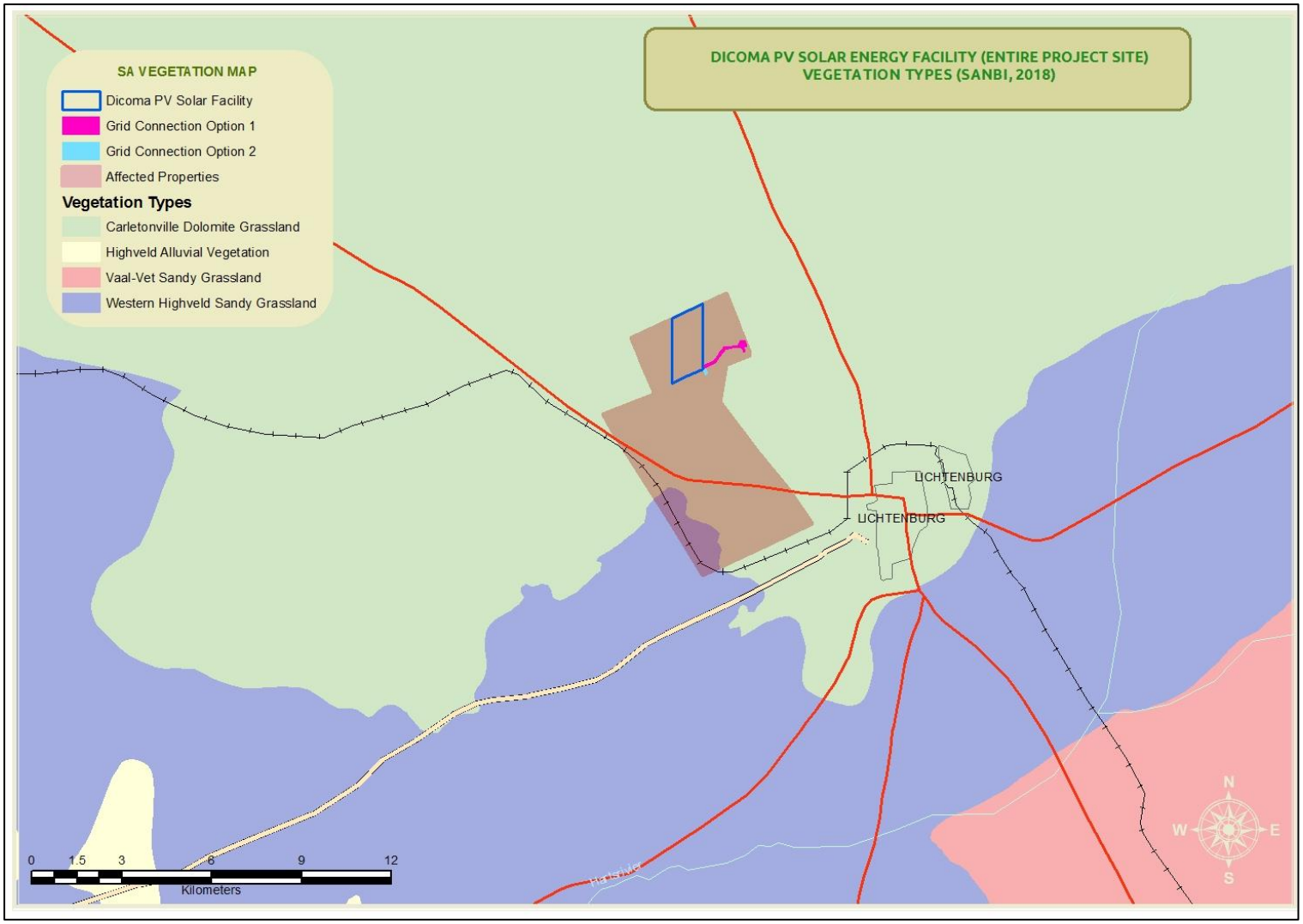

Figure 12: Map illustrating the different vegetation types, according to VegMap 2018, found on the project site and in the general region.

5.2. Species of Conservation Concern

A list was obtained from the SANBI database (POSA — Plants of southern Africa; http://posa.sanbi.org/) containing all plant species that have been recorded to date from the surroundings of the study area. POSA generated species lists also contain updated Red Data information according to the Red List of South African Plants (Raimondo et al., 2009; updated online version: http://redlist.sanbi.org/). Species listed as protected were also identified in the list. Therefore, only SoCC that may potentially occur in the study area have been listed within the baseline study section of this report. The field surveys were aimed at confirming which of these species actually occur within the study area, and also whether any additional species that may not yet have been recorded in official databases, are present on site (see section 6.2).

Of the 453 -plant species, three are listed Red Data species whilst 16 South African Endemic species have been recorded within the region (Table 12). Furthermore, according to the generated species list, 8 species have been recorded within the area which is protected under the Transvaal Nature Conservation Ordinance, whist one tree species has been recorded which is protected under the National Forest Act namely *Vachellia* (*Acacia*) *erioloba*.

A previous study conducted by Strohbach (2013) within the affected properties identified 187 species with a second-order jack-knife estimate of 271 species. Furthermore, this study did not confirm any plant SCC (Red data and range restricted species), however 10 South African Endemic species, five provincially protected and one national protected tree species (*V. erioloba*) was confirmed within the affected properties (Table 12).

Table 12: List of floral species that are of conservation concern, and/or protected within the various relative environmental legislatures and which may potentially be found within the development footprint.

Species	STATUS	BODATSA-POSA, 2021	Strohbach, 2013	Likelihood of Occurrence
Nananthus vittatus	DD	X		Low
Cleome conrathii	NT & Endemic	X		Moderate
Brachystelma incanum	VU & Endemic	X		Moderate
Gladiolus elliotii	Protected	X		Low
Gladiolus permeabilis	Protected	X		Moderate
Gladiolus sp.	Protected	X		
Crinum graminicola	Protected	X		Moderate
Crinum macowanii	Protected	X	X	High
Brachystelma foetidum	Protected	X		High
Habenaria epipactidea	Protected	X		Low
Acacia erioloba	Protected	X	X	Confirmed
Schizocarphus nervosus	Protected	X		Confirmed

In terms of the Red Data species recorded within the region; one species is listed as Data Deficient (DD), one species as Near Threatened (NT) and one as Vulnerable (VU).

Nananthus vittatus (Brakveldvygie): *N. vittatus* is a dwarf succulent listed as Data Deficient and is typically associated with short grasslands on brackish, black, loamy-clay to clayey soils (bottomlands and edges of drainage systems and pans). This mesemb has a distribution that includes the Free State-, Northern Cape- and North West Province. This species was not confirmed during the site visits, and based on the observations made during this site visit it was determined that there is a Low Likelihood of Occurrence due to the mostly absence of preferred edaphic factors and habitats. However, this species can tolerate a wide variety of environmental factors and rocky areas (dolerite outcrops) with shallow soils and a low grass cover may provide suitable habitat for this species.

Cleome conrathii: This small (10 – 30cm) erect annual herb is listed as Near Threatened (D2) by Pfab et al. (2005) and is known from eight locations found within the Gauteng, North West and Northern Cape Province (South African Endemic - Kuruman to Pretoria). Even though populations are regarded as stable, urban expansion, invasive alien plants, a deleterious fire regime, overgrazing, trampling and erosion may pose a future threat to populations. This species is found within the grassland and savanna biomes where it prefers stony quartzite slopes, usually in red sandy soils. This species was not confirmed during the site visits, and based on the observations made during this site visits it was determined that there is a Moderate Likelihood of Occurrence due to some potential preferable habitat within the project area.

Brachystelma incanum: This is a tuberous perennial herb with short decumbent to slightly spreading annual shoots and is listed as Vulnerable (B1ab(iii)) by Hahn & von Staden (2016). This South African Endemic species has a fairly wide distribution range but is very rare within this range (Fee State- and North West Province). This species is known form 10 populations (Lichtenburg, Wolmaransstad and Sasolburg) which is currently under threat due to ongoing habitat loss and degradation (large portion of habitat is lost due to agriculture, urban expansion and mining). *B. incanum* prefers sandy loam soils in thornveld and *Themeda*-grassland. This species was not confirmed during the site visits, and based on the observations made during this site visit it was determined that there is a Moderate Likelihood of Occurrence due to some potential preferable habitat within the project area. These tuberous species tend to become inactive/dormant during the dry, colder months with their shoots dying back and may make it difficult to identify these species outside of the active growing season.

6. FINDINGS OF THE BOTANICAL ASSESSMENT

6.1. Site Specific Vegetation Description – Fine Scale Vegetation Patterns

In this section, the different habitats and vegetation patterns observed within the study site are described. As these are field-based observations taken directly from the site, they are of greater reliability and pertinence than the coarsely mapped results of the National Vegetation Map, which does not represent the finer details of the site adequately.

According to the National Vegetation Map 2018, only Carletonville Dolomite Grassland is mapped for the proposed development footprint (see Figure 12 and section 5.1.1). Ground truthing confirmed that the vegetation found within die development footprint was consistent with that characteristic of Carletonville Dolomite Grassland.

Small-scale plant diversity and ecological state of vegetation varied across the development footprint and was primarily driven by edaphic and geological factors as well as land use practices (current and historical). Soil depth and surface rockiness were determined to be the most important drivers followed by land use practices (historical cultivation).

Following the site visit three vegetation communities were identified namely:

- *Searsia pyroides – Elionurus muticus* open savanna-grassland on shallow soils overlying dolerite (VegComm SE).
- *Senegalia hereroensis – Triraphis andropogonoides* open savanna-grassland on shallow to moderately shallow soils overlying chert and dolerite (VegComm AT).
- *Hyparrhenia hirta – Eragrostis lehmanniana* secondary grassland on moderately deep soils (VegComm HE)

Some variations may occur within these vegetation communities especially within disturbed areas such as around livestock watering points, kraals, homesteads, along power lines, access routes and firebreaks. Livestock watering points, kraals and homesteads are typically characterised by weedy as well as alien invasive plants.

Representative photos of the various units are shown in Figure 14 – Figure 16, while Figure 17 – Figure 19 shows photos of some plant species found in each of them. Also, total area sizes for the vegetation types (within the development footprint) are given by Table 14 and a species summary is given by Table 15.

Briefly: a total of 225 plant species were found on site, indicating a fairly moderate species diversity. Grasses formed the dominant layer, however forbs where also quite prominent and relive high in diversity. Higher shrubs and trees were typically clustered together with such clumps scattered throughout the grassland. However, the historically ploughed area

comprised fewer trees and shrubs. As mentioned, the forb and graminoid layer were well developed and are represented by 137 species (86 forbs and 51 graminoid species). Even though the tree and tall shrub layer are represented by a low diversity of species (17 species), these species play an important role in the vegetation structure of the project site. Geophytes (10.2%), dwarf shrubs (15.5%) and succulents (2.6%) only make up 28.7% of the total species composition. Furthermore, the most dominant plant families within the project site are; Poaceae with 22.2%, Asteraceae with 14.2% and Fabaceae with 7.1%. Other noteworthy plant families observed within the affected properties includes; Malvaceae, Acanthaceae, Apocynaceae, Rubiaceae, Verbenaceae and Amaranthaceae.

Dominant/Key species recorded within the project site are provided below in Table 13

Table 13: Key species identified within the project site

DOMINANT SPECIES	
Growth Form	**Key Species**
Graminoids	*Anthephora pubescens, Aristida diffusa, A. congesta, A. adscensionis, A. meridionalis Cymbopogon caesius, C. pospischilii, Cynodon dactylon, Elionurus muticus, Eragrostis gummiflua, E. lehmanniana, E. trichophora, Heteropogon contortus, Schizachyrium jeffreysii, Themeda triandra, Triraphis andropogonoides, Hyparrhenia hirta, Stipagrostis uniplumis*
High Shrubs and Trees	*Vachellia erioloba, Senegalia hereroensis, Celtis africana, Grewia flava, Gymnosporia heterophylla, Searsia lancea, S pyroides.*
Low shrubs	*Asparagus setaceus, A. suaveolens, Clematis brachiata, Indigofera heterotricha, Lippia scaberrima, Rosenia humilis, Selago densiflora, Hilliardiella oligocephala, Helichrysum zeyheri, Felicia muricata*
Herbs	*Achyranthes aspera, Berkheya onopordifolia, Chaetacanthus costatus, Geigeria burkei, Helichrysum aureonitens, H. cephaloideum, H. melanacme, Ipomoea oblongata, Barleria macrostegia, Dicoma anomala, Blepharis squarrosa, Pentarrhinum insipidum, Senecio coronatus, S. venosus, Ursinia nana*
Geophytic Herbs	*Boophone disticha, Hypoxis rigidula, Ledebouria cooperi, Rhynchosia minima, Babiana hypogea*
Succulent Herbs	*Aloe davyana*
Geoxylic Suffrutex	*Elephantorrhiza elephantina, Ziziphus zeyheriana.*

During the survey no Species of Conservation Concern (SoCC) where recorded within the project site, whilst four protected species were observed and eight South African endemics. All of the SA endemic plants observed within the project site, can be regarded as fairly abundant within their ranges.

The following protected species were observed;

- *Acacia erioloba* (National Forest Act);
- *Babiana hypogea* (Transvaal Nature Conservation Ordinance);

» *Gladiolus spp*. (Transvaal Nature Conservation Ordinance); and
» *Schizocarphus nervosus* (Transvaal Nature Conservation Ordinance);

The following South African endemics were observed;

» *Gymnosporia polyacantha, Selago tenuifolia, Blepharis squarrosa, B. angusta, Chaetacanthus costatus, Ipomoea bathycolpos, Acalypha caperonioides and Delosperma floribundum*

Even though, the following species are not listed within the Red Data list (2017) or protected within any legislation, these species and their populations have been determined to be declining and it is subsequently worth mentioning:

» *Hypoxis hemerocallidea, Boophone disticha and Pelargonium spp. (sidoides)*

Weeds and invasive alien species are not significantly abundant within the more natural areas and tend to be more prominent within recent and/or regularly disturbed areas such as around the kraals, watering points, access roads and trampled areas. At total of 35 weeds and 16 alien plants (APs) have been observed within the project site, with five of the alien plants being listed as Invasives (IAPs) within the NEM:BA - Alien and Invasive Species List (2020). Weeds and APs frequently observed within disturbed areas include; *Alternanthera pungens, Conyza bonariensis, Schkuhria pinnata, Tagetes minuta, Zinnia peruviana, Verbena aristigera, Aristida congesta, Cynodon dactylon, Chloris virgata*, and *Urochloa panicoides*. Near the homestead a small *Eucalyptus* woodlot have been established. Invasive Alien Plants recorded within the project site include; *Eucalyptus camaldulensis* (woodlot), *E. sideroxylon* (woodlot), *Datura stramonium Verbena bonariensis, V. aristigera* and *Xanthium spinosum*.

Table 14: Total area sizes (approximately) for the fine scale mapped vegetation types.

Vegetation Type	Total Area (ha)	Total Area (%)
Searsia pyroides – Elionurus muticus open savanna-grassland (VegComm SE)	174.6	62.6%
Acacia hereroensis – Triraphis andropogonoides open savanna-grassland (VegComm AT)	28.8	10.3%
Hyparrhenia hirta – Eragrostis lehmanniana secondary grassland (VegComm HE)	67.7	24.3%
Eucalyptus Woodlot	0.7	0.3%
Highly disturbed areas	6.9	2.5%
Total	***279***	***100%***

Table 15: Plant species summary statistics for the vegetation communities. Unique species are those that were only found in the vegetation type in question, and not in the others. Shared species are species of the specific vegetation type that were shared with one or more of the other vegetation types. Thus, since some species were found in more than one vegetation type, the "Total" species numbers given below are not necessarily unique to each type. VegComm = Vegetation community (see text for vegetation community names).

VegComm	Total	Unique	%Unique	Shared	SA Endemic	Red List	Protected (Provincially)	Protected (National Forest Act)	Weeds	Alien Plants (Not Listed)	Invasive Alien Plants (Category 2b)
SE	152	32	21%	120	6	0	1	0	28	6	0
AT	151	32	21%	119	7	0	2	1	19	8	1
HE	125	13	10%	112	4	0	2	1	23	10	3
	259	**N/A**	**N/A**	**N/A**	**8**	**0**	**3**	**1**	**35**	**11**	**3**

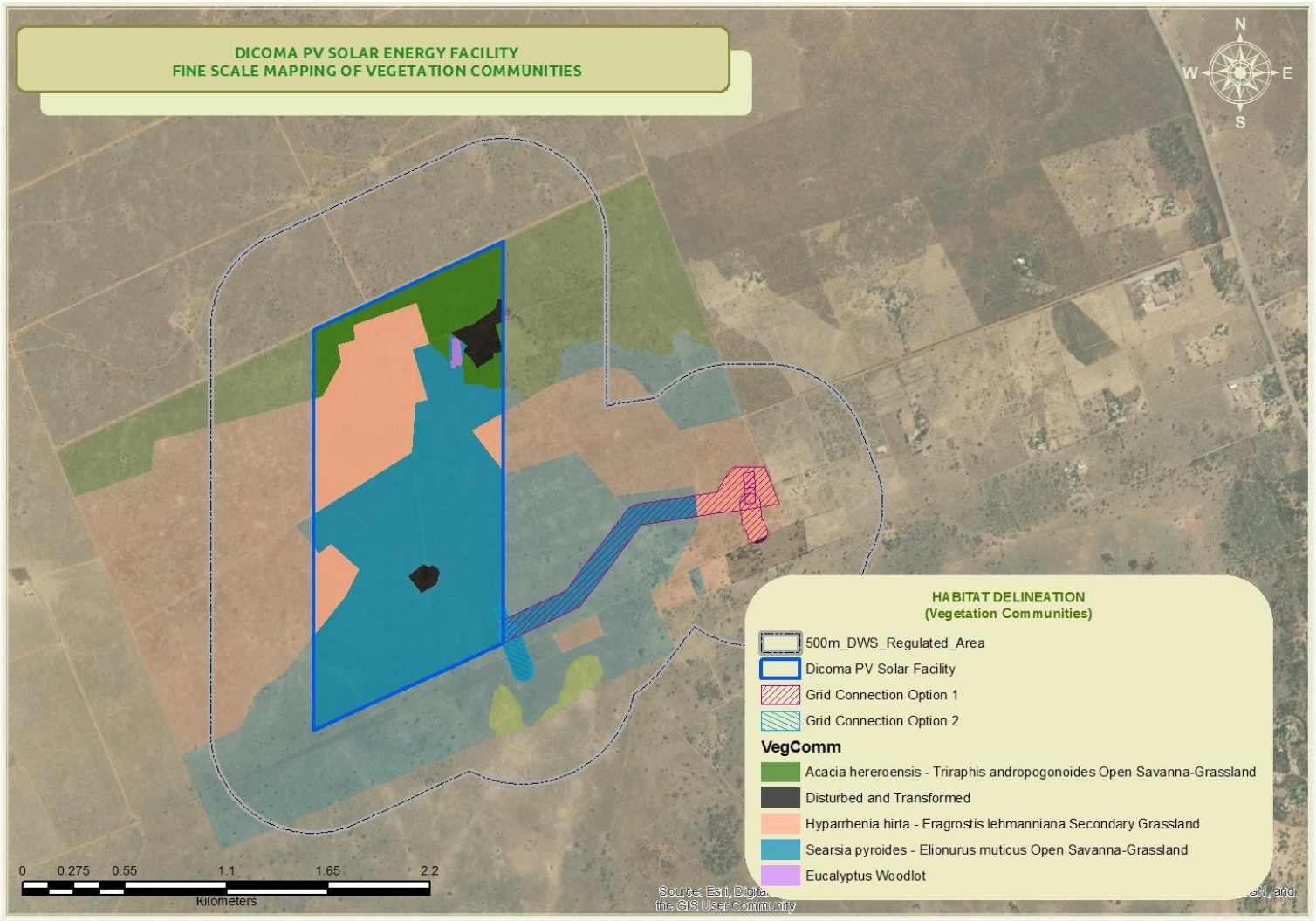

Figure 13: Fine scale mapping (ground truth/actual extent) of vegetation communities identified within the proposed Dicoma PV development footprint.

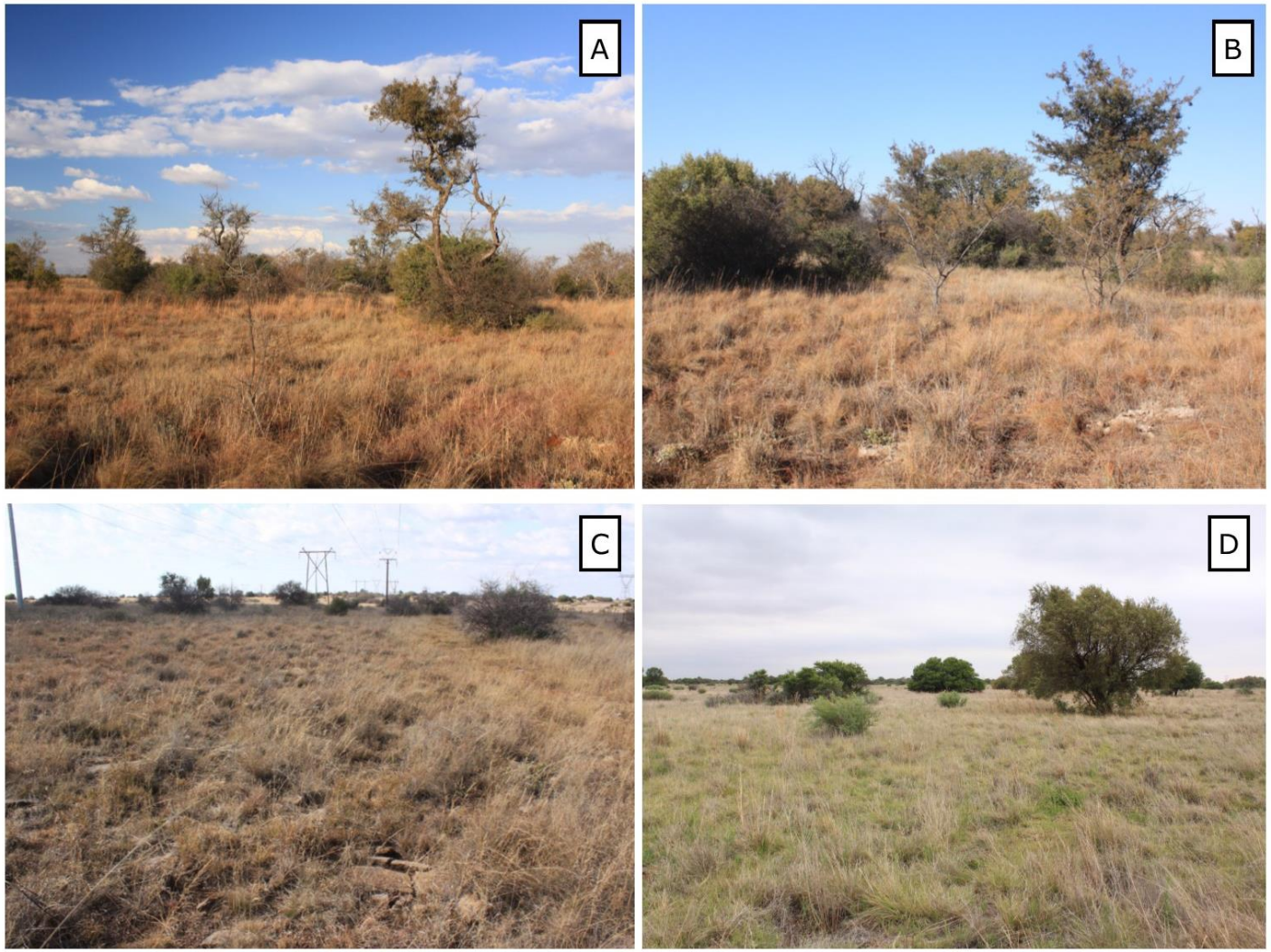

Figure 14: Representative photos of *Senegalia hereroensis – Triraphis andropogonoides* Savanna-Grassland (VegComm AT; A and B) and *Searsia pyroides – Elionurus muticus* Savanna Grassland (VegComm SE; C and D).

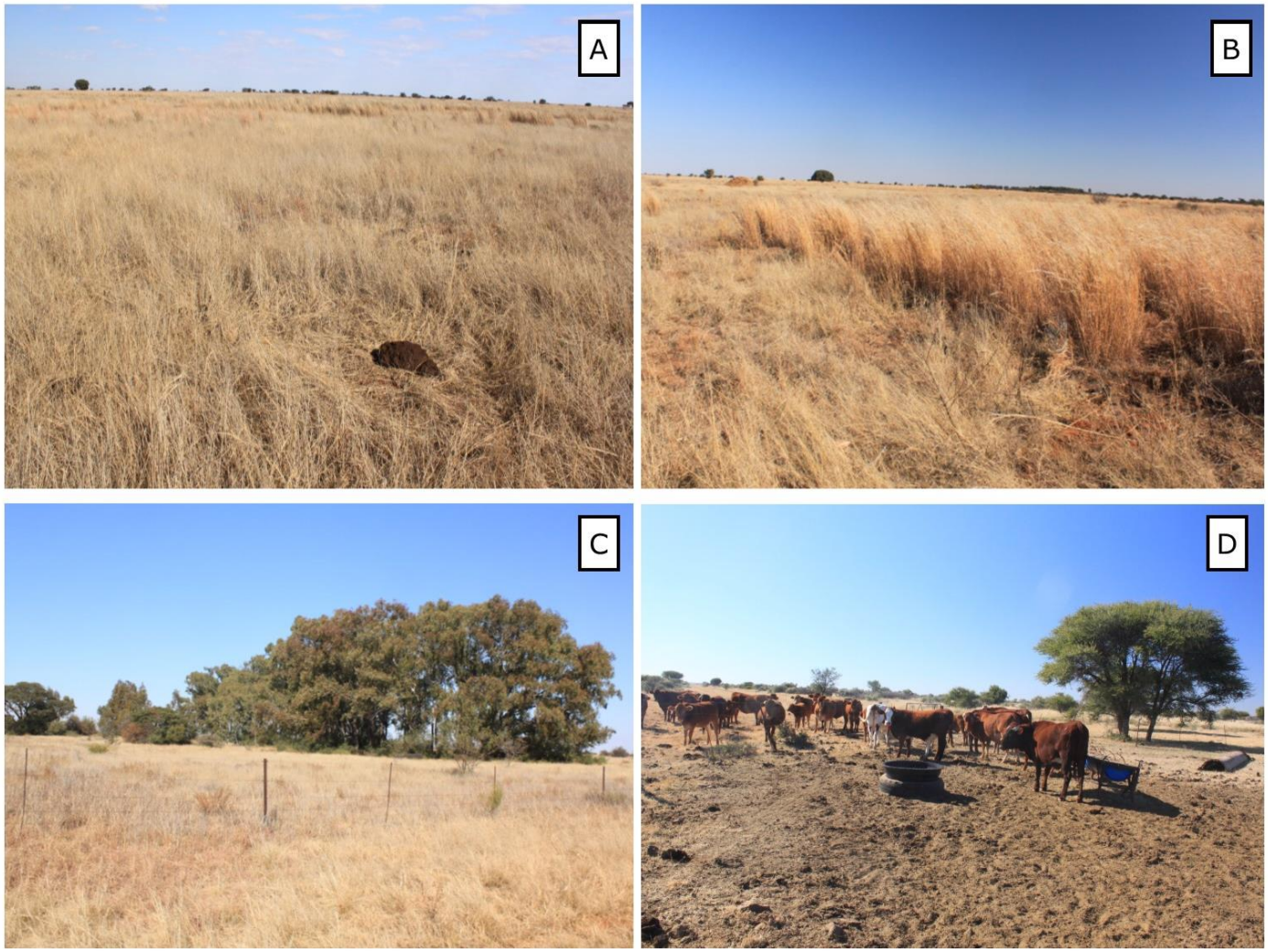

Figure 15: Representative photos of *Hyparrhenia hirta – Eragrostis lehmanniana* Secondary Grassland (VegComm HE, A and B), the *Eucalyptus* woodlot (C) and the primary land use within the project site namely cattle farming (D).

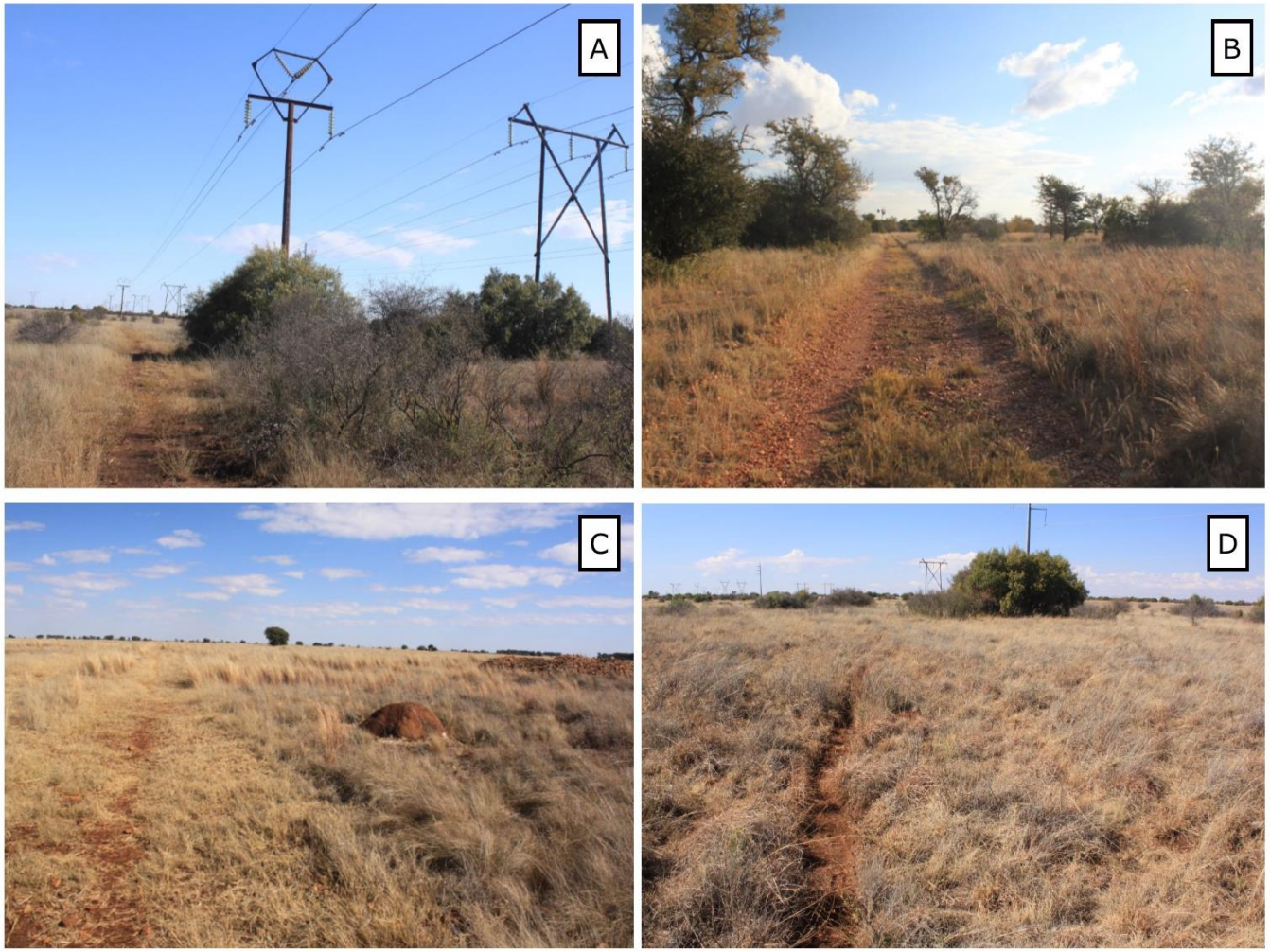

Figure 16: Other forms of infrastructure and disturbances present within the project site: A: Powerline; B: Twin tracks, C: Fire break and twin track and D: Trampled cattle path.

6.1.1. Searsia pyroides – Elionurus muticus Savanna-Grassland (VegComm SE)

The bulk of the project site (62.6%) is located within this vegetation community (easter, southern and most of the central section). This vegetation community has been impacted by historical overgrazing; however, the vegetation cover has since stabilized and comprise moderate dense grass coverage with a few tree/tall shrub clusters scattered throughout this vegetation community. The moderate dense coverage of this grassland is likely due to combination of past management regimes (heavy stocking rates) as well as the relative shallow soils and high degree of surface rockiness.

This savanna-grassland type comprises a dominant open grassland with some scattered shrubs and trees (mainly *Searsia pyroides, S. Lancea, Celtis africana, Gymnosporia polyacanthus, Diospyros lycioides* and *Grewia flava*). Taller trees are relatively scarce and usually clumped together. Such clumps where, as mentioned scarce within the project site and typically comprise of *Searsia lanceae, S. pyroides, Ziziphus mucronata, Celtis africana, Gymnosporia polyacanthus* and *Asparagus setaceus*.

Variations within this community exist within the project site and are mainly as a result of the varying edaphic and geological characteristics as well as grazing impacts. These variations have resulted in a variety of mosaic patches with different small-scale species composition. This array of different microhabitats results in the relative high diversity on these plains. Deeper sandy areas typically comprise of a more open grassland with less trees and shrubs and a well-developed, dense grass layer and a high diversity of forb species. Dominant grass species include; Anthephora pubescens, *Aristida meridionals, A. adscensionis, A. canescens, Eragrostis trichophora, E. lehmanniana, E. chloromelas, Elionurus muticus, Themeda triandra, Cymbopogon caesius, C. pospischilii, Elionurus muticus, Eragrostis trichophora,* and *E. chloromelas*.

Taller shrubs are likely associated isolated deeper soil pockets interspersed between the shallow dolomite areas. These shrubs may occur as singular species dotted throughout the project site, or as clusters of taller tree and shrub species.

The overall ecological state of this vegetation appears to be slightly degraded, considering the relatively moderate vegetation cover and the dominance of low-value and less palatable grasses.

The more natural grassland areas contain very few weeds and aliens, however along the access routes and especially around kraals and watering points, were significant trampling and continued overgrazing have occurred, weeds and alien plants are especially abundant.

A total of 152 species were recorded within this unit, of which 32 were found only in this unit (21%) and 120 were shared with one or more of the other units. Furthermore, six South-African endemics were found in this unit, namely *Gymnosporia polyacanthus, Selago tenuifolia, Ipomoea bathycolpos, Blepharis squarrosa, Chaetacanthus costatus* and *Acalypha caperonioides*. The unit did not contain any Red List species. However, the

following protected species were recorded within this vegetation community; *Schizocarphus nervosus* and *Acacia erioloba*.

As mentioned, the tree/tall shrub layer had a fairly low coverage (±3%) within this community and tend to occur in small clusters scattered throughout this community. The height of this layer was between 3 and 4.5 meters. The grass layer is the dominant layer, covering approximately 50-75% of this community. Even though the forb layer only constitutes 20% of the total cover, this layer contains the highest species diversity.

It is expected that the bulk of the PV panels of the development will be situated within this savanna-grassland community, furthermore the bulk of both gridline options will traverse this vegetation community whilst gridline option one's onsite substation will be also be located within this community. Due to the slight degraded nature of this vegetation community, as well as the fairly large extent of this community within the area (well beyond the development footprint), development within this vegetation community is regarded as acceptable.

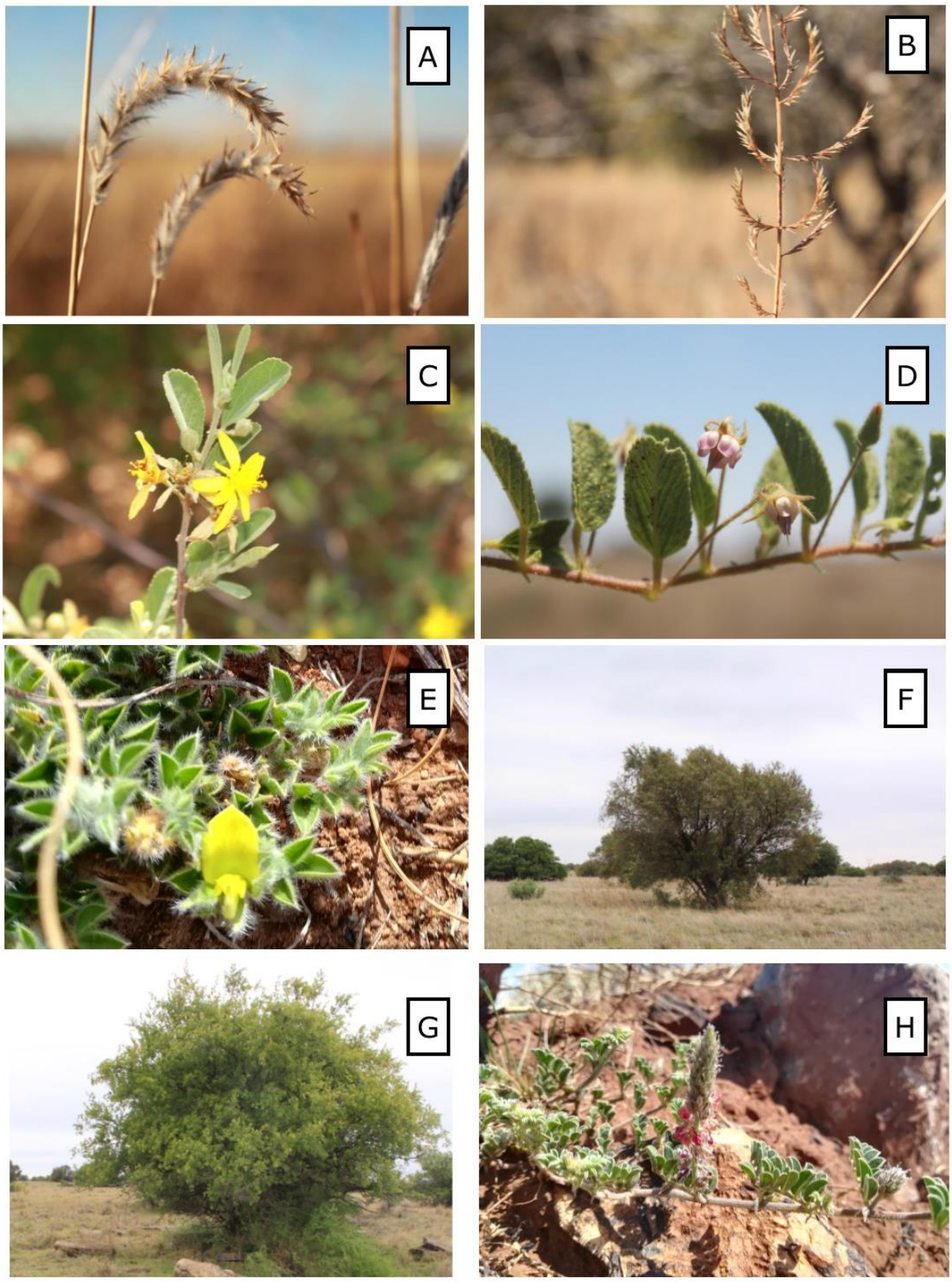

Figure 17: Some species found within VegCom SE: A) *Elionurus muticus*, B) *Pogonarthria squarrosa*, C) *Grewia flava*, D) *Hermannia tomentosa*, E *Lotononis calycina*, F) *Searsia lycioides*, G) *Searsia pyroides*, and F) *Indigofera daleoides*.

6.1.2. Senegalia hereroensis – Triraphis andropogonoides Savanna-Grassland (VegComm AT)

The slightly elevated northern portion of the development footprint comprise an open woodland-grassland in a largely natural condition. This vegetation community was the smallest of the three types found within the development site (± 28.8 ha or 10.3% of development footprint). The area is characterized by gritty and stony soils that vary in depth and primarily overlies chert with some dolomite which may become exposed in some areas.

This dense tufted grassland is scattered with solitary low trees and high shrubs. Small woodland patches also occur within the grassland and comprise of low growing trees, especially *Senegalia hereroensis* and *Searsia pyroides*. Key grass species within this vegetation community include; *Triraphis andropogonoides*, *Cymbopogon pospischilii, Schizachyrium jeffreysii, Eragrostis lehmanniana, E. trichophora, Aristida congesta* and *Heteropogon contortus*. The dominance of Increaser I, Climax grasses such as *C. pospischilii, T. andropogonoides*, and *S. jeffreysii* indicate that this grassland is in a stable, understocked condition. These grass species are fairly unpalatable and capable of growing without the any defoliation (through grazing and fire). Due to low stocking rates (infrequent defoliation of the grasses) a build up of organic material have occurred. Apart from the dense gras cover, the lower forb layers are also characterized by a fairly high diversity of herbaceous plants which may in some areas become fairly dense. Dominant herbs include; *Helichrysum dasymallum, H. aureonitens, H. melanacme, H. cerastioides, Dicoma anomala, Geigeria burkei* and *Ursinia nana*. Other species frequently observed within this vegetation community include *Aloe davyana, Lippia scaberrima, Ziziphus zeyheriana, Babiana hypogea, Hypoxis rigidula, Asparagus laricinus, Grewia flava, Diospyros lycioides* and *Gymnosporia senegalensis*.

The overall ecological state of this vegetation appears to be largely natural and understocked with the dominance of less palatable, climax grasses.

The natural grassland areas contain very few to almost no weeds and aliens, however along the access routes and especially around kraals, were significant trampling and continued overgrazing have occurred, weeds and alien plants are fairly abundant.

A total of 151 species were recorded within this unit, of which 32 were found only in this unit (21%) and 119 were shared with one or more of the other units. Furthermore, seven South-African endemics were found in this unit, namely *Blepharis angusta, Selago tenuifolia, Ipomoea bathycolpos, Blepharis squarrosa, Chaetacanthus costatus, Delosperma floribundum* and *Acalypha caperonioides*. The unit did not contain any Red List species. However, the following protected species were recorded within this community; *Vachelia erioloba, Gladiolus spp.* and *Babiana hypogea*.

As mentioned, the tree/tall shrub layer had a fairly low coverage, although slightly higher than the *S. pyrioides – E. muticus* Savanah Grassland community (4 - 8%). The height

of this layer was between 2 and 4 meters. The grass layer is the dominant layer, covering approximately 65-75% of this community. Even though the forb layer only constitutes 20% of the total cover, this layer contains the highest species diversity.

It is expected that some of the PV panels of the development will be situated within this savanna-grassland community. Due to the fairly small portion of this vegetation community which will be impacted by this development, it is highly unlikely that the propose development will have a significant impact on the extent of this form of Carletonville Dolomite Grassland with the bulk of this vegetation community located outside of the development footprint to the north. As such, development within this vegetation community is regarded as acceptable.

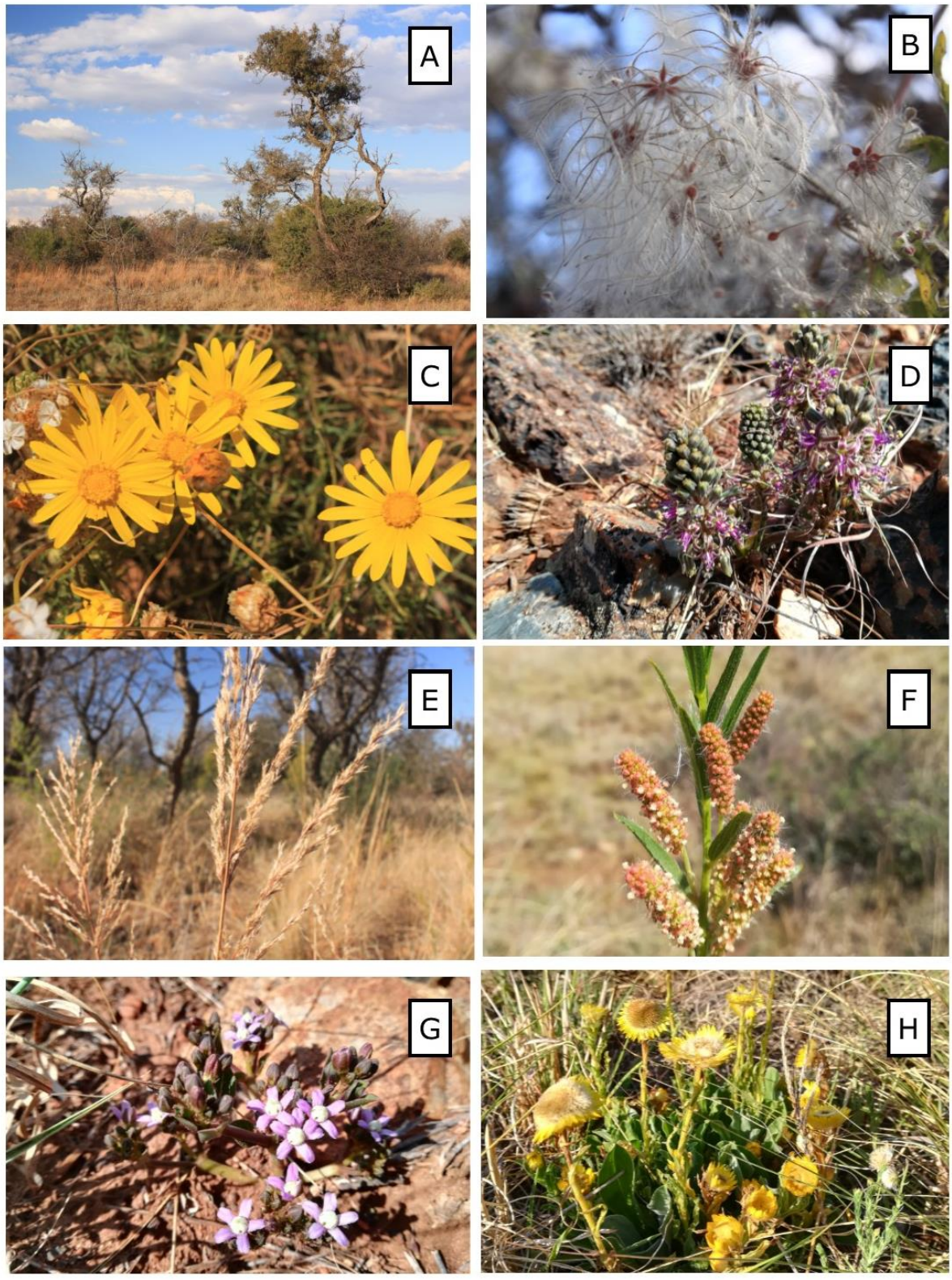

Figure 18: Some species found within Senegalia hereroensis – Triraphis andropogonoides Savanna Grassland. A) *Senegalia hereroense*, B) *Clematis brachiata*, C) *Ursinia nana*, D) *Ledebouria luteola*, E) *Triraphis andropogonoides*, F) *Acalypha caperonioides*, G) *Raphionacme hirsuta*, and H) *Helichrysum setosum*.

6.1.3. Hyparrhenia hirta – Eragrostis lehmanniana Secondary Grassland

This vegetation unit can also be regarded as a plagioclimax unit that has established and stabilised on old cultivated areas (<30years). Soils are deeper, with rock material being removed from the upper soil layer in order to accommodate cultivation. As mentioned earlier, these rock piles are still present along the edges of these historically cultivated areas. The soil consists of fairly fine-grained loams that are prone to sheet erosion and soil capping.

This secondary grassland comprises a moderate to dense, tall grassland with a variably small-scale species composition. Shrubs and trees tend to be sparse and occur as a few isolated specimens (mainly *Celtis africana*). The dominance of Increaser I, climax and sub-climax grasses are indicative of the past disturbance as well as the fact that some stability have been reached. Dominant grass species include; *Hyparrhenia hirta, Cymbopogon caesius, Eragrostis lehmanniana, E. chloromelas, Cynodon dactylon, Aristida congesta* and *Pogonarthria squarrosa*. In comparison with the previous described vegetation communities, the herb and shrub diversity within this vegetation community is fairly poor and include; *Seriphium plumosum, Asparagus laricinus, Berkheya onopordifolia, Conyza podocephala, Crabbea hirsuta, Geigeria burkei, Helichrysum cephaloideum, H. rugulosum, Ipomoea oblongata* and *Schkuhria pinnata*.

The overall ecological state of this vegetation appears to degraded with the dominance of low palatable grasses.

A total of 125 species were recorded within this unit, of which 13 were found only in this unit (10%), of which most weeds and alien plants. Furthermore, 112 species were shared with one or more of the other units. Four, South-African endemics were found in this unit, namely; *Blepharis squarrosa, Chaetacanthus costatus, Delosperma floribundum* and *Acalypha caperonioides*. The unit did not contain any Red List species. However, three protected species were recorded within this vegetation community namely; *Vachellia erioloba, Schizocarphus nervosus* and *Babiana hypogea*. The few isolated *V. erioloba* trees, are likely specimens that have been retained during the earlier cultivation.

As mentioned, the tree/tall shrub layer had a low coverage (1%). The height of this layer was between 2 and 4 meters. The grass layer is the dominant layer, covering approximately 75% of this community whilst the herb layer only constitutes 12%.

Almost one quarter of the project footprint will be located within this vegetation community (24.3%) and due to the degraded nature of this vegetation community, development within this area is regarded as acceptable.

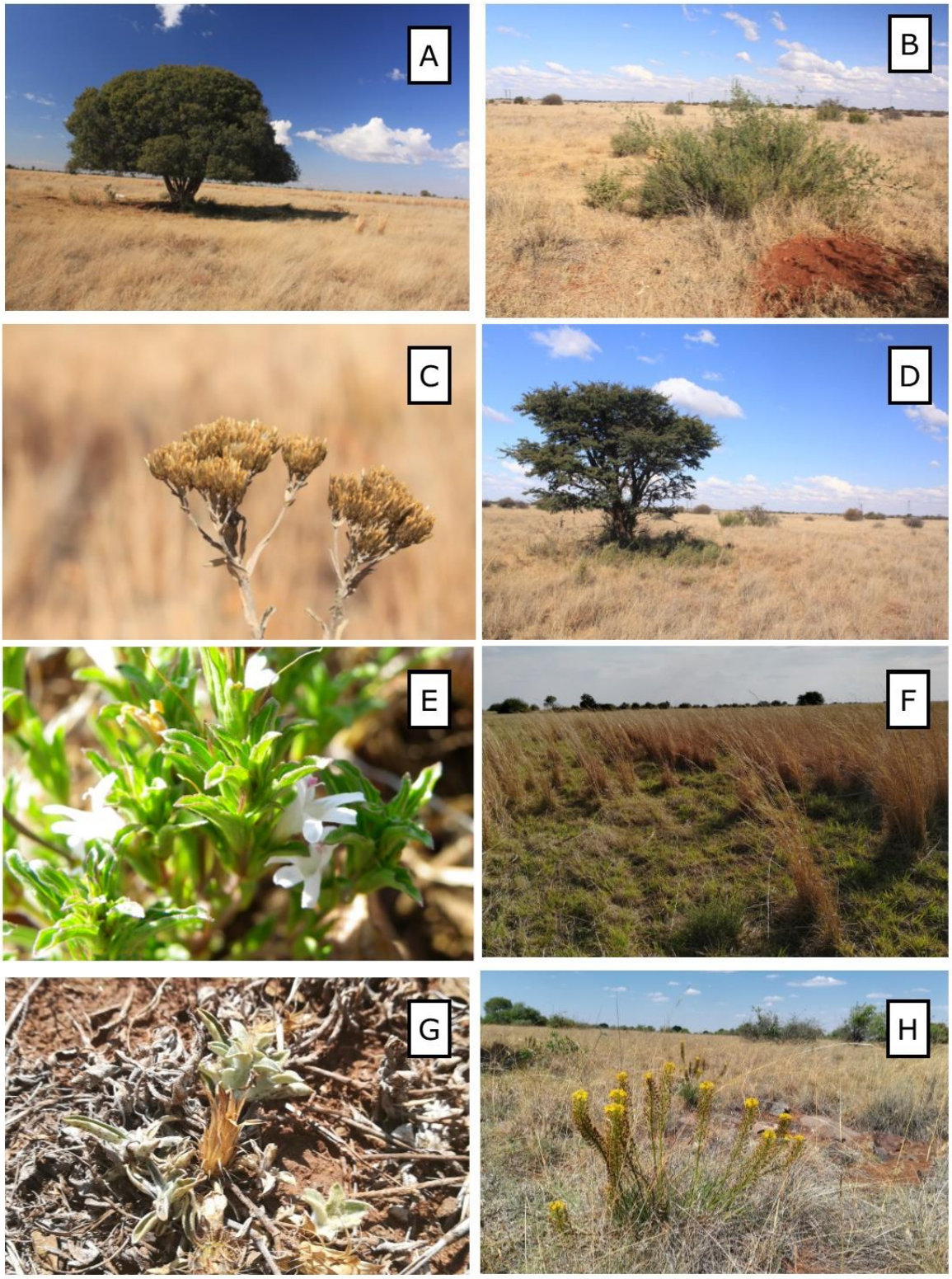

Figure 19: Some species found within the secondary grassland. A) *Celtis africanus*, B) *Asparagus laricinus*, C) *Helichrysum zeyheri*, D) *Vachellia erioloba*, E) *Chaetacanthus costatus*, F) *Hyparrhenia hirta*, G) *Blepharis spp.* and H) *Bulbine abyssinica*).

6.2. Species of Conservation Concern

As mentioned in sections 2.3, a species list was obtained from the SANBI database (POSA) for the study area and surrounding environment. According to this list a total of three plant Species of Conservation Concern occur within the area namely *Nananthus vittatus* (Data Deficient), *Cleome conrathii* (Near Threatened) and *Brachystelma incanum* (Vulnerable). Furthermore, a total of nine protected species have been recorded within the area.

Ground truthing confirmed no Species of Conservation Concern (SCC) with the affected property whilst three provincially protected species (Transvaal Nature Conservation Ordinance) and one protected tree (National Forest Act) were confirmed to be present on site (Table 16). All of these species are fairly common within the region and have a fairly wide range within South Africa. *Babiana hypogea* were fairly common within the project area and were recorded frequently within all three vegetation communities. A few Vachellia erioloba trees occurred as scattered, individuals, mostly within VegCom SE and HE. A slightly higher density of *V. erioloba* trees have been observed around the kraals and watering points and it is likely that these species have been introduced to these areas by cattle.

It is highly unlikely that the proposed development will have a significant impact on these species and their populations within the area as these species are also well represented outside of the development footprint.

Also, worth mentioning are species that are not protected or listed as Red Data species, but are declining (population decline within South Africa). Such species recorded within the project site include*; Boophone disticha, Hypoxis hemerocallidea* and *Pelargonium dolomiticum*. Due to there medicinal value, these species are often exposed to illegal collection and trade within the muti-industry. All of these species have a fairly wide distribution range and are regarded as fairly abundant within the Lichtenburg are, and as such it is highly unlike that the development will have a significant impact on local populations.

Table 16: Protected Plant Species recorded within the affected properties. "TNCO" = Transvaal Nature Conservation Ordinance; "NFA" = National Forest Act.

Species	IUCN Red List	TNCO (Schedule)	NFA	Declining National Populations
Vachellia erioloba	LC		X	X
Gladiolus spp.	LC	7		
Schizocarphus nervosus	LC	7		
Babiana hypogea	LC	7		
Pelargonium dolomiticum	LC			X
Boophone disticha	LC			X
Hypoxis hemerocallidea	LC			X

6.3. Alien Plant Species

A total of 16 alien plant (AP) species were found within the development footprint (refer to Figure 20 for examples of APs and Weeds observed within the development footprint). Of these 16 APs four have been listed as Invasive Alien Plants (NEM:BA Alien & Invasive Species Regulations) (Table 17) and include: *Eucalyptus camaldulensis* (Category 2), *E. sideroxylon* (Category 2), *Datura stramonium* (Category 1b), *Verbena stramonium* (Category 1b) and *V. aristigera* (Category 1b). Furthermore, a total of 35 Weeds were recorded of which most were associated with the secondary grassland (Table 17).

For the primary grassland communities (VegComm SE and AT) weeds (W) and alien plants (AP) where largely absent from the more natural areas. However trampled and overgrazed area as well as the margins of access routes and firebreaks contained varying levels of weeds and alien plants. The most common weeds and APs recorded within these areas includes; *Alternanthera pungens* (AP), *Conyza bonariensis* (AP), *Schkuhria pinnata* (AP), *Zinnia peruviana* (AP), *Nidorela resedifolia* (W), *Aristida congesta* (W), *Aristida adscensionis* (W), *Berkheya onopordifolia* (W), *Cynodon dactylon* (W), *Chloris virgata* (W), *Heteropogon contortus* (W) and *Urochloa panicoides* (W). Severely degraded and trampled areas are prone to the invasion of Invasive Alien Plants (IAPs), especially *Datura stramonium* and *Xanthium spinosum* (e.g. trampled areas around kraal and artificial water points).

As mentioned within Section 6.1.3, the secondary grassland (VegComm HE) comprise numerous weeds as well as a few alien plants and include; *Conyza podocephala* (AP), *C. bonariensis* (AP), *Schkuhria pinnata* (AP), *Tagetes minuta* (AP), *Chrysocoma ciliata* (W), *Nidorella resedifolia* (W), *Aristida congesta* (W), *Asparagus laricinus* (W), *Solanum lichtensteinii* (W), *Aristida adscensionis* (W), *Hyparrhenia hirta* (W), *Berkheya onopordifolia* (W), *Geigeria burkei* (W) and *Cynodon dactylon* (W).

IAPs that were not recorded within the development footprint but was observed within the affected properties or in close proximity to the development footprint include: *Melia azedarach* (Category 1b), *Pyracantha angustifolia* (Category 1b), *Solanum sisymbriifolium* (Category 1b), *S. elaeagnifolium* (Category 1b), *Flaveria bidentis* (Category 1b), *Argemone ochroleuca* (Category 1b), *Opuntia ficus-indica* (Category 1b) and *O. humifusa* (Category 1b). The potential for some of these species to encroach and establish in the disturbed development footprint, during the construction phase an operational phase, are relative high and as such these species should also be taken into account when drafting the Invasive Alien Plant Management Plan.

Table 17: Alien plant species recorded within the project site; W = Weed; AP = Alien Plant; IAP = Invasive Alien Plant.

Family	Species	Status
Acanthaceae	*Chamaesyce inaequilatera*	W

Family	Species	Status
Amaranthaceae	*Achyranthes aspera*	W
Amaranthaceae	*Alternanthera pungens*	AP
Amaranthaceae	*Gomphrena celosioides*	AP
Apocynaceae	*Gomphocarpus physocarpus*	W
Asparagaceae	*Asparagus laricinus*	W
Asteraceae	*Berkheya onopordifolia*	W
Asteraceae	*Bidens biternata*	AP
Asteraceae	*Chrysocoma ciliata*	W
Asteraceae	*Conyza bonariensis*	AP
Asteraceae	*Conyza podocephala*	AP
Asteraceae	*Geigeria burkei*	W
Asteraceae	*Lactuca inermis*	W
Asteraceae	*Nidorella resedifolia*	W
Asteraceae	*Pseudognaphalium lutea-album*	AP
Asteraceae	*Schkuhria pinnata*	AP
Asteraceae	*Tragopogon dubius*	AP
Asteraceae	*Zinnia peruviana*	AP
Convolvulaceae	*Convolvulus sagittatus*	W
Cucurbitaceae	*Cucumis zeyheri*	W
Fabaceae	*Tagetes minuta*	AP
Fabaceae	*Tripteris aghillana*	W
Gnidiaceum	*Gnidia polycephala*	W
Myrtaceae	*Eucalyptus camaldulensis*	IAP: Category 2
Myrtaceae	*Eucalyptus sideroxylon*	IAP: Category 2
Plantaginaceae	*Plantago lanceolata*	AP
Poaceae	*Aristida adscensionis*	W
Poaceae	*Aristida adscensionis*	W
Poaceae	*Aristida congesta subsp. Barbicollis*	W
Poaceae	*Aristida congesta subsp. Congesta*	W
Poaceae	*Aristida stipitata*	W
Poaceae	*Chloris virgata*	W
Poaceae	*Cynodon dactylon*	W
Poaceae	*Eragrostis biflora*	W
Poaceae	*Heteropogon contortus*	W
Poaceae	*Hyparrhenia hirta*	W
Poaceae	*Melinis repens*	W
Poaceae	*Schmidtia kalahariensis*	W
Poaceae	*Setaria sphacelata var. torta*	W
Poaceae	*Setaria verticillata*	W
Poaceae	*Sporobolus pyramidalis*	W
Poaceae	*Tragus berteronianus*	W
Poaceae	*Trichoneura grandiglumis*	W
Poaceae	*Urochloa panicoides*	W
Rubiaceae	*Kohautia caespitosa*	W
Asteraceae	*Seriphium plumosum*	W
Solanaceae	*Datura stramonium*	IAP: Category 1b
Solanaceae	*Solanum lichtensteinii*	W
Solanaceae	*Solanum panduriforme*	W

Family	Species	Status
Verbenaceae	*Verbena aristigera*	IAP: Category 1b
Verbenaceae	*Verbena bonariensis*	IAP: Category 1b
Verbenaceae	*Verbena bonariensis*	IAP: Category 1b

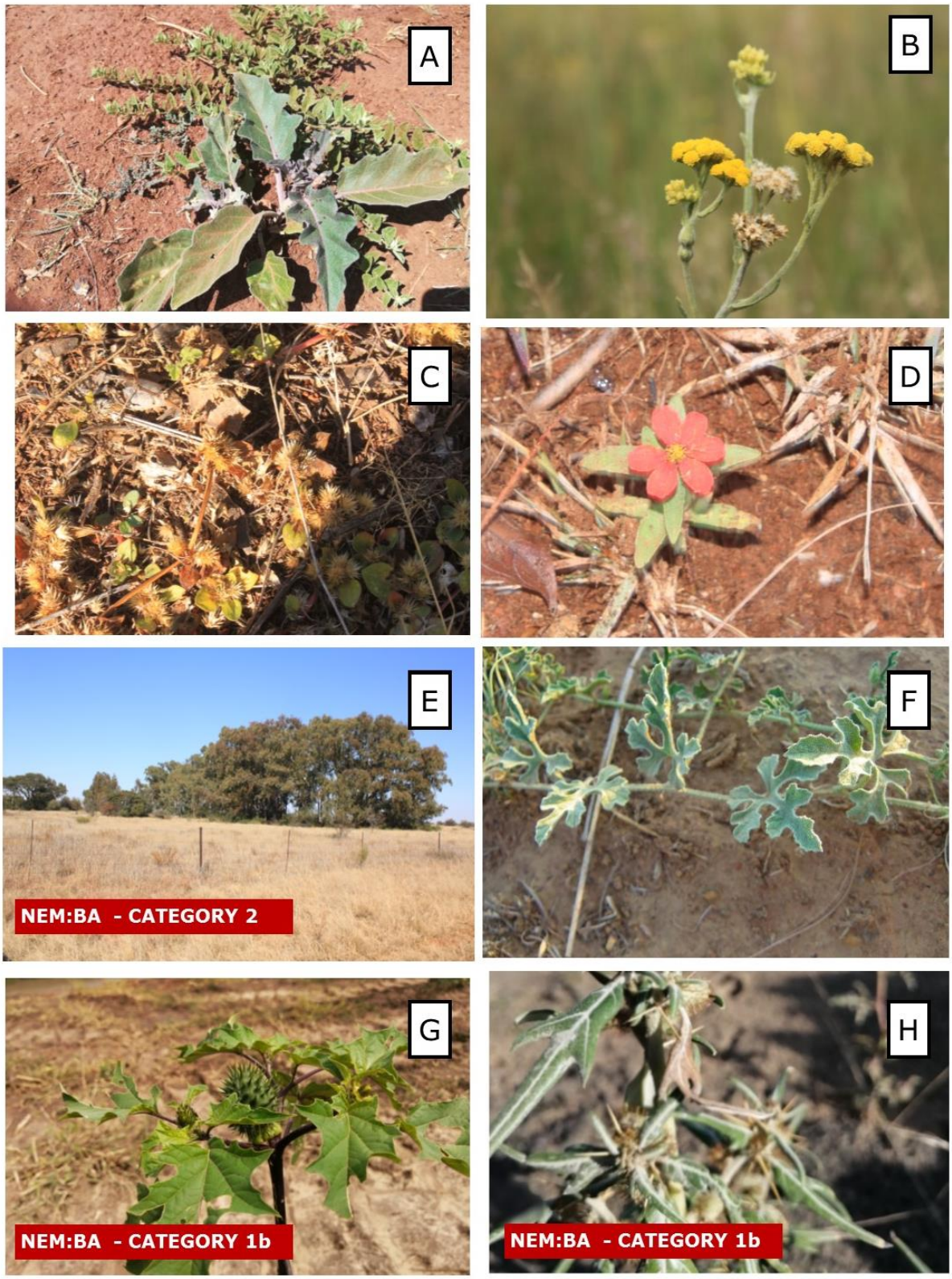

Figure 20: Alien plant species that were found on Kluitjieskraal. NEM:BA listed invasive species are indicated where applicable. A) *Solanum lichtensteinii (*Weed), B) *Nidorela resedifolia* (Weed), C) *Alternanthera pungens* (AP), D) *Zinnia peruviana* (AP), E) *Eucalyptus camaldulensis* (Category 2 IAP), F) *Cucumis zeyheri* (Weed), G) *Datura stramonium* (Category 1b) and H) *Xanthium spinosum* (Category 1b).

6.4. Plant Habitat Sensitivity

6.4.1. Searsia pyroides – Elionurus muticus Savanna-Grassland (VegComm SE)

The sensitivity of this vegetation community is considered to **Medium** based on the following;

Present Ecological State:

» This primary grassland is located within the southern portion of the project site. This vegetation community has been impacted by historical overgrazing; however, the vegetation cover has since stabilized and comprise moderate dense grass coverage. Thus, this vegetation community is in a moderately modified ecological condition (Present Ecological State – PES) and has undergone a moderate change in ecosystem processes. Furthermore, a loss of natural habitat has taken place but the natural habitat remains predominantly intact.

Conservation Status:

» Plant community which is representative of Carletonville Dolomite Grassland which is listed as Least Concern.
» Plant diversity within this vegetation community is fairly high.
» No Plant SoCC have been recorded.
» Localised occurrence of protected species (*Vachellia erioloba and Schizocarphus nervosus*)
» Furthermore, the western portion of this vegetation community forms part of an ESA.
» Based on the above-mentioned characteristics this vegetation community is of medium importance in terms of its conservation status.

Ecosystem Function:

» Due to species composition and structural variation within this vegetation community, potential faunal niche diversity can be regarded as moderate.
» Furthermore, the stable vegetation cover;
    - maintains the functionality of the soil,
    - provide a food resource for fauna,
    - limit the loss of water resources, and
    - prevent degradation of the ecosystem

6.4.2. Senegalia hereroensis – Triraphis andropogonoides Savanna-Grassland (VegComm AT)

The sensitivity of this vegetation community is considered to **Medium** based on the following;

Present Ecological State:

» This primary grassland is located within the northern portion of the project site. This vegetation community has been slightly impacted by understocking and has resulted in the dominance of Increaser I, Climax grasses. However, the vegetation is in a stable condition. Thus, this vegetation community is in a largely natural ecological condition (Present Ecological State – PES) with a slight change in ecosystem processes. Furthermore, only a small loss of natural habitat and biota may have taken place.

Conservation Status:

» Plant community which is representative of Carletonville Dolomite Grassland which is listed as Least Concern.
» In terms of species and structural composition this vegetation community is a fairly unique variation of the Carletonville Dolerite Grassland.
» Plant diversity within this vegetation community is high.
» No Plant SoCC have been recorded.
» Localised occurrence of protected species (*Vachellia erioloba, Babiana hypogea, Gladiolus spp. and Schizocarphus nervosus*)
» Furthermore, the western portion of this vegetation community forms part of an ESA.
» Based on the above-mentioned characteristics this vegetation community is of medium-high importance in terms of its conservation status.

Ecosystem Function:

» Due to species composition and structural variation within this vegetation community, potential faunal niche diversity can be regarded as moderate-high.
» Furthermore, the stable vegetation cover;
    - maintains the functionality of the soil,
    - provide a food resource for fauna,
    - limit the loss of water resources, and
    - prevent degradation of the ecosystem

6.4.3. Hyparrhenia hirta – Eragrostis lehmanniana Secondary Grassland

The sensitivity of this vegetation community is considered to **Low-Medium** based on the following;

Present Ecological State:

» This is a plagioclimax grassland (secondary grassland) that has established and stabilised on old cultivated areas (<30years). Thus, this vegetation community is in a largely modified ecological condition (Present Ecological State – PES) and has undergone a large change in ecosystem processes. Furthermore, a loss of natural habitat and biota have occurred, however some establishment of habitat and return of biota have occurred over time.

Conservation Status:

» Plant community which is representative of a degraded form of Carletonville Dolomite Grassland which is listed as Least Concern.
» Plant diversity within this vegetation community is moderate to low with the dominant species being mostly generalists and weeds, typical of degraded habitats.
» No Plant SoCC have been recorded.
» Localised occurrence of protected species (*Vachellia erioloba, Babiana hypogea* and *Schizocarphus nervosus*)
» The western portion of this vegetation community forms part of an ESA.
» Based on the above-mentioned characteristics this vegetation community is of low importance in terms of its conservation status.

Ecosystem Function:

» Even though, this vegetation community has disturbed in the past, a fairly stable vegetation cover has re-established within the area, allowing for some functions and services to return
» Due to the fairly low species composition and structural variation within this vegetation community, potential faunal niche diversity can be regarded as low.
» Furthermore, the stable vegetation cover;
    - ensures stability of the soil,
    - enhances moisture retention,
    - slows down runoff;
    - increases water infiltration;
    - prevents the establishment and proliferation of invasive alien plants
    - provide a grazing habitat for fauna,

7. FINDINGS OF THE FAUNAL ASSESSMENT

7.1. Mammals

7.1.1. Mammal Diversity and Habitats

The IUCN Red List Spatial Data lists 84 mammal species that could be expected to occur within the vicinity of the project site. This is regarded as a moderately species diversity.

Of these species, 11 are medium to large conservation dependant species, or species that had a historical range that included the project area, but with natural populations since becoming locally "extinct" in these areas. These species are now generally restricted to protected areas such as game reserves and protected areas, with most of these species being re-introduced in these areas.

Examples of such species are:

- Wide-lipped Rhinoceros – *Ceratotherium simum* (Near Threatened);
- Blue Wildebeest – *Connochaetes taurinus* (Least Concern);
- Black Wildebeest – *Connochaetes taurinus* (Least Concern);
- Cheetah – *Acinonyx jubatus* (Vulnerable);
- Cape Buffalo – *Syncerus caffer* (Near Threatened); and
- Hook-lipped Rhinoceros – *Diceros bicornis bicornis* (Endangered)

These species are not expected to occur in the project site and are removed from the expected Species of Conservation Concern (SCC) list.

According to the ADU database 93 mammals have been previously recorded within the larger survey area (Quarter Degree Grid: 2626DA) and includes a number of "exotic" mammals, especially antelope species, that have been primarily introduced by game farmers. Most of these species are confined by fences and should be considered as part of the farming system (game farming and hunting) rather than as wildlife per se. Some of these species are indigenous to South African but do not have a natural distribution that include this area. Examples of such introduced mammas species include.

- Roan Antelope – *Hippotragus equinus* (Endangered);
- One-humped Camel – *Camelus dromedarius* (Exotic);
- Fallow Deer – *Dama dama* (Exotic);
- Impala – *Aepyceros melampus* (Least Concern);
- Red River Hog – *Potamochoerus porcus* (Exotic);
- Southern Reedbuck – *Redunca arundinum* (Least Concern);
- Nyala – *Tragelaphus angasii* (Least Concern) and
- South African Giraffe – *Giraffa giraffa giraffa* (Least Concern)

.

Furthermore, according to the Animal Demographic Unit (ADU) database the following indigenous mammal species have been frequently observed within the relevant QDG:

- Slender Mongoose – *Herpestes sanguineus* (No. of Records: 168)
- South African Ground Squirrel – *Xerus inauris* (No. of Records: 165);
- Black-backed Jackal – *Canis mesomelas* (No. of Records: 161);
- Common Duiker – *Sylvicapra grimmia* (No. of Records: 122);
- Yellow Mongoose – Cynictis penicillata (No. of Records: 122);
- Steenbok - *Raphicerus campestris* (No. of Records: 62)
- Spring Hare – *Pedetes capensis* (No. of Records: 61);
- Cape Porcupine – *Hystrix africaeaustralis* (No. of Records: 55);
- Aardwolf – *Proteles cristata* (No. of Records: 52); and
- Cape Hare – *Lepus capensis* (No. of Records: 52)

SITE VISIT OBSERVATIONS:

Of the 73 remaining small- to medium sized mammal species, nineteen (18) indigenous mammal species and one (1) introduced species have been observed (refer to Table 18) through direct observations, camera trap photographs, Sherman traps, and/or the presence of visual tracks & signs. within the project site. These data represent strong evidence as to a low diverse and functional mammal assemblage populating the study area.

However, it must be reiterated that the poor trapping success (±1% trapping success rate) has likely deprived the habitat of its predicted total diversity. The low success rate of trapping can most likely be attributed to the extensive drought period that the area has experienced up to the previous season. The prolonged drought conditions have most likely resulted in a population collapse to some degree, especially in terms of the more herbivorous rodents and such populations will take a couple of seasons to re-establish. The bulk of the small mammals that were trapped, where adaptable omnivores. Numerous abandoned, old rodent (gerbil) burrows and pathways indicate that this area likely had a fairly strong small mammalian population. A stable and healthy small mammalian populations is crucial as these species along with invertebrates form the base of the trophic chain within this region. From the number of small meso-predators observed within the project site it is clear that these populations small mammals and invertebrates as well as small terrestrial/ground dwelling bird populations) are still however strong enough to sustain these mesopredators (Otocyon megalotis – *Bat-eared Fox*, Yellow Mongoose – *Cynictis penicillata*, Aardwolf – *Proteles cristata*).

Based on the various sampling techniques, the following mammals were the most frequently observed within the project site:

- » Red Veld Rat (*Aethomys chrysophilus):* No of Records - 8 specimens have been trapped and numerous runways and burrows were recorded around bush clumps.
- » Bushveld Gerbil (*Gerbilliscus leucogaster*): No of Records - 2 specimens have been trapped and numerous old burrows have been recorded, especially within the secondary grassland.
- » Cape Porcupine (*Hystrix africaeaustralis*): No of Records 3 (and numerous feeding/gnawing signs);
- » Cape Mole-rat (Cryptomys hottentotus): More than 10 locations containing excavated gravel heaps;
- » Bat-eared Fox (*Otocyon megalotis*): No of Records 2;
- » Black-backed Jackal: No of Records – 1 (track where also frequently observed);

Table 18: List of Mammalian species that has been observed within the various habitat types.

Species	Common Name	Faunal Habitats		
		Wooded Grasslands	Secondary Grassland	Disturbed and Transformed Areas
Common Duiker	Sylvicapra grimmia	X		X
Raphicerus campestris	Steenbok		X	
Cynictis penicillata	Yellow Mongoose	X		
Otocyon megalotis	Bat-eared Fox		X	
Canis mesomelas	Black-backed Jackal	X	X	X
Proteles cristata	Aardwolf	X		
Phacochoerus africanus	Common Warthog	X	X	
Lepus capensis	Cape Hare	X	X	
Rhabdomys pumilio	Four-striped Grass Rat	X	X	X
Gerbilliscus leucogaster	Bushveld Gerbil		X	X
Xerus inauris	Cape Ground Squirrel	X		X
Cryptomys hottentotus	Cape Mole-rat	X	X	
Hystrix africaeaustralis	Cape Porcupine	X	X	X
Mastomys coucha	Southern Multimammate Mouse		X	
Aethomys chrysophilus	Red Veld Rat	X		
Tragelaphus strepsiceros	Greater Kudu	X	X	
Ictonyx striatus	Striped Polecat	X	X	
Orycteropus afer	Aardvark	X	X	
Felis catus	Domestic Cat	X		

Structural and compositional habitat/vegetation unit diversity can be described as low to moderate low diverse within the project site. The most significant habitat within the project site is the wooded/savanna – grassland especially the denser variation dominated by *Senegalia hereroensis*. The dense vegetation cover within this wooded-grassland maintains the functionality of the soil, maintains food resources for fauna, limits loss of water resources and nutrient resources from the system, creates a diverse habitat for small fauna and prevents degradation of the ecosystem. This habitat type is fairly diverse in terms of its structural diversity allowing for most of the mammal diversity, observed within the project site, to inhabit this area. Furthermore, the higher rodent, and invertebrate activities associated with both wooded grassland habitat (but especially with the *Senegalia hereroensis* variation) also makes this habitat a valuable forage/hunting

area for meso-predators and insectivores such as Bat-eared Fox, Aardvark, Black-Backed Jackal, African Striped Weasel, Yellowtail Mongoose, Striped Polecat, and Aardwolf.

The more open wooded-grassland variation dominated by *Searsia pyroides* are slightly less diverse.

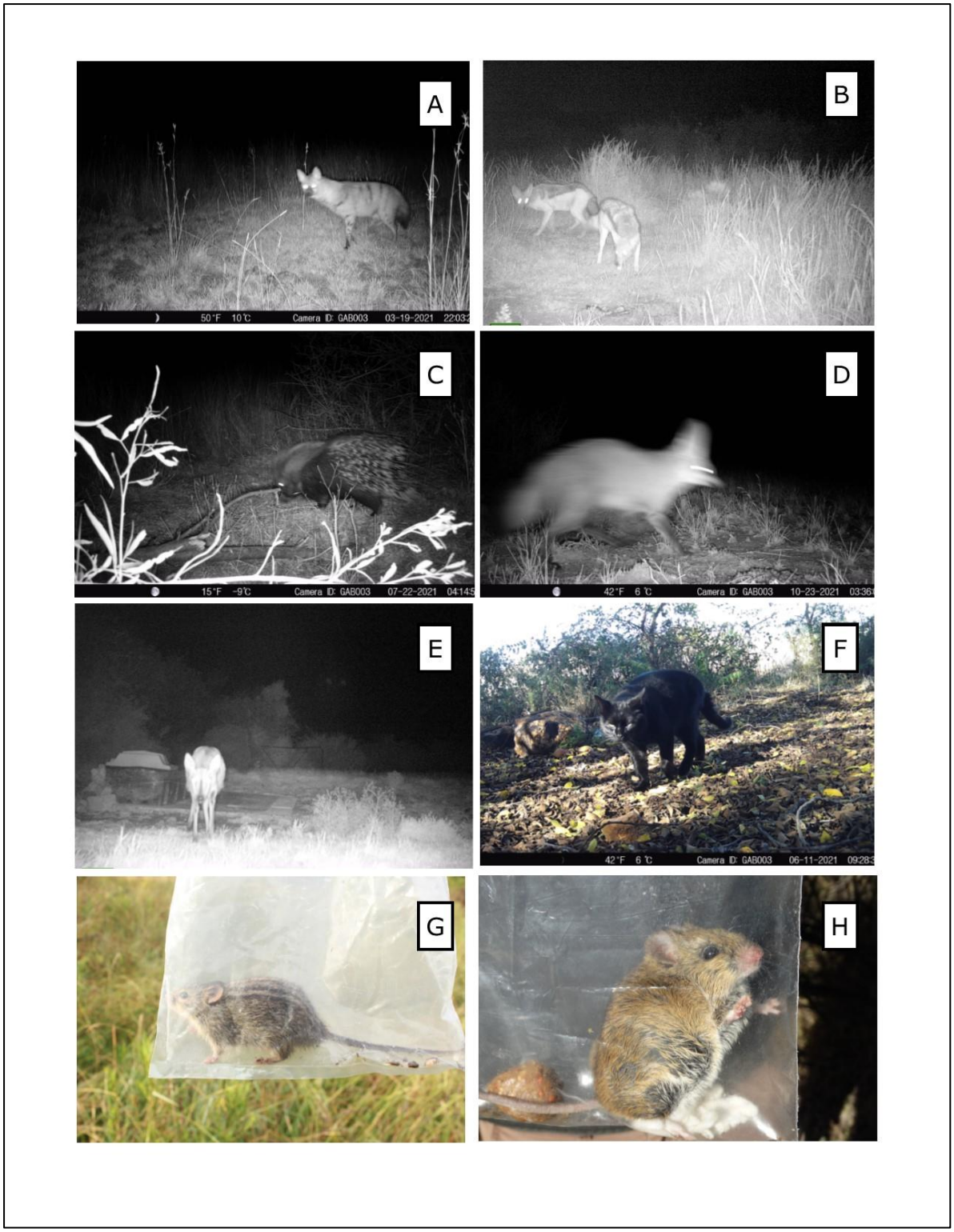

Figure 21: Some mammal species observed within the development site/property. A) Aardwolf – *Proteles cristata* (Protected), B) Black-backed Jackal – *Canis mesomelas*, C) Cape Porcupine – *Hysrix africaeaustralis*, D) Bat-eared Fox – *Otocyon megalotis* (Protected), E) Common Duiker –Sylvicapra grimmia, F) Domestic Cat – *Felis catus* (Introduced), G) Four-striped Grass Rat – *Rhabdomys pumilio*, and H) Red Veld Rat –Aethomys chrysophilus.

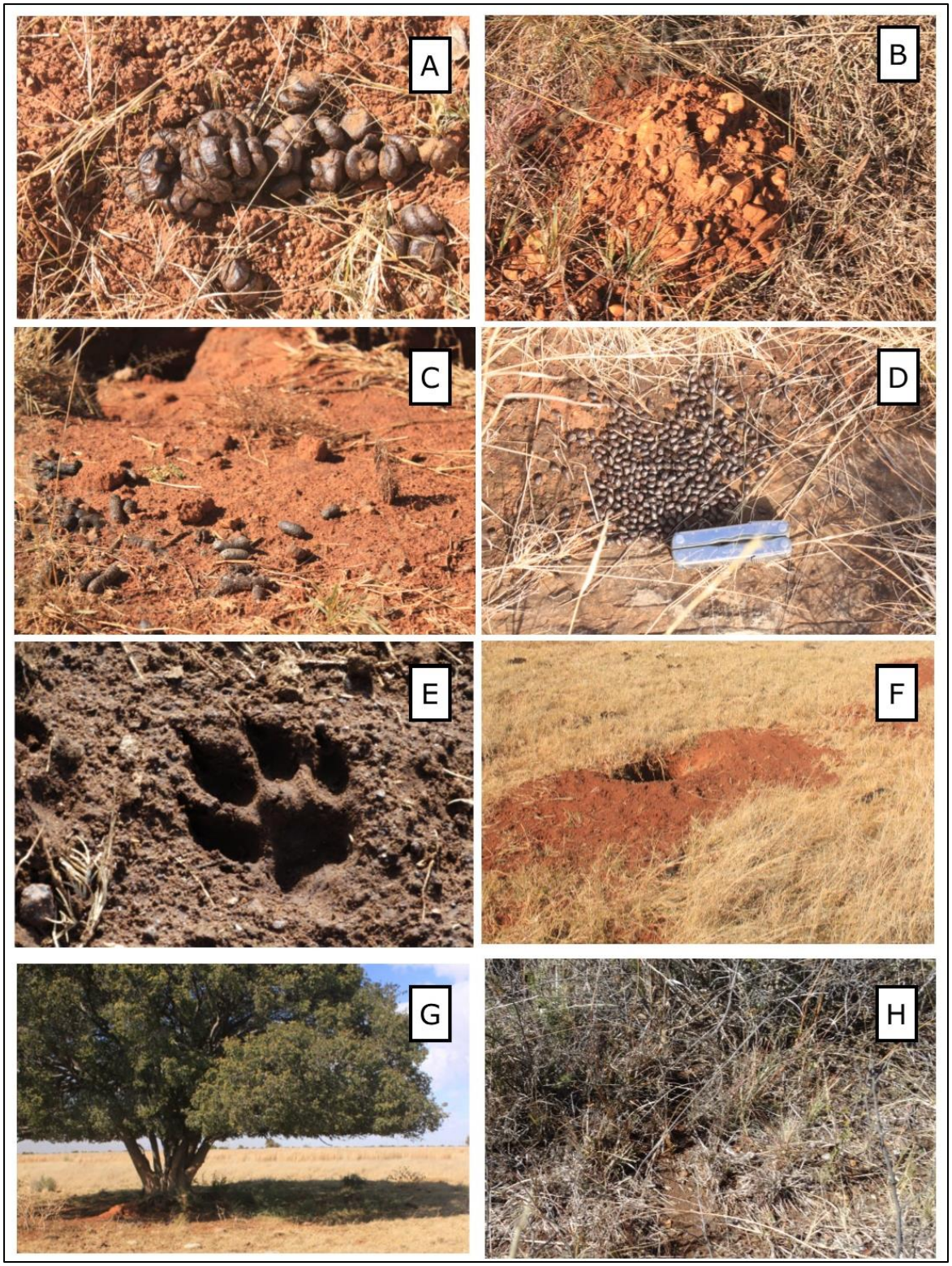

Figure 22: Mammal track and signs observed within the development site/property. A) Aardvark (*Orycteropus afer*) scat; B) Mounds created by Cape Mole-rat (*Cryptomys hottentotus*) activity, C) Yellow Mongoose (*Cynictis penicillata*) scat and burrow, D) Common Duiker (*Sylvicapra grimmia*) pellets, E) Black-backed Jackal (Canis mesomelas) track, F) Active burrow, likely created by Aardvark (*Orycteropus afer*), G) White stinkwood tree with a clear browsing line created by Kudu (*Tragelaphus strepsiceros*), and H) Runway/pathway created by Red Veld Rat (*Aethomys chrysophilus*) .

7.1.2. Mammal Species of Conservation Concern (SCC)

SCCs include those species listed within the Regional Red Data List (2016), Global Red Data List (2015), that indicate severe recent population decline and those species or populations of species that are highly range restricted.

Of the remaining 73 small- to medium sized mammal species, that have a natural distribution range that include the project site and have a likelihood of occurring within the project site, 11 (eleven) are listed as being of conservation concern on a regional or global basis (**Error! Reference source not found.**).

The list of potential species includes:

» Two (2) that are listed as Vulnerable (VU) on a regional basis; and
» Five (4) that are listed as Near Threatened (NT) on a regional scale.

Table 19: List of mammal species of conservation concern that may occur in the project area as well as their global and regional conservation statuses (IUCN, 2017; SANBI, 2016).

Species	Common Name	Conservation Status			Likelihood of Occurrence
		Red Data	IUCN	TOPS	
Anonyx capensis	Cape Clawless Otter	NT	NT		Very Low
Atelerix frontalis	South African Hedgehog	NT	LC		High
Felis nigripes	Black-footed Cat	VU	VU		Low
Hydrictis maculicollis	Spotted-necked Otter	VU	NT		Very Low
Leptailurus serval	Serval	NT	LC		Moderate
Mystromys albicaudatus	White-tailed Rat	VU	EN		Moderate
Crocidura mariquensis	Swamp Musk Shrew	NT	DD		Very Low
Smutsia temminckii	Ground Pangolin	VU	VU		Low
Panthera pardus	Leopard	VU	VU		Low
Parahyaena brunnea	Brown Hyena	NT	NT		Moderate
Poecilogale albinucha	African Striped Weasel	NT	LC		Moderate

» *Mystromys albicaudatus* (White-tailed Rat) is a South African and Lesotho Endemic, primarily inhabiting Highveld grasslands but also Succulent Karoo and fynbos. This species is widespread across the assessment region but patchily distributed. Very little is known about this rare species habitat preference and ecology. However, it appears that the White-tailed Rat is a habitat specialist preferring calcrete soils within grasslands. They have never been found/collected/trapped on soft, sandy substrate, rocks, wetlands or river banks. Records from the Free State Province and Borakalalo Nature Reserve, North West Province show that they can occur in disturbed areas (heavily grazed) and in sparse grasslands. The current population trend appears to be decreasing and habitat fragmentation and loss of grasslands due to agricultural, industrial and urban expansion as well as the suppression of fire, appears to be the main culprits. Even though this species is rare and has a

patchy distribution, there is suitable habitat in the project area and therefore the likelihood of occurrence is rated as **Moderate**.

» *Crocidura mariquensis* (Swamp Musk Shrew): This species has a wide distribution across Southern Africa but is restricted to wetlands and waterlogged areas (habitat specialist) where they tend to occupy areas close to open water with intact riverine and semi-aquatic vegetation such as reedbeds, wetlands and the thick grass along river banks. They are often sampled in waterlogged areas, such as inundated grasslands and vleis. *C. mariquensis* are primarily nocturnal. They are furthermore found to regularly use the paths made by Vlei Rats (*Otomys* spp.) and Marsh Rats (*Dasymys* spp.). The main threat to *C. mariquensis* is the loss or degradation of moist, productive areas such as wetlands and rank grasslands within suitable habitat. The two main drivers behind this are abstraction of surface water and draining of wetlands through industrial, agricultural, afforestation and residential expansion, and overgrazing of moist grasslands, which leads to the loss of ground cover (reduces habitat structural complexity) and decreases small mammal diversity and abundance. Overgrazing is particularly threatening for this species, as it relies on medium to tall grass cover. Based on the absence of any perennial rivers or wetlands within the project area the likelihood of occurrence of this species occurring in the project area is considered to be **Very Low**.

» *Smutsia temminckii (*Ground Pangolin) Ground Pangolins, while widely distributed across the savannah region, are now largely confined to protected areas and well-managed livestock and wildlife farms. These species are severely threatened by electrified fences, local and international bushmeat and traditional medicine trades, road collisions and incidental mortalities in gin traps. *S. temminckii* is a nocturnal, predominantly solitary, terrestrial species that is present in various woodland and savannah habitats, preferring arid and mesic savannah and semi-arid environments at lower altitudes, often with thick undergrowth. They also occur in floodplain grassland, rocky slopes and sandveld, but are absent from Karroid regions, tropical and coastal forests, Highveld grassland and coastal regions. The range is believed to largely be determined by the presence and abundance of ant and termite prey species and the availability of dens or above-ground debris in which to shelter. As mentioned, it occupies well-managed livestock and wildlife farms, but is absent from areas under crop farming, and occupies a wide range of soil types from heavy clay soils through alluvium to Kalahari sands. Due to the fractured nature of the landscape, agricultural practices (especially cultivation) within the area, the presence of roads and other anthropogenic activities, the likelihood of occurrence of this species is regarded as **Low**.

» *Aonyx capensis* (Cape Clawless Otter) is the most widely distributed otter species in Africa (IUCN, 2017). This species is predominantly aquatic, and it is seldom found far from water. Based on the absence of any perennial rivers or wetlands within the project area the likelihood of occurrence of this species occurring in the project area is considered to be **Very Low**.

» *Atelerix frontalis* (South African Hedgehog) has a tolerance of a degree of habitat modification and occurs in a wide variety of semi-arid and sub-temperate habitats (IUCN, 2017). Based on the Red List of Mammals of South Africa, Lesotho and Swaziland (2016), A. frontalis populations are decreasing due to the threats of electrocution, veld fires, road collisions, predation from domestic pets and illegal harvesting. Although the species is cryptic and therefore not often seen, there is suitable habitat in the project area and therefore the likelihood of occurrence is rated as **High**.

» *Felis nigripes* (Black-footed cat) is endemic to the arid regions of southern Africa. This species is naturally rare, has cryptic colouring is small in size and is nocturnal. These factors have contributed to a lack of information on this species. The habitat in the project area can be considered suitable for the species, however due to regular human activity within the area the likelihood of occurrence is rated as **Low**.

» *Hydrictis maculicollis* (Spotted-necked Otter) inhabits freshwater habitats where water is, unpolluted, and rich in small to medium sized fishes (IUCN, 2017). No suitable habitat is available in the project area for this species and therefore the likelihood of occurrence is **Very Low**.

» *Leptailurus serval* (Serval) occurs widely through sub-Saharan Africa and is commonly recorded from most major national parks and reserves (IUCN, 2017). The Serval's status outside reserves is not certain, but they are inconspicuous and may be common in suitable habitat as they are tolerant of farming practices provided there is cover and food available. In sub-Saharan Africa, they are found in habitat with well-watered savanna long-grass environments and are particularly associated with reedbeds and other riparian vegetation types. Due to the presence of some natural grassland areas, the likelihood of occurrence for this species is rated as **Moderate**.

» *Panthera pardus* (Leopard) has a wide distributional range across Africa and Asia, but populations have become reduced and isolated, and they are now extirpated from large portions of their historic range (IUCN, 2017). Impacts that have contributed to the decline in populations of this species include continued persecution by farmers, habitat fragmentation, increased illegal wildlife trade, excessive harvesting for ceremonial use of skins, prey base declines and poorly managed trophy hunting (IUCN, 2017). Although known to occur and persist outside of formally protected areas, the densities in these areas are considered to be low. The likelihood of occurrence in the project area is regarded as **Low**.

» *Parahyaena brunnea* (Brown Hyaena) is endemic to southern Africa. This species occurs in dry areas, generally with annual rainfall less than 100 mm, particularly along the coast, semidesert, open scrub and open woodland savanna. Given its known ability to persist outside of formally protected areas the likelihood of occurrence of this species in the project area is moderate to good. This species is

known to persist outside of protected areas and even within agricultural lands and as such the likelihood of occurrence is regarded as **Moderate**.

» *Poecilogale albinucha* (African Striped Weasel) is usually associated with savanna habitats, although it probably has a wider habitat tolerance (IUCN, 2017). Due to its secretive nature, it is often overlooked in many areas where it does occur. There is sufficient habitat for this species in the project area and the likelihood of occurrence of this species is therefore considered to be **Moderate**.

» *Miniopterus natalensis* (Natal Long-fingered Bat). This small bat (±11g) species is widespread across the assessment region but patchily distributed. Very little is known about this rare species habitat preference and ecology. However, it appears that the White-tailed Rat is a habitat specialist preferring calcrete soils within grasslands. They have never been found/collected/trapped on soft, sandy substrate, rocks, wetlands or river banks. Records from the Free State Province and Borakalalo Nature Reserve, North West Province show that they can occur in disturbed areas (heavily grazed) and in sparse grasslands. The current population trend appears to be decreasing and habitat fragmentation and loss of grasslands due to agricultural, industrial and urban expansion as well as the suppression of fire, appears to be the main culprits. Even though this species is rare and has a patchy distribution, there is suitable habitat in the project area and therefore the likelihood of occurrence is rated as **Moderate**.

SITE VISIT OBSERVATIONS:

During the site visit no Mammal SCC were recorded through active searching (diurnal and nocturnal surveys), camera trapping, Sherman trapping and through random observations. Based on the ecology and behaviour of the potential Mammal SCC that may occur within the region, it is highly unlikely that this development will threaten local individuals and populations of Mammal SCC.

7.1.3. Protected Mammal Species

These area species that are either protected nationally within TOPS (Threatened and Protected Species Issued in terms of Section 56(1) of the National Environmental Management: Biodiversity Act, 2004) or provincially within Schedule 2 and 4 of the Transvaal Nature Conservation Ordinance (No 12 of 1983).

TOPS Regulations:

» The Threatened or Protected Species (TOPS) regulations, 2007, provide a national approach to sustainable use of species that are threatened with extinction, or in need of national protection, while ensuring the survival of the species in the wild, thus ensuring the conservation of the species.

» The TOPS regulations address multiple issues including: unethical hunting practices such as hunting in confined spaces, or hunting of tranquilised animals or by means of bait; activities related to the management of damage-causing animals; hybridisation and spreading diseases as a result of translocation; activities threatening cycad populations; and registration of captive breeding and keeping facilities.
» NEMBA enabled the Minister to prohibit activities that may impact on the survival of species in the wild, and to regulate activities to ensure sustainable use of indigenous biological resources.
» According to the definitions provided within the TOPS regulations (Section 56 (1)):
    • a Protected Species (56(1)(d)) is any indigenous species which are of high conservation value or national importance, or required regulation in order to ensure that the species are managed in an ecologically sustainable manner. Furthermore, all indigenous species listed within CITES (Conservation on International Trade in Endangered Species of Wild Fauna and Flora) are also automatically listed as a Protected Species within TOPS.

Schedule 1 and 2 of the Northern Cape Nature Conservation Act No 9 of 2009 (NCNCA):

» The aim/purpose of the Act is to provide for;
    • the sustainable utilisation of wild animals, aquatic biota and plants;
    • to provide for the implementation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora;
    • to provide for offences and penalties for contravention of the Act;
    • to provide for the appointment of nature conservators to implement the provisions of the Act;
    • to provide for the issuing of permits and other authorisations; and
    • to provide for matters connected therewith.

SITE VISIT OBSERVATIONS:

During the site visit three protected mammal species (within TOPS as well as Provincial Act) were recorded namely:

» Steenbok (*Raphicerus campestris*): 2 recordings within wooded grassland.
» Aardwolf (*Proteles cristata)*: 1 physical recording, 1 active borrow and 1 latrine. The species as well as the active burrow was observed within the wooded grassland. Take note that there were numerous other burrows present within the project site which may be utilised by this species.
» Aardvark (*Orycteropus afer*): 1 physical recording, 2 active borrows of an active burrow within the alluvial wash habitat. The species as well as the active burrows was observed within the wooded grassland. Take note that there were numerous other burrows present within the project site which may be utilised by this species.

The most significant habitat for these protected species, are the wooded grassland (both variations), especially were the soils are suitable for burrowing. Numerous termite mounds were present, especially within the secondary grassland, and these termites for the foundation of the Aardwolf and Aardvark's diet.

7.2. Herpetofauna

7.2.1. Herpetofaunal Diversity and Habitats

Based on the IUCN Red List Spatial Data (IUCN, 2017), 55 reptilian species can be expected to occur within the vicinity of the project site, whist according to the distribution maps of Bates et al. (2014) a total of 71 terrestrial reptilian species may be found within the region. Due to the relatively homogenous nature of the study area, it is expected that the diversity within the study area itself will be relatively low.

Of these 71 reptile species, 28 have been previously recorded within the larger survey area (Quarter Degree Grids: 2626AA, 2625BB, 2525DD and 2526CCCB) according to the Animal Demographic Unit (ADU) database. Species that has been frequently observed within the these QDGs are:

- Common Dwarf Gecko – *Lygodactylus capensis* (No. of Records: 9)
- Southern Rock Agama – *Agama atra atra* (No. of Records: 8);
- Fork-marked Sand Snake – *Psammophis trinasalis* (No. of Records: 8);
- Common Girdled Lizard – *Cordylus vittifer* (No. of Records: 6);
- Yellow-throated Plated Lizard – *Gerrhosaurus flavigularis* (No. of Records: 6); and
- Cape Skink – *Trachylepis capensis* (No. of Records: 6)

Based on the IUCN Red List Spatial Data (IUCN, 2017), 19 amphibian species can be expected to occur within the vicinity of the project site, whist according to the distribution maps of Du Preez & Carruthers (2009) and Minter *et a*l. (2004) a total of 21 amphibian species may be found within the region.

Of the 21 amphibian species, 21 have been previously recorded within the larger survey area (Quarter Degree Grids: 2626AA, 2625BB, 2525DD and 2526CCCB) according to the Animal Demographic Unit (ADU) database. Species that has been frequently observed within the these QDGs are:

- Guttural Toad – *Sclerophrys gutturalis* (No. of Records: 15)
- Common Caco – *Cacosternum boetteri* (No. of Records: 9);
- Bubbling Kassina – *Kassina senegalensis* (No. of Records: 8); and

SCREENING SITE VISIT OBSERVATIONS:

Of the 71 reptile species that have a distribution that include the project area, only six (6) indigenous reptile species have been observed through direct observations, within the project site.

The area is, regarded as containing a potentially low diverse and functional reptile assemblage populating.

The following reptiles were observed within the project site:

- Cape Thick-toed Gecko (*Pachydactylus capensis*): No of Records 3;
- Holub's Sandveld Lizard (*Nucras holubi*): No of Records 1;
- Wahlberg's Snake-eyed Skink (*Afroablepharus wahlbergii*): No of Records 5;
- Cape Skink (*Trachylepis capensis)*: No of Records 1;
- Speckled Rock Skink (*Trachylepis punctatissima*): No of Records 1; and
- Mole Snake (*Pseudaspis cana*): No of Records 1

No amphibian species have been recorded within the project area, with very limited suitable habitat available for amphibian species. Artificial water points may provide some potential habitat for highly adaptive amphibians such as the Common Caco.

Impacts on amphibians will be low given the absence of suitable habitat within the project site.

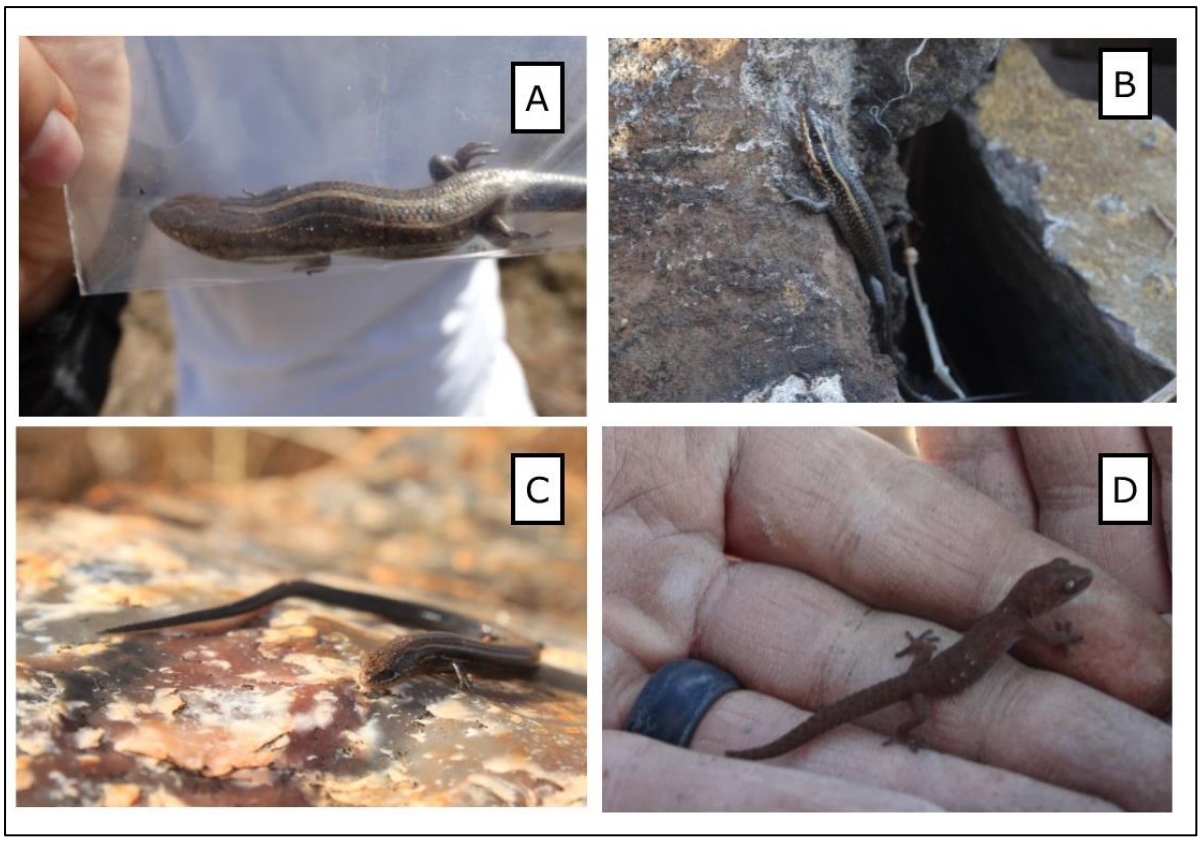

Figure 23: Some reptile species observed within the development site/property. A) Cape Skink – *Trachylepis capensis*, B) Speckled Rock Skink – *Trachylepis punctatissima*, C) Wahlberg's Snake-eyed Skink – *Afroablepharus wahlbergii*, and D) Cape Thick-toed Gecko – *Pachydactylus capensis.*

7.2.2. Herpetofauna Species of Conservation Concern (SCC)

SCCs include those species listed within the Regional Red Data List (2017), Global Red Data List (2015), that indicate severe recent population decline and those species or populations of species that are highly range restricted.

Of the 71 reptile species that have a natural distribution range that include the project site, and have a likelihood of occurring within the project site, none are listed as being of conservation concern on a regional or global basis.

Of the 21 amphibian species that have a natural distribution range that include the project site, only one species is regarded as of conservation namely *Pyxicephalus adspersus* (Giant Bullfrog) – Declining Population Trend. However due to the absence of suitable habitat, it is highly unlikely that this species will occur within the project site.

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7.2.3. Protected Herpetofaunal Species

These area species that are either protected nationally within TOPS (Threatened and Protected Species Issued in terms of Section 56(1) of the National Environmental Management: Biodiversity Act, 2004) or provincially within Schedule 2 and 4 of the Transvaal Nature Conservation Ordinance (No 12 of 1983).

According to the Transvaal Nature Conservation Ordinance al species of reptiles excluding Water Monitor (*Varanus niloticus*), Rock Monitor (*Varanus albigularis*), and all species of snakes (Sub-Order Serpentes) are protected within Schedule 2. Furthermore, in terms of Amphibians, only the Gian Bullfrog (Pyxicephalus adspersus) is protected within Schedule 2.

In terms of TOPS, only one species that has a distribution range that include the project site, is protected namely, the Southern African Python (*Python natalensis).* The likelihood of this species occurring within the project site is moderate.

7.3. Faunal Habitat Sensitivity

Faunal species are adapted to a particular niche with often comprises a unique set of environmental conditions creating optimal habitat. The reliance of fauna on species-specific plant resources indicates the interconnected nature between faunal and floristically diversity. These "micro-habitats" do not always correspond strictly to vegetation associations, but rather to a combination of vegetation structure and species composition, topography, land use, available food source and other factors. Landscape composed of spatially heterogeneous abiotic conditions create a greater diversity of potential niches for fauna species, providing both diverse forage as well as refuge areas. Habitat availability is often used to determine databases due to the often cryptic, nocturnal and highly mobile nature displayed by many fauna species.

7.3.1. Wooded Grassland (*Senegalia hereroensis variation*)

This habitat is the smallest habitat within the project site (located to the north and nort-east), but contains the highest faunal and flora diversity.

These habitat shows good potential for mammal and reptile species. This habitat provides good refugia (moderate structural complexity) and forage, especially for small mammal species, which in turn form the basis for the trophic food chain. The grasses in this habitat are dense but is of a fair to poor forage value. Species diversity within these habitats were fairly moderate, with most of the species recorded, regarded as habitat generalists. Connectivity with similar habitats as well as other habitats are regarded as good.

Thus, overall diversity, connectivity and sensitivity of this habitat can be regarded as **Moderate**.

7.3.2. Wooded Grassland (*Searsia pyroides* variation)

These habitat shows a fair potential for mammal and reptile species.

This habitat provides moderate to relative good refugia and forage for small mammal species, which in turn form the basis for the trophic food chain. The grasses in this habitat is moderately dense and of fair to poor forage value. Positive effects are from moderate structural complexity and fairly strong foraging potential and overall, the species diversity for this area was moderate-low, with species from most trophic levels present. Most of the species recorded within this habitat type can be regarded as habitat generalists

Overall diversity, connectivity and sensitivity of these areas can be regarded as **Moderate**.

7.3.3. Secondary Grassland (*Hyparrhenia hirta* grassland)

This is a plagioclimax grassland that has established on old cultivated lands. This grassland comprise of a fairly low diversity of plants and the structural complexity of this grassland can be regarded as low. Although the grass layer was moderately dense, the fairly species poor nature of the habitat reduces habitat and foraging potential in comparison with the above described habitats. The softer substrate is however more optimal for fossorial or burrowing species such as mole rats, mongooses, Suids (pig species) and porcupines.

The overall diversity, connectivity and sensitivity of these areas were **Low**.

8. COMBINED SENSITIVITY (PLAN, ANIMAL AND TERRESTRIAL BIODIVERSITY THEMES)

The map below (Figure 24) illustrates the sensitivities identified within the faunal, floral and terrestrial biodiversity assessments.

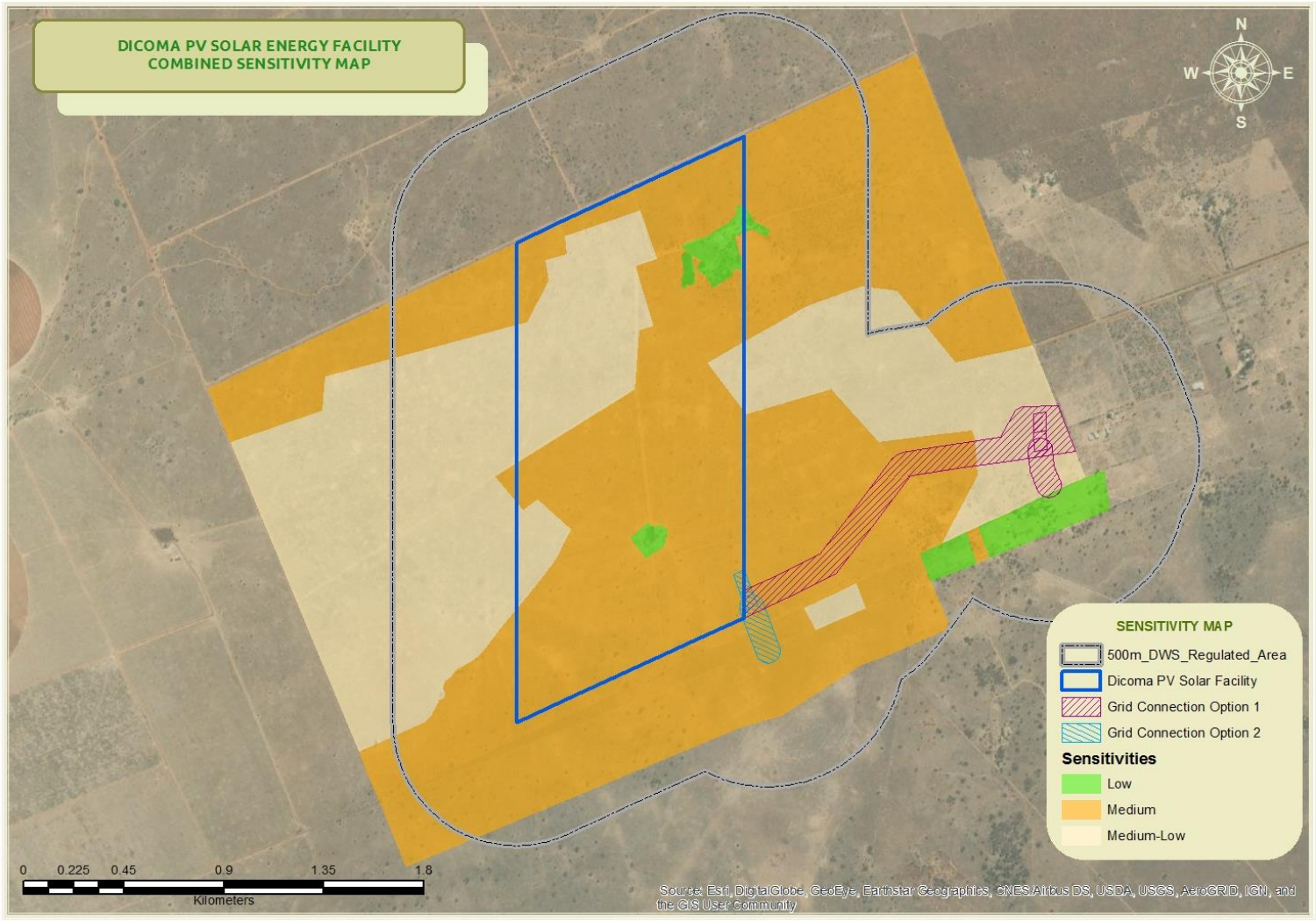

Figure 24: Sensitivity mapping for the Dicoma PV solar Facility.

9. ASSESSMENT OF PROPOSED IMPACTS

9.1. Assumptions

The following is assumed and/or known:

- » A thorough ecological walkthrough of all footprint areas will be conducted to, detect and map all protected species. These results should then be used during the permit application process, for the removal/relocation, destruction and disturbance of these protected species (Relevant authority: Free State Department: Economic, Small Business Development, Tourism and Environmental Affairs – DESEA).
    - Such an investigation should be carried out by a suitably qualified botanist prior to commencement of construction, and
    - must be carried out at a time when the maximum amount of species is actively growing and thus visible, (preferably between January and March)
- » Prior to development and after construction the development footprint will be routinely cleared of all alien invasive plants if detected.
- » The construction phase itself will be associated with clearing of vegetation within the development footprint only.
- » Where practically possible, the need for grading is expected to be minimal, limited mostly to contour buffer strips and/or small-scale levelling where necessary.
- » All removal of vegetation for construction purposes will be done mechanically, without the use of herbicides for indigenous species and in the case of Invasive Alien Plant only were deemed absolutely necessary and with the authorisation of the EO.
- » A continuous vegetation layer is the most important aspect of ecosystem functionality within and beyond the project site.
    - A weakened or absent vegetation layer not only exposes the soil surface, but also lacks the binding and absorption capacity that creates the buffering functionality of vegetation to prevent or lessen erosion as a result of floods.
- » All existing access and service roads will be used as far as possible.

9.2. Fixed and Tracking PV Panels

Impacts on the environment will be influenced by the types of PV panel arrays to be used. The most important differences that are envisaged to influence the impact on the ecological environment (Tsoutsos et al. 2005, Turney and Fthenakis 2011) can be summarised as follows:

Types of PV panel array	Fixed panel	Tracking panel
Size of land needed	smaller	larger
Shading and associated change of vegetation	More continuous and intense shading. Less stable and dense vegetation expected, reduced buffering	More variable and less intense overall shading. More stable and denser vegetation cover expected, smaller reduction of

	capacity of extreme weather events by vegetation expected.	buffering capacity of extreme weather events expected.
Effect on runoff and accelerated erosion	Larger continuous panel area, more concentrated runoff, constant runoff edges potentially create more erosion, especially where vegetation is weakened.	Smaller continuous panel areas, runoff more dissipated, moderate variation of runoff edges that are expected to create less erosion where vegetation is weakened.
Mounting height	PV panels may be as low as 50 cm above ground to allow for higher panels, increasing the limits of permissible vegetation due to maintenance and fire risks.	Expected to be more than 1 m off the ground, increasing the possibility of low vegetation establishment and small fauna movement without compromising safety.

9.3. Localised vs. Cumulative Impacts: Some explanatory notes

Ecosystems consist of a mosaic of many different patches. The size of natural patches affects the number, type and abundance of species they contain. At the periphery of patches, influences of neighbouring patches become apparent, known as the 'edge effect'. Patch edges may be subjected to increased levels of heat, dust, desiccation, disturbance, invasion of exotic species and other factors. Edges seldom contain species that are rare, habitat specialists or species that require larger tracts of undisturbed core habitat. Fragmentation due to development reduces core habitat and greatly extends edge habitat, which causes a shift in the species composition, which in turn puts great pressure on the dynamics and functionality of ecosystems (Perlman & Milder 2005).

Cumulative impacts of developments on population viability of species can be reduced significantly if new developments are kept as close as possible to existing developed and/or transformed areas or, where such is not possible, different sections of a development be kept as close together as possible. Thus, new power lines should follow routes of existing servitudes if such exist. Renewable energy facilities, like solar PVs should be constructed as close as possible to existing infrastructure or substations, and if several developments are planned within close proximity, these developments should be situated as close together as possible, not scattered throughout the landscape.

Existing solar energy projects that were considered in terms of their potential cumulative terrestrial ecological impacts that are in an approximate 30 km radius of the Dicoma PV Solar Energy Facility illustrated below in Figure 25. Eleven PV Solar projects (including Barleria and Setaria PV facilities) are located within the 30 km radius and as such the cumulative impacts in the area is expected to be moderate at this point.

In terms of the cumulative impact on the ESAs: Approximately 90% of the project site is situated within a Terrestrial ESA1 (linkage/corridor) and the entire site is situated within an Aquatic ESA1 (important groundwater recharge area).

However, during this study it was determined that:

» Terrestrial ESA1:

- This function of forming a corridor for movement (within the potential area of influence) is somewhat influenced, mainly through the highly fractured nature of the landscape (access roads, cultivated areas, boundary and other farm fences). Having said this, the natural to semi-natural areas are still likely to provide habitat for numerous smaller mammals as well as reptile species.
- Due to the large extent of this ESA1, and the availability of ample natural to near natural areas still available between the two mentioned valleys the development will unlikely have an impact on this ESA, and its ability to function as an important corridor.

» Aquatic ESA1:
- Due to the nature of a Solar PV developments and their associated infrastructure (limited use of chemicals, hazardous and toxic materials), it is unlikely that such a development will have a significant impact on groundwater quality. However, Solar PV developments may slightly influence local infiltration and subsequently ground water recharge.

Conclusion on cumulative impacts due to this and the surrounding developments:

» Minimal transformation of intact, sensitive habitats. These impacts could compromise the ecological functioning of these habitats and may contribute to the further fragmentation of the landscape and would potentially disrupt the connectivity of the landscape for fauna and flora and impair their ability to respond to environmental fluctuations. This contribution of the proposed project to this impact would be limited due to the fact that the proposed development is situated mostly within a low sensitivity area with most of the high sensitive areas being avoided.
» Excessive clearing of vegetation can and will influence runoff and stormwater flow patterns and dynamics, which could cause excessive accelerated erosion of plains, small ephemeral to larger intermittent drainage lines, wetlands, rivers and this could also have detrimental effects on the larger lower freshwater resource systems.
- Rehabilitation and revegetation of all surfaces disturbed or altered during construction is desirable.
- Runoff from sealed surfaces or surfaces that need to be kept clear of vegetation to facilitate operation of a development needs to be monitored regularly to ensure that erosion control and stormwater management measures are adequate to prevent the degradation of the surrounding environment.

» Large-scale disturbance of indigenous vegetation creates a major opportunity for the establishment of invasive species and the uncontrolled spread of alien invasives into adjacent agricultural land and rangelands.
- A regular monitoring and eradication protocol must be part of all developments long term management plans.

» The loss of and transformation of intact habitats could compromise the status and ecological functioning of the Critical Biodiversity and Ecological Support Areas and may fracture and disrupt the connectivity of these CBAs and ESAs, impacting the Province's ability to meet its conservation targets.

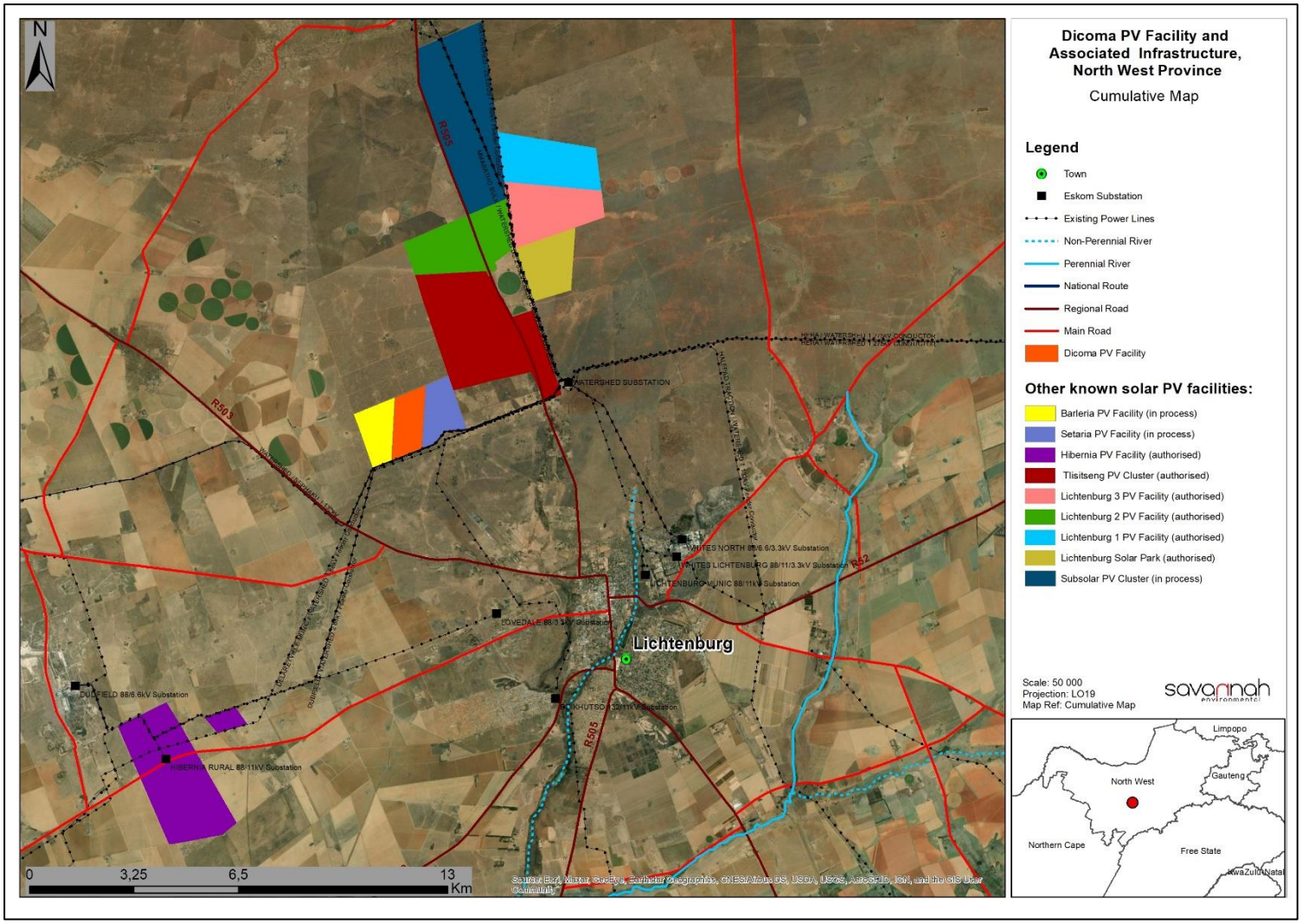

Figure 25: Location Map of the proposed Dicoma Solar Energy Facility relative to the other solar facilities planned within a radius of 30 km.

9.4. Identification of Potential Terrestrial Ecological Impacts and Associated Activities

Potential ecological impacts resulting from the proposed development would stem from a variety of different activities and risk factors associated with the construction and operation phases of the project including the following:

Construction Phase

- Human presence and uncontrolled access to the site may result in negative impacts on fauna and flora through poaching of fauna and uncontrolled collection of plants for traditional medicine or other purpose.
- Site clearing and exploration activities for site establishment.
- Vegetation clearing could impact listed plant species. Vegetation clearing would also lead to the loss of vegetation communities and habitats for fauna and avifauna and potentially the loss of faunal as well as avifaunal species, habitats and ecosystems. On a larger and cumulative scale (if numerous and uncontrolled developments are allowed to occur in the future) the loss of these vegetation communities and habitats may potentially lead to a change in the conservation status of the affected vegetation type as well as the ability of this vegetation type and associated features to fulfil its ecological responsibilities (functions). The above impact is most likely to be low due to the fact that most of the development area is situated within an area which has been largely historically transformed through cultivation practices, and long-term grazing pressure. Only limited elements of original/natural (primary) Carletonville Dolomite Grassland remain within the proposed project site and the proposed development will not impact conservation targets set out for this vegetation type. It is expected that the impact will be mostly local (concentrated within the proposed development area and within the immediate surrounding areas).
- Soil compaction and increased erosion risk would occur due to the loss of plant cover and soil disturbance created during the construction phase. This may potentially impact the downstream watercourses, wetlands and aquatic habitats, mainly due to an increase of surface water and silt inflow from the surrounding disturbed areas. These potential impacts may result in a reduction in the buffering capacities of the landscape during extreme weather events.
- Invasion by alien plants may be attributed to excessive disturbance to vegetation, creating a window of opportunity for the establishment of these alien invasive species. In addition, regenerative material of alien invasive species may be introduced to the project site by machinery traversing through areas with such plants or materials that may contain regenerative materials of such species.
- Presence and operation of construction machinery on the project site. This will create a physical impact as well as generate noise, potential pollution and other forms of disturbance at the site.
- Increased human presence can lead to poaching, illegal plant harvesting and other forms of disturbance such as fire.

Operation Phase

» The facility will require management and if this is not done effectively, it could impact adjacent intact areas through impacts such as erosion and the invasion of alien plant species.

Decommission Phase

» During decommissioning, the potential freshwater impacts will be very similar to that of the Construction Phase, although the potential for water quality and flow related risks will be lower.

Cumulative Impacts

» The loss of vegetation types on a cumulative basis from the broad area may impact the countries' ability to meet its conservation targets.
» Transformation of intact, sensitive habitats could compromise the ecological functioning of these habitats and may contribute to the fragmentation of the landscape and would potentially disrupt the connectivity of the landscape for fauna and flora and impair their ability to respond to environmental fluctuations.
» The loss of biodiversity may be exacerbated.
» Invasion of exotics and invasive species into the broader area may also potentially be exacerbated.
» Approximately 95% of the project site is situated within a Terrestrial ESA1 (linkage/corridor) and the entire site is situated within an Aquatic ESA1 (important groundwater recharge area). However, during this study it was determined that:
    - Terrestrial ESA1:
        - This function of forming a corridor for movement (within the potential area of influence) is somewhat influenced, mainly through the highly fractured nature of the landscape (access roads, cultivated areas, boundary and other farm fences). Having said this, the natural to semi-natural areas are still likely to provide habitat for numerous smaller mammals as well as reptile species.
        - Due to the large extent of this ESA1, and the availability of ample natural to near natural areas still available between the two mentioned valleys the development will unlikely have an impact on this ESA, and its ability to function as an important corridor.
    - Aquatic ESA1:
        - Due to the nature of a Solar PV developments and their associated infrastructure (limited use of chemicals, hazardous and toxic materials), it is unlikely that such a development will have a significant impact on groundwater quality. However, Solar PV developments may slightly influence local infiltration and subsequently ground water recharge.

The impacts identified above are assessed below, during the construction, operation and decommissioning phases of the facility as well as before and after mitigation.

The entire project site is taken into account, including; access roads, internal access roads, solar field, laydown areas, substation and battery areas as well as the site office.

The majority of impacts associated with the development would occur during the construction phase as a result of the disturbance associated with the operation of heavy machinery at the site and the presence of construction personnel. The major risk factors and contributing activities associated with the development are identified and briefly outlined and summarised below before the impacts are assessed. These are not necessarily a reflection of the impacts that would occur, but rather a discussion on overall potential impacts and/or extent of these potential impacts that would occur if mitigation measures are not considered and/ or sensitive areas not avoided. The assessment of these impacts is outlined in the following section.

9.4.1. **Impact 1:** Potential impacts on vegetation and listed or protected plant species.

The impacts identified above are assessed below, during the construction, operation and decommissioning phases of the facility as well as before and after mitigation.

As already mentioned, the most likely and significant impact will be on the vegetation located within the development area and development footprint of the proposed facility. The proposed development may lead to a direct loss of vegetation. Some loss of vegetation is an inevitable consequence of the development. However, the footprint of the development is mostly confined to an area that has been historically transformed through cultivation practices (secondary grassland).

***At Vegetation Level**:*

Consequences of the impact occurring may include:

- » general loss of habitat for sensitive species;
- » loss in variation within sensitive habitats due to loss of portions of it;
- » general reduction in biodiversity;
- » increased fragmentation (depending on location of impact);
- » disturbance to processes maintaining biodiversity and ecosystem goods and services; and
- » loss of ecosystem goods and services.

Only a fairly small portion of the development footprint will be located within natural/primary Carletonville Dolomite Grassland whilst the bulk of the development

footprint will be located within a secondary grassland (historically cultivated). Carletonville Dolomite Grassland has a vary extensive distribution and is currently listed as Least Threatened. Although the development will impact at a small local scale it is highly unlikely that this development will impact on the status of this vegetation type (impact on a regional scale) as the majority of the development will occur, as mentioned, within mostly transformed habitats. Furthermore, the development will be, although long term, not permanent and by selecting fixed panel technology accompanied by only mowing of lower plant layers instead of total clearance of the vegetation within the footprint area, some original vegetation will be allowed to largely persist within most of the development footprint area.

At species level:

No Plant SCC were observed within the development site; however, a few provincially protected species have been observed namely;

- *Babiana hypogea,*
- *Schizocarpus nervosus,*
- *Gladiolus spp*.

All of the above-mentioned species are fairly common within the region and have a fairly wide range within South Africa. It is highly unlikely that the proposed development will have a significant impact on these species and their populations within the area as these species are also well represented outside of the development footprint.

The nature and extent of impacts on vegetation can be evaluated, and the impacts can be largely mitigated through avoidance of identified sensitive areas and listed species, by allowing a minimum clearance of vegetation (restricted to the absolute necessary areas), or allowing for search and rescue of individuals where this is viable.

9.4.2. **Impact 2:** Direct faunal impacts**.**

Faunal species will primarily be affected by the overall loss of habitat. Increased levels of noise, disturbance, potential pollution and human presence will be detrimental to fauna. Sensitive and shy fauna would move away from the area during the construction phase as a result of the noise and human activities present, while some slow-moving species and species confined and dependant on specified habitats would not be able to avoid the construction activities and might be at risk. Some mammals and reptiles would be vulnerable to illegal collection or poaching during the construction phase as a result of the large number of construction personnel that are likely to be present. This impact is highly likely to occur during the construction phase and could also potentially occur with resident fauna within the facility after construction.

Threatened species (red data species) include those listed as critically endangered, endangered or vulnerable. For any other species a loss of individuals or localised populations is unlikely to lead to a change in the conservation status of the species. However, in the case of threatened animal species, loss of a population or individuals could lead to a direct change in the conservation status of the species and possible extinction. This may arise if the proposed infrastructure is located where it will impact on such individual or populations. Consequences may include:

» fragmentation of populations of affected species;
» reduction in the area of occupancy of affected species; and
» loss of genetic variation within the affected species.

These may all lead to a negative change in conservation status of the affected species, which implies a reduction in the chances of the species' overall survival.

As already mentioned, faunal diversity within the study area, and most likely also within the surrounding environment, is largely limited due to the fragmented condition of the landscape as well as the anthropogenic activities within the area (cultivation practices, farm and game fences and small grazing camps, roads etc). Larger mammals are typically livestock. "Natural" fauna that have historically occurred in area have been largely affected by the above-mentioned impacts and most species now found within the area are highly adaptable, tolerant species with some being capable and small enough to move between these fragments of near-natural "islands". Within the affected farm properties very little faunal activity was observed. Species confirmed within the affected farm properties include:

» Small mammals: such as Scrub Hare (*Lepus saxatilis*), Cape Porcupine *(Hystrix africaeaustralis*), African Mole-rat (*Cryptomys hottentotus*), Highveld Gerbil (*Gerbilliscus brantsii*), Four-striped Grass Mouse (*Rhabdomys pumilio*), Southern Multimammate Mouse (*Mastomys coucha*), South African Ground Squirrel (*Xerus inauris*), Black-backed Jackal (*Canis mesomelas*), Yellow Mongoose (*Cynictis penicillata*), Common Duiker (*Sylvicapra grimmia*) and Steenbok (*Raphicerus campestris*).
» Herpetofauna: Very few reptilian species were confirmed within the project site including: Thin-tailed Legless Skink (Acontias gracilicauda) - Endemic, Wahlberg's Snake-eyed Skink (Afroablepharus wahlbergii) and Peters' Thread Snake (Leptotyphlops scutifrons).

During the construction phase noise generated may however cause some temporary disturbances although it is expected that this will not deter these species.

Disturbance of faunal species can be maintained to a minimum and low significance by implementing effective mitigation measures. Livestock and "agricultural" game will most likely be relocated to other camps with some smaller species such as sheep, goat and smaller antelope species (Steenbok and Duiker) which can potentially be allowed to roam

and graze the development footprint. Most of the natural occurring species are mobile and will most likely move away from the development area during construction phase with some species likely to return during the operation phase. Less mobile species such as tortoises, snakes and potential amphibian species should be looked out for and where encountered should either be relocated as recommended by the ECO or be left undisturbed if the development will not affect the species (e.g. toads and frogs of nearby wetland habitats).

As already mentioned, the most likely and significant impact will be on the vegetation located within the development area and development footprint of the proposed facility. The proposed development may lead to a direct loss of vegetation. Some loss of vegetation is an inevitable consequence of the development. However, the footprint of the development is mostly confined to an area that has been historically transformed through cultivation practices (secondary grassland).

9.4.3. **Impact 3:** Soil erosion and associated degradation of ecosystems**.**

This impact along with the loss of vegetation is probably the most significant impact that may occur due to the proposed development. Soil erosion is a frequent risk associated with solar facilities on account of the vegetation clearing and disturbance associated with the construction phase of the development and may continue occurring throughout the operation phase. Service roads and installed infrastructure will generate increased direct runoff during intense rainfall events and may exacerbate the loss of topsoil and the effects of erosion. These eroded materials may enter the nearby watercourses and may potentially impact these systems through siltation and change in chemistry and turbidity of the water. Current erosion observed within the affected farm properties was low.

With effective mitigation measures in place including regular monitoring of the occurrence, spread and potential cumulative effects of erosion may be limited to an absolute minimum.

9.4.4. **Impact 4:** Alien Plant Invasion**.**

Major factors contributing to invasion by alien invader plants includes habitat disturbance and associated destruction of indigenous vegetation. Consequences of this may include:

- » change in the vegetation structure leading to change in various habitat characteristics and loss of indigenous vegetation;
- » replacement of palatable species with unpalatable species therefore reducing the grazing capacity of the area;
- » change in the plant species composition;
- » change in soil chemistry properties;
- » loss of sensitive habitats (e.g. downstream watercourses and wetlands);
- » loss or disturbance to individuals of rare, endangered, endemic and/or protected species;
- » fragmentation of sensitive habitats;

» change in flammability of vegetation, depending on alien species; and
» impairment of wetland function.

For the primary grassland communities (VegComm SE and AT) weeds (W) and alien plants (AP) where largely absent from the more natural areas. However trampled and overgrazed area as well as the margins of access routes and firebreaks contained varying levels of weeds and alien plants. The most common weeds and APs recorded within these areas includes; *Alternanthera pungens* (AP), *Conyza bonariensis* (AP), *Schkuhria pinnata* (AP), *Zinnia peruviana* (AP), *Nidorela resedifolia* (W), Aristida congesta (W), *Aristida adscensionis* (W), *Berkheya onopordifolia* (W), *Cynodon dactylon* (W), *Chloris virgata* (W), *Heteropogon contortus* (W) and *Urochloa panicoides* (W). Severely degraded and trampled areas are prone to the invasion of Invasive Alien Plants (IAPs), especially *Datura stramonium* and *Xanthium spinosum* (e.g. trampled areas around kraal and artificial water points).

The secondary grassland (VegComm HE) comprise numerous weeds as well as a few alien plants and include; *Conyza podocephala* (AP), *C. bonariensis* (AP), *Schkuhria pinnata* (AP), *Tagetes minuta* (AP), *Chrysocoma ciliata* (W), *Nidorella resedifolia* (W), *Aristida congesta* (W), *Asparagus laricinus* (W), *Solanum lichtensteinii* (W), *Aristida adscensionis* (W), *Hyparrhenia hirta* (W), *Berkheya onopordifolia* (W), *Geigeria burkei* (W) and *Cynodon dactylon* (W).

IAPs that were not recorded within the development footprint but was observed within the affected properties or in close proximity to the development footprint include: *Melia azedarach* (Category 1b), *Pyracantha angustifolia* (Category 1b), *Solanum sisymbriifolium* (Category 1b), *S. elaeagnifolium* (Category 1b), *Flaveria bidentis* (Category 1b), *Argemone ochroleuca* (Category 1b), *Opuntia ficus-indica* (Category 1b) and *O. humifusa* (Category 1b).

The potential for some of these species to encroach and establish in the disturbed development footprint, during the construction phase an operational phase, are relatively high and will require careful attention. With affective and meticulous mitigation measures in place this can be achieved.

9.4.5. **Impact 5:** Reduced ability to meet conservation obligations and targets**.**

In terms of the cumulative impact on the Carletonville Dolomite Grassland, as already mentioned, this vegetation type is listed as Least Threatened (approximately 76.1% is till intact) with a conservation target of 24%. Furthermore, only a fairly small portion of the development footprint will be located within natural/primary Carletonville Dolomite Grassland whilst the bulk of the development footprint will be located within a secondary grassland (historically cultivated). Subsequently it is highly unlikely that this development will impact on the status, as well as the conservation targets set out for this vegetation type (impact on a regional scale).

9.4.6. **Impact 6:** Impact on Critical Biodiversity Areas and broad-scale ecological processes.

Approximately 35% of the project site is situated within a Terrestrial ESA1 (linkage/corridor) and the entire site is situated within an Aquatic ESA1 (important groundwater recharge area). However, during this study it was determined that:

- Terrestrial ESA1:
  - This function of forming a corridor for movement (within the potential area of influence) is somewhat influenced, mainly through the highly fractured nature of the landscape (access roads, cultivated areas, boundary and other farm fences). Having said this, the natural to semi-natural areas are still likely to provide habitat for numerous smaller mammals as well as reptile species.
  - Due to the large extent of this ESA1, and the availability of ample natural to near natural areas still available between the two mentioned valleys the development will unlikely have an impact on this ESA, and its ability to function as an important corridor.
- Aquatic ESA1:
  - Due to the nature of a Solar PV developments and their associated infrastructure (limited use of chemicals, hazardous and toxic materials), it is unlikely that such a development will have a significant impact on groundwater quality. However, Solar PV developments may slightly influence local infiltration and subsequently ground water recharge.

Impacts on these ESAs can be maintained to an absolute minimum by restricting the development to disturbed and transformed areas. By furthermore implementing effective mitigation measures the functionality of these areas and connectivity between these areas may be maintained.

9.4.7. **Impact 7:** Potential cumulative impacts due to nearby renewable energy developments (solar energy facilities).

Existing renewable energy projects that were considered in terms of their potential cumulative terrestrial ecological impacts that are in an approximate 30 km radius of the Dicoma PV Facility are illustrated in Figure 25. PV Solar developments, within the larger area is still regarded as relative moderate to low, comprising of eleven projects (Lichtenburg 1, 2 and 3 solar PV Facilities, Tlisitseng 1 and 2 solar PV Facilities, Hibernia solar PV Facility, Watershed solar PV Facility, an unknow project to the east as well as the Dicoma and Setaria solar PV Facilities). The Barleria, Dicoma and Setaria solar PV Facilities are all located within the approved Watershed PV footprint which has since been withdrawn. These developments are located in relatively close proximity to each other and as such impacts are concentrated and restricted to a moderately small area, in close proximity to the town of Lichtenburg, when considering the broader context. As such the

cumulative impacts within the broader area are expected to be moderate to low at this point (refer to Figure 25for a list of renewable energy developments planned within a radius of 30km form the Dicoma PV Facility). The bulk of the surrounding land is mostly in transformed state (under cultivation or has been cultivated at some stage within the last few years), remaining pockets of land which are not arable are utilized mainly for cattle grazing, or recently for game farming (scarce large game).

Conclusion on cumulative impacts due to surrounding developments:

- » It is highly unlikely that a cumulative effect of loss of high biodiversity areas could arise from the Dicoma PV Energy Facility in combination with the other renewable energy projects in the surrounding environment for the following reasons:
    - No senstivie biodiversity features, taxa, and/or drivers have been identified within the projec site;
    - No Critical Biodiversity Areas, as identified within the North West Province Biodiversity Sector Plan (2015), are located within the project site;
    - Eventhough more than 90% of the projec site is located within an ESA (245.7ha of project site) the total size of the impacted area, in comparison with the total extent of the ESA corridor/linkage between the important freshwater resources, is very small. Only approximately 0.8% of the entire ESA will be impacted by this proposed development. Subsequently the contribution of this PV solar facility to the cumulative impact on this ESA is almost negligible small.
    - The landscape between these developments are highly fractured and isolated from one another. Subsequently, potential faunal migration routes are absent between these developments and is not considered significant from a cumulative perspective due to existing degradation.
- » It is highly unlikely that a cumulative effect of loss habitat and biota, and subsequently a reduced ability to meet conservation obligation and targets, could arise from the Dicoma PV Energy Facility in combination with the other renewable energy projects in the surrounding environment for the following reasons:
    - The Carletonville Dolomite Grassland Vegetation Type is still largely intact (76% remaining) and is subsequently listed as Least Threatened with a conservation target of 24%.
        - Whilst this vegetation type has a fairly extensive extent (1107591.2ha or 11075.912 km^2), the combined footprint for all proposed renewable energy projects within this vegetation type is 18048.4ha, and subsequently only around 1.63% of this vegetation type will be impacted.
        - Furthermore, if only the renewable projects within a 30km radius of the proposed Dicoma PV solar facility, as well as the Dicoma facility itself, is taken into account the impact footprint is even lower and only about 1.08% of the vegetation type will be impacted by these renewable energy facilities.
        - Also, a little more than 24% of the Dicoma PV solar facility's footprint is located within a historically transformed habitat.

- No existing or planned (NPAES-focus areas) protected and/or conservation important areas will be impacted by these renewable energy projects.
- These renewable energy facilities are mostly clumped together, and is located in relatively close proximity to the town of Lichtenburg and as such the contribution to habitat fragmentation is significantly reduced.
    - Ample contiguous (uninterrupted) areas are available around these renewable energy facilities, allowing for connectivity between important landscape/habitat/resource features.

9.5. Assessment of Impacts Associated with the PV Solar Facility

9.5.1. **Impact 1:** Potential impacts on vegetation and listed or protected plant species.

Impact Nature: Impacts on vegetation and listed or protected plant species would occur due to the construction of the facility and associated infrastructure. This impact is regarded as the most likely and significant impact and may lead to direct loss of vegetation including listed and protected species.

The most likely consequences include:

» local loss of habitat (to an extent as a natural ground covering will be maintained where possible);
» very small and local disturbance to processes maintaining local biodiversity and ecosystem goods and services; and
» a potential loss of a few local protected species.

The development footprint itself is primarily homogenous in terms of habitat types and vegetation cover thus providing for easier and more accurate calculation of potential impacts, more effective recommendations and implementation of management and mitigation measures, and furthermore lowering the impact and beta diversity.

	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Moderate (6)	Minor (4)
Probability	Highly Probable (4)	Probable (3)
Significance	**Medium (44)**	**Low (27)**
Status	Negative	Negative
Reversibility	Low	Moderate
Irreplaceable loss of resources	No	No
Can impacts be mitigated?	Yes, to a large extent	
Mitigation	» Preconstruction walk-through of the final development footprint for protected species that would be affected and that can be translocated. » Since a large proportion of the identified protected species at the site are geophytic (e.g. *Babiana hypogea, Schizocarphus nervosus* and *Gladiolus spp.*), the potential for successful translocation is high. Before construction commences individuals of listed species within the	

	development footprint that would be affected, should be counted and marked and translocated where deemed necessary by the ecologist conducting the pre-construction walk-through survey, and according to the recommended ratios. Permits from the relevant provincial authorities, will be required to relocate and/or disturb listed plant species. » Any individuals of protected species affected by and observed within the development footprint during construction should be translocated under the supervision of the ECO and/or Contractor's Environmental Officer (EO). » Pre-construction environmental induction for all construction staff on site to ensure that basic environmental principles are adhered to. This includes awareness to no littering, appropriate handling of pollution and chemical spills, avoiding fire hazards, minimising wildlife interactions, remaining within demarcated construction areas etc. » Demarcate all areas to be cleared with construction tape or similar material where practical. However, caution should be exercised to avoid using material that might entangle fauna. » ECO and/or Contractor's EO to provide supervision and oversight of vegetation clearing activities and other activities which may cause damage to the environment, especially at the initiation of the project, when the majority of vegetation clearing is taking place. » Ensure that laydown areas, construction camps and other temporary use areas are located in areas of low and medium sensitivity and are properly fenced or demarcated as appropriate and practically possible. » All vehicles to remain on demarcated roads and no unnecessary driving in the veld outside these areas should be allowed. » Regular dust suppression during construction, if deemed necessary, especially along access roads. » No plants may be translocated or otherwise uprooted or disturbed for rehabilitation or other purpose without express permission from the ECO and or Contractor's EO. » No fires should be allowed on-site.
Residual Impacts	Due to the shade effect of the solar panels some transformation of vegetation is likely to occur underneath the panels. As this area is already, to some extent, in a transformed state, further transformation due to the shading effect is **not likely to be significant**. However, any transformations caused by the development will take a very long time to restore and as such is regarded as a residual impact.

9.5.2. **Impact 2:** Direct faunal impacts**.**

Impact Nature: Increased levels of noise, pollution, disturbance and human presence during construction will be detrimental to fauna. Sensitive and shy fauna would move away from the area during the construction phase as a result of the noise and human activities present, while some slow-moving species would not be able to avoid the construction activities and might be killed. Some impact on fauna is highly likely to occur during construction.

	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)

Duration	Short-term (2)	Short-term (2)
Magnitude	Minor (4)	Small (2)
Probability	Probable (3)	Probable (3)
Significance	**Low (21)**	**Low (15)**
Status	Negative	Negative
Reversibility	Moderate	Moderate
Irreplaceable loss of resources	No	No
Can impacts be mitigated?	Noise and disturbance during the construction, decommission and during maintenance phases cannot be avoided but would be transient in nature and with appropriate mitigation; no long-term impacts from the construction phase can be expected.	
Mitigation	» Site access should be controlled and no unauthorised persons should be allowed onto the site. » Any fauna directly threatened by the associated activities should be removed to a safe location by a suitably qualified person. » The collection, hunting or harvesting of any plants or animals at the site should be strictly forbidden. Personnel should not be allowed to wander off the demarcated site. » Fires should not be allowed on site. » All hazardous materials should be stored in the appropriate manner to prevent contamination of the site. Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner as related to the nature of the spill. » All construction vehicles should adhere to a low speed limit (30km/h) to avoid collisions with susceptible species such as snakes and tortoises. » Construction vehicles limited to a minimal footprint on site (no movement outside of the earmarked footprint).	
Residual Impacts	The altered development area will contain a lower diversity of habitat types and niches for faunal species, however faunal diversity was in any way confirmed to be limited and as such this potential residual impact can be **regarded as low**.	

9.5.3. **Impact 3:** Soil erosion and associated degradation of ecosystems**.**

Impact Nature: During construction/decommission, there will be a lot of disturbed and loose soil at the site which will render the area vulnerable to erosion. Erosion is one of the greater risk factors associated with the development and it is therefore critically important that proper erosion control structures are built and maintained over the lifespan of the project.		
	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Short-term (2)	Very Short-term (1)

Magnitude	Moderate (6)	Minor (2)
Probability	Highly Probable (4)	Probable (3)
Significance	**Medium (36)**	**Low (12)**
Status	Negative	Negative
Reversibility	Low – if erosion has reached severe levels the impacts will not be remedied easily	High
Irreplaceable loss of resources	Potential loss of important resources.	No
Can impacts be mitigated?	Yes, to a large extent	
Mitigation	» Any erosion problems observed along access roads or any hardened/engineered surface should be rectified immediately and monitored thereafter to ensure that they do not re-occur. » All bare areas (excluding agricultural land and the development footprint), affected by the development, should be re-vegetated with locally occurring species, to bind the soil and limit erosion potential where applicable. » Re-instate as much of the eroded area to its pre-disturbed, "natural" geometry (no change in elevation and any banks not to be steepened) where possible. » Roads and other disturbed areas should be regularly monitored for erosion problems and problem areas should receive follow-up monitoring by the EO to assess the success of the remediation. » Topsoil must be removed and stored separately from subsoil. Topsoil must be reapplied where appropriate as soon as possible in order to encourage and facilitate rapid regeneration of the natural vegetation on cleared areas. » Practical phased development and vegetation clearing must be practiced so that cleared areas are not left un-vegetated and vulnerable to erosion for extended periods of time.	
Residual Impacts	The loss of fertile soil and soil capping resulting in areas which cannot fully rehabilitate itself with a good vegetation cover. With appropriate avoidance and mitigation residual impacts will be **very low**.	

9.5.4. **Impact 4:** Alien Plant Invasion**.**

Impact Nature: Increased alien plant invasion is one of the greatest risk factors associated with this development. The disturbed and bare ground that is likely to be present at the site during and after construction would leave the site vulnerable to alien plant invasion for some time if not managed. Furthermore, the National Environmental Management Biodiversity Act (Act No. 10 of 2004), as well as the Conservation of Agricultural Resources Act, (Act No. 43 of 1983) requires that listed alien species are controlled in accordance with the Act.		
	Without Mitigation	**With Mitigation**
Extent	Local - Regional (3)	Local (1)

Duration	Permanent (5)	Short-term (1)
Magnitude	Moderate (6)	Minor (4)
Probability	Definite (5)	Probable (3)
Significance	**High (70)**	**Low (18)**
Status	Negative	Neutral – Slightly Negative
Reversibility	Not Possible	High
Irreplaceable loss of resources	Potential loss of important resources due to the replacement of natural vegetation by invading alien plants	No
Can impacts be mitigated?	Yes. Alien Plant Invasion is propbably one of the greatest and most significant risk factores, associated with PV solar development, that can have a signifant impact on the affected area as well as surrounding landscape. However, this is also the risks factor that, with mitigantion measures in place, can be the most signficiantly reduced in terms of significance, as indicated above.	
Mitigation	» The successful reduction in the treat (significance) posed by Alien Invasive Plants relies on a detailed; o Site-specific eradication and management programme for alien invasive plants; o Site-specific Vegetation Rehabilitation Management Plan; and o The meticulous implementation of thes Management Plans. » Such an Alien Invasive and Vegetation Rehabilitation Management Plans must subsequently be included in the Environmental Management Programme (EMPr). » Regular monitoring by the operation and maintenance team for alien plants must occur and could be conducted simultaneously with erosion monitoring. » When alien plants are detected, these must be controlled and cleared using the recommended control measures for each species to ensure that the problem is not exacerbated or does not re-occur and increase to problematic levels. » Clearing methods must aim to keep disturbance to a minimum. » No planting or importing any listed invasive alien plant species (all Category 1a, 1b and 2 invasive species) to the site for landscaping, rehabilitation or any other purpose must be undertaken.	
Residual Impacts	If the above recommended mitigation measures are strictly implemented and some re-establishment and rehabilitation of natural vegetation is allowed the residual impact will be very low.	

9.5.5. **Impact 5:** Altered runoff and infiltration patterns due to rainfall interception by PV panel infrastructure and compacted areas resulting in high levels of erosion (Operational Phase).

Impact Nature: Disturbance created during construction could take several years to fully stabilise and the presence of an extensive area of hardened surface will generate a lot of runoff which will pose a significant erosion risk, if not managed. Erosion is one of the greater risk factors associated with this type of development, and it is therefore essential that proper erosion control structures are built and maintained over the lifespan of the project.

	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (1)
Duration	Long-term (4)	Very Short-term (1)
Magnitude	High (8)	Low (1)
Probability	Highly Probable (4)	Improbable (2)
Significance	**Medium (56)**	**Low (6)**
Status	Negative	Neutral – Slightly Negative
Reversibility	Low – if erosion has reached severe levels the impacts will not be remedied easily.	High
Irreplaceable loss of resources	Potential loss of important resources.	No
Can impacts be mitigated?	Yes, to a large extent	
Mitigation	» Regular monitoring of the site (minimum of twice annually) to identify possible areas of erosion is recommended, particularly after large summer thunder storms have been experienced. » The higher level of shading anticipated from PV panels may prevent or slow down the re-establishment of some desirable species, therefore re-establishment should be monitored and species composition adapted if vegetation fails to establish sufficiently. » Alternatively, soil surfaces where no revegetation seems possible will have to be covered with gravel or small rock fragments to increase porosity of the soil surface, slow down runoff and prevent wind- and water erosion. » Monitor the area below and around the panels regularly after larger rainfall events to determine where erosion may be initiated and then mitigate by modifying the soil micro-topography and revegetation efforts accordingly. » Due to the nature and larger runoff surfaces of the PV panels, the development area should be adequately landscaped and rehabilitated to contain expected accelerated erosion. » Runoff may have to be specifically channelled or storm water adequately controlled to prevent localised rill and gully erosion. » Any erosion problems observed should be rectified as soon as possible and monitored thereafter to ensure that they do not re-occur.	

	» Roads and other disturbed areas should be regularly monitored for erosion problems and problem areas should receive follow-up monitoring to assess the success of the remediation.
Residual Impacts	The loss of fertile soil and soil capping resulting in areas which cannot fully rehabilitate itself with a good vegetation cover. With appropriate avoidance and mitigation residual impacts will be **very low**.

9.6. Assessment of Impacts Associated with the On-Site Substation Options

» On-Site Substation Option1: This substation option will be located within a near-natural primary grassland (VegCom SE).
» On-Site Substation Option 2: This substation option will be located within a secondary grassland (VegComm HE) that has been historically cultivated.
» For both on-site substation options, the impacts relating to terrestrial ecology are very similar and as such the impact assessment conducted below, relating to terrestrial ecology, is applicable to both alternatives.

9.6.1. **Impact 1:** Potential impacts on vegetation and listed or protected plant species**.**

Impact Nature: Vegetation clearing will lead to the loss of current habitat and is an inevitable consequence of this type of activity. The extent of the proposed footprint, is however, small. Furthermore, no species of conservation concern were recorded within the proposed footprint areas.

The loss of local vegetation within the footprints are expected to be of relatively minor significance when considered on a broad scale.

	ALTERNATIVE 1 & 2	
	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Minor (3)	Small (2)
Probability	Definite (5)	Improbable (2)
Significance	**Medium (40)**	**Low (14)**
Status	Negative	Negative
Reversibility	Low	Moderate
Irreplaceable loss of resources	No	No
Can impacts be mitigated?	Yes, to a large extent	
Mitigation	» Pre-construction walk-through of the power line route/corridor to locate species of conservation concern that can be translocated or avoided. » Vegetation clearing to commence only after walkthrough has been conducted and necessary permits obtained.	

	» Pre-construction environmental induction for all construction staff on-site to ensure that basic environmental principles are adhered to. This includes awareness as to no littering, appropriate handling of pollution and chemical spills, avoiding fire hazards, remaining within demarcated construction areas, etc. » Demarcate all areas to be cleared with construction tape or similar material where practical. However, caution should be exercised to avoid using material that might entangle fauna. » Contractor's EO to provide supervision and oversight of vegetation clearing activities and other activities which may cause damage to the environment, especially at the initiation of the project, when the majority of vegetation clearing is taking place. » Vegetation clearing to be kept to a minimum. No unnecessary vegetation to be cleared. » Ensure that laydown areas, construction camps and other temporary use areas are located in areas of low and medium sensitivity and are properly fenced or demarcated as appropriate and practically possible. » All vehicles to remain within demarcated construction areas and no unnecessary driving in the veld outside these areas should be allowed. » Existing tracks should be used for access wherever possible. » The morphology and hydrology of the wetland features not be altered by unnecessary excavations, dumping of soil or other waste. » No fires should be allowed on-site.
Residual Impacts	Some residual vegetation loss will result from the development, equivalent to the operational footprint of the power line.

9.6.2. **Impact 2:** Direct faunal impacts**.**

Impact Nature: Disturbance, transformation, and loss of habitat will have a negative effect on resident fauna during construction.

There are fauna residents within the site, and these will be impacted during the construction of the power line. However, faunal diversity and density within the site are low, and post-mitigation impacts are likely to be Low and of Local significance only.

Increased levels of noise, pollution, disturbance, and human presence during the construction phase may affect the local fauna. Sensitive and shy fauna would move away from the area during the construction phase and may move back into the area upon completion of the construction phase. Some slow-moving species (i.e. tortoise & snakes) would not be able to avoid the activities and might be killed.

Faunal diversity and density within the site are low and post-mitigation impacts are likely to be Low and of Local significance only.

	ALTERNATIVE 1 & 2	
	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Short-term (2)	Short-term (2)
Magnitude	Low (2)	Low (2)
Probability	Probable (3)	Very Improbable (1)
Significance	**Low (15)**	**Low (5)**

Status	Negative	Negative
Reversibility	Moderate	Moderate to High
Irreplaceable loss of resources	Unlikely	Unlikely
Can impacts be mitigated?	Noise and disturbance during the construction, decommission and during maintenance phases cannot be avoided but would be transient in nature and with appropriate mitigation; no long-term impacts from the construction phase can be expected.	
Mitigation	» All personnel should undergo environmental induction with regards to fauna and in particular awareness about not harming or collecting species such as snakes, tortoises which are often persecuted out of superstition. » Site access should be controlled and no unauthorised persons should be allowed onto the site. » Any fauna directly threatened by the associated activities should be removed to a safe location by a suitably qualified person. » The collection, hunting or harvesting of any plants or animals at the site should be strictly forbidden. Personnel should not be allowed to wander off the demarcated site. » Fires should not be allowed on site. » All hazardous materials should be stored in the appropriate manner to prevent contamination of the site. Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner as related to the nature of the spill. » All construction vehicles should adhere to a low speed limit (30km/h) to avoid collisions with susceptible species such as snakes and tortoises. » Construction vehicles limited to a minimal footprint on site (no movement outside of the earmarked footprint).	
Residual Impacts	There will be minimal residual impact as the facility will have low operational impacts on fauna, after the construction phase.	

9.6.3. **Impact 3:** Soil erosion and associated degradation of ecosystems.

Impact Nature: During construction/decommission, there will be a lot of disturbed and loose soil at the site which will render the area vulnerable to erosion. It is critically important that proper erosion control structures are built and maintained over the lifespan of the project.

	ALTERNATIVE 1 & 2	
	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Medium-term (3)	Short-term (1)
Magnitude	Minor (4)	Small (2)
Probability	Probable (3)	Improbable (2)
Significance	**Low (24)**	**Low (8)**
Status	Negative	Negative
Reversibility	Low	High

Irreplaceable loss of resources	No	No
Can impacts be mitigated?	Yes, to a large extent	
Mitigation	» Any erosion problems observed to be associated with the access road and/or hardened/engineered surfaces should be rectified as soon as possible and monitored thereafter to ensure that they do not re-occur. » All bare areas due to the project activities should be re-vegetated with locally occurring species, to bind the soil and limit erosion potential where applicable. » An erosion control management plan should be utilised to prevent erosion » There should be reduced activity at the site after large rainfall events when the soils are wet. No driving off of hardened roads should occur immediately following large rainfall events until soils have dried out and the risk of bogging down has decreased. » Construction of gabions and other stabilisation features to prevent erosion, if deemed necessary. » Re-instate as much of the eroded area to its pre-disturbed, "natural" geometry (no change in elevation and any banks not to be steepened) where possible. » Roads and other disturbed areas should be regularly monitored for erosion problems and problem areas should receive follow-up monitoring by the EO to assess the success of the remediation. » Topsoil must be removed and stored separately from subsoil. Topsoil must be reapplied where appropriate as soon as possible in order to encourage and facilitate rapid regeneration of the natural vegetation on cleared areas.	
Residual Impacts	The loss of fertile soil and soil capping resulting in areas which cannot fully rehabilitate itself with a good vegetation cover. With appropriate avoidance and mitigation residual impacts will be **very low**.	

9.6.4. **Impact 4:** Alien Plant Invasion**.**

Impact Nature: The disturbed and bare ground that is likely to be present at the site during and after construction would leave the site vulnerable to alien plant invasion for some time if not managed. Furthermore, the National Environmental Management Biodiversity Act (Act No. 10 of 2004), as well as the Conservation of Agricultural Resources Act, (Act No. 43 of 1983) requires that listed alien species are controlled in accordance with the Act.

	ALTERNATIVE 1 & 2	
	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Short-term (1)
Magnitude	Minor (4)	Small (1)
Probability	Highly Probable (4)	Improbable (2)
Significance	**Medium (40)**	**Low (6)**
Status	Negative	Negative
Reversibility	Low	High

Irreplaceable loss of resources	No	No
Can impacts be mitigated?	Yes, to a large extent	
Mitigation	» A site-specific eradication and management programme for alien invasive plants must be implemented during construction. » Regular monitoring by the operation and maintenance team for alien plants at the within the power line servitude must occur and could be conducted simultaneously with erosion monitoring. » When alien plants are detected, these must be controlled and cleared using the recommended control measures for each species to ensure that the problem is not exacerbated or does not re-occur and increase to problematic levels. » Clearing methods must aim to keep disturbance to a minimum. » No planting or importing any listed invasive alien plant species (all Category 1a, 1b and 2 invasive species) to the site for landscaping, rehabilitation or any other purpose must be undertaken.	
Residual Impacts	If the above recommended mitigation measures are strictly implemented and some re-establishment and rehabilitation of natural vegetation is allowed the residual impact will be **very low**.	

9.6.5. **Impact 5:** Altered runoff patterns due to rainfall interception by Substation infrastructure and compacted areas resulting in high levels of erosion (Operational Phase)**.**

Impact Nature: The presence of an extensive area of hardened surface during operation will generate a lot of runoff which will pose a significant erosion risk, if not managed. Erosion is one of the greater risk factors associated with this type of development, and it is therefore essential that proper erosion control structures are built and maintained over the lifespan of the project.		
	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Short-term (1)
Magnitude	Minor (2)	Small (1)
Probability	Highly Probable (4)	Probable (3)
Significance	**Medium (32)**	**Low (9)**
Status	Negative	Negative
Reversibility	Low	High
Irreplaceable loss of resources	No	No
Can impacts be mitigated?	Yes, to a large extent	
Mitigation	» Regular monitoring of the site (minimum of twice annually) to identify possible areas of erosion is recommended, particularly after large summer thunder storms have been experienced.	

	» All bare areas due to the project activities should be re-vegetated with locally occurring species, to bind the soil and limit erosion potential where applicable. » Alternatively, soil surfaces where no revegetation seems possible will have to be covered with gravel or small rock fragments to increase porosity of the soil surface, slow down runoff and prevent wind- and water erosion. » Monitor the area below and around the panels regularly after larger rainfall events to determine where erosion may be initiated and then mitigate by modifying the soil micro-topography and revegetation efforts accordingly. » Due to the nature and larger runoff surfaces, the development area should be adequately landscaped and rehabilitated to contain expected accelerated erosion. » Runoff may have to be specifically channelled or storm water adequately controlled to prevent localised rill and gully erosion. » Any erosion problems observed should be rectified as soon as possible and monitored thereafter to ensure that they do not re-occur. » Roads and other disturbed areas should be regularly monitored for erosion problems and problem areas should receive follow-up monitoring to assess the success of the remediation.
Residual Impacts	The loss of fertile soil and soil capping resulting in areas which cannot fully rehabilitate itself with a good vegetation cover. With appropriate avoidance and mitigation residual impacts will be very low.

9.7. Assessment of Impacts Associated with the Gridline Options

- Gridline Option1: This gridline is relative short (991m) and will only traverse VegComm SE (primary grassland);
- Gridline Option 2: This gridline is the longer options (2.2m) and will traverse an addition portion of VegComm SE as well as some secondary grassland (historically cultivated) to the east.
- Due to the fact that gridline option 2 will impact a slightly large area, it is envisaged that this option will have a somewhat more significant impact on the ecology of the area. However due to the linear nature (relatively small impact area) and fact that a portion of this option will traverse secondary grassland, the significance of impacts associated with this gridline option will only be slightly higher for certain aspects whilst for other aspects the difference in significance be almost negligible.

9.7.1. **Impact 1:** Potential impacts on vegetation and listed or protected plant species.

Impact Nature: Impacts on vegetation and listed or protected plant species would occur due to the construction of the facility and associated infrastructure. This impact is regarded as the most likely and significant impact and may lead to direct loss of vegetation including listed and protected species.

The most likely consequences include:

- local loss of habitat (to an extent as a natural ground covering will be maintained where possible);
- very small and local disturbance to processes maintaining local biodiversity and ecosystem goods and services; and
- a potential loss of a few local protected species.

The development footprints for both options are primarily homogenous in terms of habitat types and vegetation cover thus providing for easier and more accurate calculation of potential impacts, more effective recommendations and implementation of management and mitigation measures, and furthermore lowering the impact and beta diversity. The loss of local vegetation within the footprint is expected to be of relatively minor significance when considered on a broad scale.

	Gridline Alternative 1		**Gridline Alternative 2**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Extent	Local (1)	Local (1)	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)	Long-term (4)	Long-term (4)

Magnitude	Minor (4)	Small (2)	Moderate (5)	Minor (3)
Probability	Definite (5)	Improbable (2)	Definite (5)	Improbable (2)
Significance	**Medium (45)**	**Low (14)**	**Medium (50)**	**Low (16)**
Status	Negative	Negative	Negative	Negative
Reversibility	Low	Moderate	Low	Moderate
Irreplaceable loss of resources	No	No	No	No
Can impacts be mitigated?	Yes, to a large extent			
Mitigation:	» Pre-construction walk-through of the power line route/corridor to locate species of conservation concern that can be translocated or avoided. » Vegetation clearing to commence only after walkthrough has been conducted and necessary permits obtained. » Pre-construction environmental induction for all construction staff on-site to ensure that basic environmental principles are adhered to. This includes awareness as to no littering, appropriate handling of pollution and chemical spills, avoiding fire hazards, remaining within demarcated construction areas, etc. » Demarcate all areas to be cleared with construction tape or similar material where practical. However, caution should be exercised to avoid using material that might entangle fauna. » Contractor's EO to provide supervision and oversight of vegetation clearing activities and other activities which may cause damage to the environment, especially at the initiation of the project, when the majority of vegetation clearing is taking place. » Vegetation clearing to be kept to a minimum. No unnecessary vegetation to be cleared. » Ensure that laydown areas, construction camps and other temporary use areas are located in areas of low and medium sensitivity and are properly fenced or demarcated as appropriate and practically possible. » All vehicles to remain within demarcated construction areas and no unnecessary driving in the veld outside these areas should be allowed. » Existing tracks should be used for access wherever possible. » The morphology and hydrology of the wetland features not be altered by unnecessary excavations, dumping of soil or other waste. » No fires should be allowed on-site.			
Residual Impacts	» Some residual vegetation loss will result from the development, equivalent to the operational footprint of the power line.			

9.7.2. **Impact 2:** Direct faunal impacts**.**

Impact Nature: Disturbance, transformation, and loss of habitat will have a negative effect on resident fauna during construction.

There are fauna residents within the site, and these will be impacted during the construction of the power line. However, faunal diversity and density within the site are low, and post-mitigation impacts are likely to be Low and of Local significance only.

Increased levels of noise, pollution, disturbance, and human presence during the construction phase may affect the local fauna. Sensitive and shy fauna would move away from the area during the construction phase and may move back into the area upon completion of the construction phase. Some slow-moving species (i.e. tortoise & snakes) would not be able to avoid the activities and might be killed.

Faunal diversity and density within the site are low and post-mitigation impacts are likely to be Low and of Local significance only.

	Gridline Alternative 1		**Gridline Alternative 2**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Extent	Local (1)	Local (1)	Local (1)	Local (1)
Duration	Short-term (2)	Short-term (2)	Short-term (2)	Short-term (2)
Magnitude	Low (4)	Minor (2)	Low (4)	Minor (2)
Probability	Probable (3)	Very Improbable (1)	Probable (3)	Very Improbable (1)
Significance	**Low (21)**	**Low (5)**	**Low (21)**	**Low (5)**
Status	Negative	Negative	Negative	Negative
Reversibility	Low	Moderate	Low	Moderate
Irreplaceable loss of resources	Unlikely	Unlikely	Unlikely	Unlikely
Can impacts be mitigated?	Yes, to a large extent			

Mitigation:	» All personnel should undergo environmental induction with regards to fauna and in particular awareness about not harming or collecting species such as snakes, tortoises which are often persecuted out of superstition. » Site access should be controlled and no unauthorised persons should be allowed onto the site. » Any fauna directly threatened by the associated activities should be removed to a safe location by a suitably qualified person. » The collection, hunting or harvesting of any plants or animals at the site should be strictly forbidden. Personnel should not be allowed to wander off the demarcated site. » Fires should not be allowed on site. » All hazardous materials should be stored in the appropriate manner to prevent contamination of the site. Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner as related to the nature of the spill. » All construction vehicles should adhere to a low speed limit (30km/h) to avoid collisions with susceptible species such as snakes and tortoises. » Construction vehicles limited to a minimal footprint on site (no movement outside of the earmarked footprint).
Residual Impacts	» There will be minimal residual impact as the facility will have low operational impacts on fauna, after the construction phase.

9.7.3. **Impact 3:** Soil erosion and associated degradation of ecosystems**.**

Impact Nature: During construction/decommission, there will be a lot of disturbed and loose soil at the site which will render the area vulnerable to erosion. It is critically important that proper erosion control structures are built and maintained over the lifespan of the project.

	Gridline Alternative 1		**Gridline Alternative 2**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Extent	Local (1)	Local (1)	Local (1)	Local (1)
Duration	Medium-term (3)	Short-term (1)	Medium-term (3)	Short-term (1)
Magnitude	Low (4)	Minor (2)	Low (5)	Minor (2)
Probability	Probable (3)	Improbable (2)	Probable (3)	Improbable (2)
Significance	**Low (24)**	**Low (8)**	**Low (27)**	**Low (8)**
Status	Negative	Negative	Negative	Negative

Reversibility	Low	High	Low	High
Irreplaceable loss of resources	No	No	No	No
Can impacts be mitigated?	Yes, to a large extent			
Mitigation:	» Any erosion problems observed to be associated with the access road and/or hardened/engineered surfaces should be rectified as soon as possible and monitored thereafter to ensure that they do not re-occur. » All bare areas due to the project activities should be re-vegetated with locally occurring species, to bind the soil and limit erosion potential where applicable. » An erosion control management plan should be utilised to prevent erosion » There should be reduced activity at the site after large rainfall events when the soils are wet. No driving off of hardened roads should occur immediately following large rainfall events until soils have dried out and the risk of bogging down has decreased. » Construction of gabions and other stabilisation features to prevent erosion, if deemed necessary. » Re-instate as much of the eroded area to its pre-disturbed, "natural" geometry (no change in elevation and any banks not to be steepened) where possible. » Roads and other disturbed areas should be regularly monitored for erosion problems and problem areas should receive follow-up monitoring by the EO to assess the success of the remediation. » Topsoil must be removed and stored separately from subsoil. Topsoil must be reapplied where appropriate as soon as possible in order to encourage and facilitate rapid regeneration of the natural vegetation on cleared areas.			
Residual Impacts	» The loss of fertile soil and soil capping resulting in areas which cannot fully rehabilitate itself with a good vegetation cover. With appropriate avoidance and mitigation residual impacts will be **very low**.			

9.7.4. **Impact 4:** Alien Plant Invasion**.**

Impact Nature: The disturbed and bare ground that is likely to be present at the site during and after construction would leave the site vulnerable to alien plant invasion for some time if not managed. Furthermore, the National Environmental Management Biodiversity Act (Act No. 10 of 2004), as well as the Conservation of Agricultural Resources Act, (Act No. 43 of 1983) requires that listed alien species are controlled in accordance with the Act.				
	Gridline Alternative 1		**Gridline Alternative 2**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**

Extent	Local (1)	Local (1)	Local (1)	Local (1)
Duration	Permanent (5)	Short-term (1)	Permanent (5)	Short-term (1)
Magnitude	Low (4)	Small (1)	Low (5)	Small (1)
Probability	Highly Probable (4)	Improbable (2)	Highly Probable (4)	Improbable (2)
Significance	**Medium (40)**	**Low (6)**	**Medium (44)**	**Low (6)**
Status	Negative	Negative	Negative	Negative
Reversibility	Low	High	Low	High
Irreplaceable loss of resources	No	No	No	No
Can impacts be mitigated?	Yes, to a large extent			
Mitigation:	» A site-specific eradication and management programme for alien invasive plants must be implemented during construction. » Regular monitoring by the operation and maintenance team for alien plants at the within the power line servitude must occur and could be conducted simultaneously with erosion monitoring. » When alien plants are detected, these must be controlled and cleared using the recommended control measures for each species to ensure that the problem is not exacerbated or does not re-occur and increase to problematic levels. » Clearing methods must aim to keep disturbance to a minimum. » No planting or importing any listed invasive alien plant species (all Category 1a, 1b and 2 invasive species) to the site for landscaping, rehabilitation or any other purpose must be undertaken.			
Residual Impacts	» If the above recommended mitigation measures are strictly implemented and some re-establishment and rehabilitation of natural vegetation is allowed the residual impact will be **very low**.			

9.8. Cumulative Impacts (PV Solar Facility, On-site Substation and Gridline)

9.8.1. **Impact 1:** Reduced ability to meet conservation obligations and targets**.**

Impact Nature: The loss of unprotected vegetation types on a cumulative basis from the broader area impacts the countries' ability to meet its conservation targets

As indicated below, is highly unlikely that a cumulative effect of loss habitat and biota, and subsequently a reduced ability to meet conservation obligation and targets, could arise from the Dicoma PV Energy Facility in combination with the other renewable energy projects in the surrounding environment for the following reasons:

» The Carletonville Dolomite Grassland Vegetation Type is still largely intact (76% remaining) and is subsequently listed as Least Threatnened with a conservaton target of 24%.

- Whilst this vegetation type has a fairly extensive extent (1107591.2ha or 11075.912 km^2), the combined footprint for all proposed renewable energy projects within this vegetation type is 18048.4ha, and subsequently only around 1.63% of this vegetation type will be impacted.
- Furthermore, if only the renewable projects within a 30km radius of the proposed Dicoma PV solar facility, as well as the Dicoma facility itself, is taken into account the impact footprint is even lower and only about 1.08% of the vegetation type will be impacted by these renewable energy facilities.
- Also, a little more than 24% of the Dicoma PV solar facility's footprint is located within a historically transformed habitat.

» No existing or planned (NPAES-focus areas) protected and/or conservation important areas will be impacted by these renewable energy projects.

» These renewable energy facilities are mostly clumped together, and is located in relatively close proximity to the town of Lichtenberug and as such the contribution to habitat fragmentation is significantly reduced.

- Ample contiguous (uninterrupted) areas are available around these renewable energy facilities, allowing for connectivity between important landscape/habitat/resource features.

	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects within the area**
Extent	Local (1)	Regional (3)
Duration	Long Term (4)	Long-Term (4)
Magnitude	Small (1)	Minor (4)
Probability	Improbable (2)	Improbable (2)
Significance	**Low (12)**	**Low (22)**
Status	Slightly Negative	Slightly Negative
Reversibility	Low	Low

Irreplaceable loss of resources	No	No
Can impacts be mitigated?	Yes, to a large extent	
Mitigation	» The development footprint should be kept to a minimum and natural vegetation should be encouraged to return to disturbed areas. » An open space management plan should be developed for the site, which should include management of biodiversity within the fenced area, as well as that in the adjacent rangeland. » Reduce the footprint of the facility within sensitive habitat types as much as possible.	

9.8.2. **Impact 2** Impact on Critical Biodiversity Areas and broad-scale ecological processes.

Impact Nature: Transformation of intact habitat could potentially compromise ecological processes of ESAs as well as ecological functioning of important habitats and would contribute to the fragmentation of the landscape and would potentially disrupt the connectivity of the landscape for fauna and flora and impair their ability to respond to environmental fluctuations.

It is highly unlikely that a cumulative effect of loss of high biodiversity areas could arise from the Dicoma PV Energy Facility in combination with the other renewable energy projects in the surrounding environment for the following reasons:

- » No senstivie biodiversity features, taxa, and/or drivers have been identified within the projec site;
- » No Critical Biodiversity Areas, as identified within the North West Province Biodiversity Sector Plan (2015), are located within the project site;
- » Eventhough more than 90% of the projec site is located within an ESA (245.7ha of project site) the total size of the impacted area, in comparison with the total extent of the ESA corridor/linkage between the important freshwater resources, is very small. Only approximately 0.8% of the entire ESA will be impacted by this proposed development. Subsequently the contribution of this PV solar facility to the cumulative impact on this ESA is almost negligible small.
- » The landscape between these developments are highly fractured and isolated from one another. Subsequently, potential faunal migration routes are absent between these developments and is not considered significant from a cumulative perspective due to existing degradation.

	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects within the area**
Extent	Local (1)	Regional (2)
Duration	Long Term (4)	Long Term (4)
Magnitude	Small (1)	Moderate (6)
Probability	Improbable (2)	Improbable (2)
Significance	**Low (12)**	**Low (24)**
Status	Neutral – Slightly Negative	Slightly Negative
Reversibility	Low	Low

Irreplaceable loss of resources	No	Likely
Can impacts be mitigated?	Yes, to a large extent	
Mitigation	» The development footprint should be kept to a minimum and natural vegetation should be encouraged to return to disturbed areas. » An open space management plan should be developed for the site, which should include management of biodiversity within the fenced area, as well as that in the adjacent rangeland. » Reduce the footprint of the facility within sensitive habitat types as much as possible. » Small to medium sized mammals can be allowed to move between the development area and surrounding areas by creating artificial passageways underneath boundary fences (this is optional and may be implemented by developer if deemed necessary).	

9.8.3. **Impact 3:** Potential cumulative impacts due to nearby renewable energy developments (solar energy facilities)**.**

Impact Nature: Cumulative loss of habitats (including sensitive habitats) and further increase in the fractured nature of the landscape may lead to the loss of features responsible for maintaining biodiversity and providing ecosystem goods and services and may potentially lead to;

» A change in the status of the Vegetation Unit, subsequently also reducing the ability to meet national conservation obligations and targets;
» A reduction in biodiversity and even the loss of some species from the area;
» Fracturing and isolation of landscapes may cut off important migration routes and prevent genetic variability thus reducing "genetic health" which may in turn lead to weaker species incapable to adapt and react to potential environmental changes and consequently also to a reduction in biodiversity and the extinction of some species from certain areas.
» The loss of ESA's which may lead to the province, being incapable to meet their required biodiversity pattern a process targets.
» The loss of important corridors essential for some species to allow for movement between important habitat types crucial for the survival of these species.

	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects within the area**
Extent	Local (1)	Regional (2)
Duration	Long Term (4)	Long Term (4)
Magnitude	Small (1)	Minor (4)
Probability	Very Improbable (1)	Improbable (2)
Significance	**Low (6)**	**Low (20)**
Status	Neutral	Slightly Negative
Reversibility	Low	Low

Irreplaceable loss of resources	No	Likely
Can impacts be mitigated?	Yes, to a large extent	
Mitigation	» The development footprint should be kept to a minimum and natural vegetation should be encouraged to return to disturbed areas. » An open space management plan should be developed for the site, which should include management of biodiversity within the fenced area, as well as that in the adjacent rangeland. » Reduce the footprint of the facility within sensitive habitat types as much as possible. » Small to medium sized mammals can be allowed to move between the development area and surrounding areas by creating artificial passageways underneath boundary fences (this is optional and may be implemented by developer if deemed necessary).	

9.9. Assessment of Impacts Associated with the Gridline Options and their associated On-Site Substation

A summary of the assessment of impacts done for the Dicoma PV solar Facilities' gridline options/alternatives (and associated on-site substations) are detailed below and include the identification of the preferred alternative, in terms of its potentials impacts on terrestrial resource features. The overall impact significance provided in the table below are essentially a combination of the aspects assessed above and their impact significance ratings, with the implementation of mitigation measures.

Take note that "not-preferred" does not necessarily mean that such an option contains a fatal flaw and may not be considered at all (unless specified as such). If not specified otherwise, it merely means that in terms of the available options this is not the most preferable and may need some layout adjustments/amendments in order to avoid any sensitive features.

<table>
<tr><th>PV Solar Project</th><th>Alternative Grid Option 1</th><th>Alternative Grid Option 2</th><th>Reasons (incl. potential issues)</th></tr>
<tr><td rowspan="4">Dicoma PV Solar Facility</td><td colspan="2">Overall Impact Significance in terms Terrestrial Ecological Features</td><td rowspan="4">» Alternative Grid Option 2 will impact a large area as such impacts associated with this option will be slightly higher in significance.
» However, due to the nature of such linear developments and that fact that both options will not impact any sensitive habitats with a portion of the second options traversing a secondary grassland, the significance of impacts associated with grid option 2 will only be slightly higher for certain aspects whilst for other aspects the difference in significance be almost negligible.</td></tr>
<tr><td colspan="2">Both options are fairly similar in terms of their potential impacts on terrestrial features. The significance scores of these impacts do however differ very slightly between the two options, with the impacts associated with Alternative Grid Option 1 being only slightly less significant than the impacts associated with Alternative Grid Options 2

Generally, the impacts for both options are Low to Medium prior to Mitigation and Low with Mitigation considered</td></tr>
<tr><td colspan="2">Preference</td></tr>
<tr><td>Favorable</td><td>Still acceptable but less preferred</td></tr>
</table>

10. CONCLUSION

This study aimed to conduct a screening assessment of the projects site to:

- Identify and describe ecological sensitive areas;
- Confirm or dispute the current use of the land and environment sensitivity as identified by the national web-based environmental screening tool;
- Provide motivation and evidence of either the verified or different use of the land and environmental sensitivity;
- Identify sensitive areas to be avoided (including corresponding spatial data);
- Provide recommendations regarding the areas available for the development of solar energy facilities;
- Determine and assess impacts associated within the PV solar development;
- Provide mitigation measures in order to avoid or reduce the impacts to acceptable and manageable levels;
- Compile an Ecological Sensitivity and Impact report meeting the requirements for environmental themes in terms of section 24(5)(a) and (h) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA);

As part of this Assessment detailed field surveys was undertaken over the course of 10 – 12 June 2021 (winter) and 26 – 27 November (summer and active growing season).

The outcome of this report is an ecological sensitivity map visually illustrating the findings and results which will then aid in the final planning and design phase of the Dicoma PV solar Facility with the purpose of avoiding any sensitive areas.

Habitat sensitivity classification was based on available GIS coverages including various terrestrial ecosystems and biodiversity data, a recent screening survey, and the expert's mapping from Google Earth satellite imagery (altitude 1 to 2 km).

The affected properties are almost entirely used for grazing. Based on historical satellite imagery and the site visit it was found that a little more than 24% of the project site is covered by a secondary grassland (plagioclimax) that has established on historically cultivated areas (> 40 years). Infrastructure within the property is minimal and consists of kraals, a homestead, boreholes, small reservoirs, feeding and drinking points, stores, and power line infrastructure.

From a terrestrial ecological perspective, it was found that the bulk of project site is located within a slightly degraded to near-natural savanna grassland type characterized by *Searsia pyroides.* Furthermore, about a quarter of the project site is located within a secondary grassland. To the north and north-east the vegetation comprises of a mostly natural savanna grassland type characterized by *Senegalia hereroensis*. Both of savanna/wooded grasslands are variations of

the Carletonville Dolomite Grassland vegetation type which is listed as Least Threatened.

Almost the entire development footprint (gird and PV Solar) is located within an ESA1 (Corridor/Linkage) (>90% of development footprint). Due to the large extent of this ESA1 (outside of the development footprint), and the availability of ample natural to near natural areas still available the development will not have a significant impact on this ESA, and its ability to function as an important corridor.

No high sensitive features and "No-Go" areas were identified within the project area with the bulk of the project site located within a medium sensitive area whilst the remainder of the project has been classified as medium sensitive.

Overall, no significant terrestrial ecological flaws that could pose a problem to the proposed PV Facility development were identified during the EIA phase assessment.

General Results:

» The project site is located within three vegetation communites:
  - *Searsia pyroides – Elionurus muticus* open savanna-grassland on shallow soils overlying dolerite (VegComm SE).
  - *Senegalia hereroensis – Triraphis andropogonoides* open savanna-grassland on shallow to moderately shallow soils overlying chert and dolerite (VegComm AT).
  - *Hyparrhenia hirta – Eragrostis lehmanniana* secondary grassland on moderately deep soils (VegComm HE)

National and regional conservation context:

» The project site is located within a single vegetation type namely; Carletonville Dolomite Grassland. However, a little more than 24% have been historically transformed whilst the northern and north-eastern portion of the project site resembles a unique and natural variation of the grassland type. The southern, eastern and most of the central portions of the project site on the other hand resembles a slightly degraded to near-natural variation of this grassland type (more common variation).
  - It is highly unlikely that this development will have an impact on the status of the Ecosystem as well as Vegetation Type Status due to the extent of the development.
» From a provincial conservation perspective, >90% of the site is located in a Terrestrial ESA1 whilst the entire site is located within an Aquatic ESA1. A summary of the assessment of the underlying ESA features within the project site is provided below:

- Terrestrial ESA1: This ESA1 functions as a linkage/corridor (comprising of natural vegetation) between the major freshwater resource features (Harts River and Molopo River watercourses and associated tributaries) and their fringing terrestrial habitats. This function of forming a corridor for movement (within the potential area of influence) is somewhat influenced, mainly through the highly fractured nature of the landscape (access roads, cultivated areas, boundary and other farm fences). Having said this, the natural to semi-natural areas are still likely to provide habitat for numerous smaller mammals as well as reptile species.
    - Due to the large extent of this ESA1 (located outside of the development footprint), and the availability of ample natural to near natural areas still available between the two mentioned valleys the development will unlikely have an impact on this ESA, and its ability to function as an important corridor.
- Aquatic ESA1: This ESA1 is associated with the Bo-Molopo Karst Belt and is regarded as an important recharge area.
    - Due to the nature of a Solar PV developments and their associated infrastructure (limited use of chemicals, hazardous and toxic materials), it is unlikely that such a development will have a significant impact on groundwater quality. However, Solar PV developments may slightly influence local infiltration and subsequently ground water recharge. This impact can however, be successfully mitigated through careful planning and with effective mitigation measures in place.

» During the site visit it was confirmed that no freshwater resource features (watercourses and wetlands) are located within close proximity to the site (500m regulated DWS area)

Flora specific results:

» Ground truthing of the site confirmed a total of 225 species present.
» No conservation important species were confirmed within the property, however a total of four protected species were observed:
- *Acacia erioloba* (National Forest Act);
- *Babiana hypogea* (Transvaal Nature Conservation Ordinance);
- *Gladiolus s*pp. (Transvaal Nature Conservation Ordinance); and
- *Schizocarphus nervosus* (Transvaal Nature Conservation Ordinance);

» Weeds and invasive alien species are not significantly abundant within the more natural areas and tend to be more prominent within recent and/or regularly disturbed areas such as around the kraals, watering points, access roads and trampled areas. At total of 35 weeds and 16 alien plants (APs) have been observed within the project site, with five of the alien plants being listed as Invasives (IAPs)
» In terms of ecological sensitivity and conservation value / importance, the bulk of the site is located within a Low-Medium sensitive secondary grassland with a low conservation value. The remaining vegetation constitutes savannah-grassland variations classified as medium sensitive and of a moderate conservation value.

» A Pre-Construction Faunal Walk-Through will have to be conducted in order to identify any sensitive species (protected and SCC) that may occupy/inhabit the development footprints of the SEFs and to assist in the biodiversity permitting processes.

Faunal specific results:

» No faunal species of conservation concern (SCC) was observed during the site-visit
» Due to a moderate habitat and structural complexity as well as the fact that large tracts of land within the region are still largely intact, the site is likely to have a moderate faunal diversity.
  - The wooded grassland to the north (*Senegalia hereroensis* variation) is regarded as the most important faunal habitat, however this faunal habitat along with the wooded savannah to the south (*Searsia lycioides* variation) are both regarded as medium sensitive habitats, whilst the secondary grassland is regarded as a low sensitive faunal habitat.
» A Pre-Construction Faunal Walk-Through will have to be conducted in order to identify any sensitive species (protected and SCC) that may occupy/inhabit the development footprints of the SEFs and to assist in the biodiversity permitting processes.
» Through the implementation of mitigation measures, regional faunal populations will likely not be significantly impacted and impacts on any potential faunal SCC should be successfully avoided.

Sensitivity and associated development recommendations:

» The site can be classified as ranging from medium sensitive to Low-Medium sensitive.
» More than 70% of the project site is located within Medium sensitive aread
» No high sensitive and/or "No-Go" areas have been identified.
» Overall, no significant terrestrial ecological flaws that could pose a problem to the proposed PV Facility development were identified during the EIA phase assessment.

Impact Assessment:

The most significant potential impacts expected to occur within the development are of the proposed Dicoma SEF are:

» Reduction of a stable vegetation cover and associated below-ground biomass that currently increases soil surface porosity, water infiltration rates and thus improves the soil moisture availability. Without the vegetation, the soil will be prone to extensive surface capping, leading to accelerated erosion and further loss of organic material and soil seed reserves from the local environment.
» Disturbed vegetation in the study area carries a high risk of invasion by alien invasive plants, which may or may not be present in the study area or nearby. The control

and continuous monitoring and eradication of alien invasive plants will form and integral part of the environmental management of the facility from construction up to decommissioning.

General Recommendations:

General Development Recommendations

» To prevent the onset of accelerated erosion, it is recommended that vegetation clearing be limited to clearing high shrubs, all invasive trees and other alien invasives, even if that means that remaining vegetation will be subjected to vehicle damage (from which it can recover over time). Grading should only be done where absolutely necessary and to mitigate existing erosion channels. If extensive grading will become necessary, it will be advisable to create contour buffer strips to slow down runoff and prevent erosion, which could develop into gully erosion damaging the development in the long run as well.
» It is currently not known which species will be able to persist under the shading of PV arrays, but the establishment of the naturally occurring *Cynodon dactylon* (couch grass), a low creeping grass, should be encouraged. Its dense and deep rooting system will spread to stabilise soil, whilst potentially dense mats could greatly reduce rain splash impact. In addition, its stature and biomass would be too low to present a fire risk.
» All indigenous shrubs that will be cleared should be shredded and added to the soil as mulch.
» Alien species must be removed entirely from site and not used as mulch to prevent the spread of regenerative material.

In conclusion, due to the fact that:

» **No high sensitive features and "No-Go" areas were identified;**
» **The bulk of the project site located within Medium sensitive areas whilst the remainder of the project has been classified as Low-Medium and Low sensitive, and**
» **no significant terrestrial ecological flaws, that could pose a problem to the proposed PV Facility development, were identified during the EIA phase assessment.**

We, Gerhard Botha and Jan-Hendrik Keet, as the appointed ecological specialists, have no objections to the development of the Dicoma PV solar facility (from a terrestrial ecological perspective), and as such the aforementioned projectd may be approved by the competent authority.

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12. APPENDICES

Appendix 1 Plant Species List (Site and POSA Generated List)

The species list presented here is a combination of online (POSA) and site survey data. Descriptions of colours and symbols are given below:

Species in **bold**: Observed on site.
Species marked with "*": Protected species.
Species marked with "†": Red List species.
Species highlighted in blue: Alien species.
Species marked with NEM:BA: Alien species listed in the NEM:BA Alien and Invasive Species Regulations.
Species marked with NCE: Northern Cape Endemic.

Family	Species	IUCN	Family	Species	IUCN
Acanthaceae	*Acanthopsis carduifolia*	LC	**Asteraceae**	***Ursinia nana* subsp. *nana***	**LC**
Acanthaceae	*Acanthopsis villosa*	LC	Boraginaceae	*Heliotropium curassavicum*	NE
Acanthaceae	***Blepharis furcata***	**LC**	**Boraginaceae**	***Trichodesma africanum***	**LC**
Acanthaceae	***Justicia spartioides***	**LC**	**Brassicaceae**	***Heliophila laciniata*** NCE	**LC**
Agavaceae	***Chlorophytum undulatum***	**LC**	**Brassicaceae**	***Lepidium desertorum***	**LC**
Aizoaceae	**Aloinopsis luckhoffii*	LC	**Cactaceae**	***Opuntia ficus-indica*** NEM:BA	**NE**
Aizoaceae	**Conophytum uviforme* subsp. *uviforme*	LC	Caryophyllaceae	*Dianthus namaensis* var. *dinteri*	LC
Aizoaceae	**Drosanthemum sp.*		Caryophyllaceae	*Spergularia bocconei*	LC
Aizoaceae	****Galenia africana***	**LC**	**Colchicaceae**	***Colchicum capense* subsp. *ciliolatum***	**LC**
Aizoaceae	**Galenia fruticosa*	LC	**Colchicaceae**	***Ornithoglossum vulgare***	**LC**
Aizoaceae	****Galenia sarcophylla***	**LC**	**Crassulaceae**	***Crassula muscosa***	**LC**
Aizoaceae	**Galenia squamulosa*	LC	**Crassulaceae**	***Crassula subaphylla* var. *subaphylla***	**LC**
Aizoaceae	****Lampranthus otzenianus***	**LC**	**Crassulaceae**	***Tylecodon wallichii* subsp. *wallichii***	**LC**
Aizoaceae	****Mesembryanthemum baylissii***	**LC**	**Euphorbiaceae**	****Euphorbia rhombifolia***	**LC**
Aizoaceae	****Mesembryanthemum brevicarpum***	**LC**	**Fabaceae**	****Lessertia spinescens*** NCE	**LC**
Aizoaceae	****Mesembryanthemum guerichianum***	**LC**	**Fabaceae**	***Lotononis leptoloba***	**LC**
Aizoaceae	****Mesembryanthemum junceum***	**LC**	**Fabaceae**	***Melolobium candicans***	**LC**
Aizoaceae	****Mesembryanthemum noctiflorum* subsp. *noctiflorum***	**LC**	**Fabaceae**	***Prosopis glandulosa* var. *torreyana*** NEM:BA	**NE**
Aizoaceae	****Mesembryanthemum tetragonum***	**LC**	**Frankeniaceae**	***Frankenia pulverulenta***	**LC**
Aizoaceae	****Mesembryanthemum vaginatum***	**LC**	**Geraniaceae**	***Monsonia crassicaulis***	**LC**
Aizoaceae	****Ruschia grisea***	**LC**	**Geraniaceae**	***Monsonia salmoniflora***	**LC**
Aizoaceae	****Ruschia spinosa***	**LC**	**Geraniaceae**	****Pelargonium pseudofumarioides***	**LC**
Aizoaceae	****Tetragonia reduplicata***	**LC**	**Hyacinthaceae**	***Albuca leucantha*** NCE	**LC**
Amaranthaceae	*Atriplex eardleyae*	NE	**Hyacinthaceae**	***Albuca longipes***	**LC**
Amaranthaceae	***Atriplex lindleyi* subsp. *inflata***	**NE**	**Hyacinthaceae**	***Albuca secunda***	**LC**
Amaranthaceae	*Atriplex nummularia* subsp. *nummularia* NEM:BA	NE	**Hyacinthaceae**	***Albuca spiralis***	**LC**
Amaranthaceae	***Atriplex semibaccata***	**NE**	**Hyacinthaceae**	***Albuca suaveolens***	**LC**
Amaranthaceae	***Chenopodium murale* var. *murale***	**NE**	**Hyacinthaceae**	***Dipcadi crispum***	**LC**
Amaranthaceae	***Salsola aphylla***	**LC**	**Hyacinthaceae**	****Lachenalia xerophila*** NCE	**LC**
Amaranthaceae	*Salsola henriciae*	LC	**Hyacinthaceae**	***Ledebouria apertiflora***	**LC**

Amaranthaceae	***Salsola kali*** [NEM:BA]	**NE**	**Iridaceae**	****Ferraria variabilis***	**LC**
Amaranthaceae	*Salsola procera*	LC	**Iridaceae**	****Gladiolus orchidiflorus***	**LC**
Amaranthaceae	***Sericocoma avolans***	**LC**	**Iridaceae**	****Gladiolus scullyi***	**LC**
Amaranthaceae	***Suaeda fruticosa***	**LC**	**Iridaceae**	****Tritonia karooica***	**LC**
Amaranthaceae	*Suaeda merxmuelleri*	LC	Lamiaceae	*Salvia disermas*	LC
Amaryllidaceae	**Brunsvigia comptonii*	LC	**Lamiaceae**	***Salvia verbenaca***	**LC**
Anacardiaceae	***Schinus molle***	**NE**	**Lamiaceae**	***Stachys cuneata***	**LC**
Apiaceae	****Deverra denudata* subsp. *aphylla***	**LC**	**Malvaceae**	***Malva parviflora* var. *parviflora***	**NE**
Apocynaceae	****Gomphocarpus filiformis***	**LC**	**Melianthaceae**	***Melianthus comosus***	**LC**
Asparagaceae	***Asparagus capensis* var. *capensis***	**LC**	**Neuradaceae**	***Grielum humifusum* var. *humifusum***	**LC**
Asphodelaceae	****Aloe falcata***	**LC**	**Neuradaceae**	***Grielum humifusum* var. *parviflorum***	**LC**
Asphodelaceae	****Gonialoe variegata***	**LC**	**Orobanchaceae**	***Hyobanche glabrata***	**LC**
Asphodelaceae	****Trachyandra flexifolia***	**LC**	**Oxalidaceae**	***†*Oxalis hirsuta*** [NCE]	**DD**
Asphodelaceae	****Trachyandra revoluta***	**LC**	**Oxalidaceae**	****Oxalis lichenoides***	**LC**
Asteraceae	***Amellus microglossus***	**LC**	**Oxalidaceae**	****Oxalis pes-caprae* var. *pes-caprae***	**LC**
Asteraceae	***Amphiglossa triflora***	**LC**	**Oxalidaceae**	****Oxalis pulchella***	**LC**
Asteraceae	***Arctotis fastuosa***	**LC**	**Oxalidaceae**	****Oxalis purpurea***	**LC**
Asteraceae	***Athanasia minuta* subsp. *minuta***	**LC**	**Oxalidaceae**	****Oxalis reclinata* var. *reclinata***	**LC**
Asteraceae	*Didelta carnosa* var. *carnosa*	LC	**Papaveraceae**	***Argemone ochroleuca* subsp. *ochroleuca***	**NE**
Asteraceae	***Didelta spinosa***	**LC**	**Plumbaginaceae**	***Dyerophytum africanum***	**LC**
Asteraceae	***Dimorphotheca pinnata* var. *pinnata***		**Poaceae**	***Ehrharta calycina***	**LC**
Asteraceae	***Dimorphotheca polyptera***	**LC**	**Poaceae**	***Enneapogon scaber***	**LC**
Asteraceae	***Eriocephalus namaquensis***	**LC**	**Poaceae**	***Lolium perenne***	**NE**
Asteraceae	*Eriocephalus spinescens*	LC	**Poaceae**	***Phragmites australis***	**LC**
Asteraceae	***Felicia bergeriana***	**LC**	**Poaceae**	***Schismus barbatus***	**LC**
Asteraceae	***Foveolina dichotoma***	**LC**	**Poaceae**	***Stipagrostis ciliata* var. *capensis***	**LC**
Asteraceae	***Gazania heterochaeta***	**LC**	**Poaceae**	***Stipagrostis namaquensis***	**LC**
Asteraceae	***Gazania jurineifolia* subsp. *jurineifolia***	**LC**	**Poaceae**	***Stipagrostis obtusa***	**LC**
Asteraceae	***Gazania lichtensteinii***	**LC**	**Poaceae**	***Tribolium tenellum***	**LC**
Asteraceae	***Helichrysum herniarioides***	**LC**	**Rubiaceae**	***Nenax namaquensis*** [NCE]	**LC**
Asteraceae	***Helichrysum tinctum***	**LC**	**Rutaceae**	****Agathosma virgata***	**LC**
Asteraceae	***Hirpicium alienatum***	**LC**	**Santalaceae**	***Thesium lineatum***	**LC**
Asteraceae	*Lasiopogon glomerulatus*	LC	**Santalaceae**	***Viscum capense***	**LC**
Asteraceae	***Lasiospermum brachyglossum***	**LC**	**Scrophulariaceae**	***Aptosimum indivisum***	**LC**
Asteraceae	***Leysera tenella***	**LC**	**Scrophulariaceae**	***Aptosimum procumbens***	**LC**
Asteraceae	***Oedera spinescens***	**LC**	**Scrophulariaceae**	***Aptosimum spinescens***	**LC**
Asteraceae	***Oncosiphon piluliferus***	**LC**	**Scrophulariaceae**	***Lyperia tristis***	**LC**
Asteraceae	***Oncosiphon suffruticosus***	**LC**	**Scrophulariaceae**	****Nemesia anisocarpa***	**LC**
Asteraceae	***Osteospermum sinuatum* var. *sinuatum***	**LC**	**Scrophulariaceae**	****Nemesia calcarata***	**LC**
Asteraceae	***Osteospermum spinescens***	**LC**	**Scrophulariaceae**	****Nemesia ligulata***	**LC**
Asteraceae	***Pegolettia retrofracta***	**LC**	**Scrophulariaceae**	***Zaluzianskya pilosissima*** [NCE]	**LC**
Asteraceae	***Pentzia incana***	**LC**	**Solanaceae**	***Lycium cinereum***	**LC**
Asteraceae	***Pteronia glauca***	**LC**	**Solanaceae**	***Lycium pumilum***	**LC**
Asteraceae	***Pteronia glomerata***	**LC**	**Solanaceae**	***Nicotiana glauca*** [NEM:BA]	**NE**
Asteraceae	***Pteronia incana***	**LC**	**Tamaricaceae**	***Tamarix usneoides***	**LC**
Asteraceae	*Pteronia leucoclada*	LC	**Tecophilaeaceae**	****Cyanella hyacinthoides***	**LC**
Asteraceae	***Pteronia mucronata***	**LC**	**Zygophyllaceae**	***Augea capensis***	**LC**
Asteraceae	***Pteronia onobromoides***	**LC**	**Zygophyllaceae**	***Roepera lichtensteiniana***	**LC**
Asteraceae	***Senecio arenarius***	**LC**	**Zygophyllaceae**	***Tetraena retrofracta***	**LC**
Asteraceae	***Senecio niveus***	**LC**	**Zygophyllaceae**	***Tetraena rigida***	**LC**
Asteraceae	*Sonchus oleraceus*	NE	Zygophyllaceae	*Tetraena simplex*	LC

Appendix 2 Specialist Curriculum Vitae

CURRICULUM VITAE:

Gerhard Botha

Name:	:	Gerhardus Alfred Botha
Date of Birth	:	11 April 1986
Identity Number	:	860411 5136 088
Postal Address	:	PO Box 12500 Brandhof 9324
Residential Address	:	3 Jock Meiring Street Park West Bloemfontein 9301
Cell Phone Number	:	084 207 3454
Email Address	:	gabotha11@gmail.com
Profession/Specialisation	:	Ecological and Biodiversity Consultant
Nationality:	:	South African
Years Experience:	:	8
Bilingualism	:	Very good – English and Afrikaans

Professional Profile:

Gerhard is a Managing Director of Nkurenkuru Ecology and Biodiversity (Pty) Ltd. He has a BSc Honours degree in Botany from the University of the Free State Province and is currently completing a MSc Degree in Botany. He began working as an environmental specialist in 2010 and has since gained extensive experience in conducting ecological and biodiversity assessments in various development field, especially in the fields of conventional as well as renewable energy generation, mining and infrastructure development. Gerhard is a registered Professional Natural Scientist (Pr. Sci. Nat.)

Key Responsibilities:

Specific responsibilities as an Ecological and Biodiversity Specialist include, inter alia, professional execution of specialist consulting services (including flora, wetland and fauna studies, where required), impact assessment reporting, walk through surveys/ground-truthing to inform final design, compilation of management plans, compliance monitoring and audit reporting, in-house ecological awareness training to on-site personnel, and the development of project proposals for procuring new work/projects.

Skills Base and Core Competencies

- Research Project Management

- Botanical researcher in projects involving the description of terrestrial and coastal ecosystems.
- Broad expertise in the ecology and conservation of grasslands, savannahs, karroid wetland, and aquatic ecosystems.
- Ecological and Biodiversity assessments for developmental purposes (BAR, EIA), with extensive knowledge and experience in the renewable energy field (Refer to Work Experiences and References)
- Over 3 years of avifaunal monitoring and assessment experience.
- Mapping and Infield delineation of wetlands, riparian zones and aquatic habitats (according to methods stipulated by DWA, 2008) within various South African provinces of KwaZulu-Natal, Mpumalanga, Free State, Gauteng and Northern Cape Province for inventory and management purposes.
- Wetland and aquatic buffer allocations according to industry best practice guidelines.
- Working knowledge of environmental planning policies, regulatory frameworks, and legislation
- Identification and assessment of potential environmental impacts and benefits.
- Assessment of various wetland ecosystems to highlight potential impacts, within current and proposed landscape settings, and recommend appropriate mitigation and offsets based on assessing wetland ecosystem service delivery (functions) and ecological health/integrity.
- Development of practical and achievable mitigation measures and management plans and evaluation of risk to execution
- Qualitative and Quantitative Research
- Experienced in field research and monitoring
- Working knowledge of GIS applications and analysis of satellite imagery data
- Completed projects in several Provinces of South Africa and include a number of projects located in sensitive and ecological unique regions.

Education and Professional Status

Degrees:

- *2015:* Currently completing a M.Sc. degree in Botany (Vegetation Ecology), University of the Free State, Bloemfontein, RSA.
- *2009:* B.Sc. Hons in Botany (Vegetation Ecology), University of the Free State, Bloemfontein, RSA.
- *2008:* B.Sc. in Zoology and Botany, University of the Free State, University of the Free State, Bloemfontein, RSA.

Courses:

- *2013*: Wetland Management (ecology, hydrology, biodiversity, and delineation) – University of the Free State accredited course.
- *2014*: Introduction to GIS and GPS (Code: GISA 1500S) – University of the Free State accredited course.

Professional Society Affiliations:

- The South African Council of Natural Scientific Professions: Pr. Sci. Nat. Reg. No. 400502/14 (Botany and Ecology).

Employment History

- December 2017 – Current: Nkurenkuru Ecology and Biodiversity (Pty) Ltd
- 2016 – November 2017: ECO-CARE Consultancy

- *2015 - 2016*: Ecologist, Savannah Environmental (Pty) Ltd
- *2013 – 2014*: Working as ecologist on a freelance basis, involved in part-time and contractual positions for the following companies
    - Enviroworks (Pty) Ltd
    - GreenMined (Pty) Ltd
    - Eco-Care Consultancy (Pty) Ltd
    - Enviro-Niche Consulting (Pty) Ltd
    - Savannah Environmental (Pty) Ltd
    - Esicongweni Environmental Services (EES) cc
- *2010 - 2012*: Enviroworks (Pty) Ltd

Publications

Publications:

- Botha, G.A. & Du Preez, P.J. 2015. A description of the wetland and riparian vegetation of the Nxamasere palaeo-river's backflooded section, Okavango Delta, Botswana. S. *Afr. J. Bot*., **98**: 172-173.

Congress papers/posters/presentations:

- Botha, G.A. 2015. A description of the wetland and riparian vegetation of the Nxamasere palaeo-river's backflooded section, Okavango Delta, Botswana. 41st Annual Congress of South African Association of Botanists (SAAB). Tshipise, 11-15 Jan. 2015.
- Botha, G.A. 2014. A description of the vegetation of the Nxamasere floodplain, Okavango Delta, Botswana. 10st Annual University of Johannesburg (UJ) Postgraduate Botany Symposium. Johannesburg, 28 Oct. 2014.

Other

- Guest speaker at IAIAsa Free State Branch Event (29 March 2017)
- Guest speaker at the University of the Free State Province: Department of Plant Sciences (3 March 2017):

References:

- Christine Fouché
  Manager: GreenMined (Pty) LTD
  Cell: 084 663 2399
- Professor J du Preez
  Senior lecturer: Department of Plant Sciences
  University of the Free State
  Cell: 082 376 4404

CURRICULUM VITAE:

Jan-Hendrik Keet, PhD

Address: Unit 29 Avignon, Hillcrest Road
Land en Zeezicht, Somerset West
South Africa
7130
Email: jhkeet@hotmail.com
Phone: +27 71 451 4853

Expertise and experience

- Current profession: Post Doctoral Researcher – Centre for Invasion Biology (Department of Botany and Zoology), Stellenbosch University
- Specialisation: Botany, ecology, invasive plant species, and invasion biology
- Years of experience: 7 years
- Published in various national and international scientific journals

Skills and competencies

- Invasive species biology
- Plant biogeography and ecology
- Plant identification and taxonomy
- Vegetation surveys and mapping
- Soil microbiomes, function, and chemistry
- Geographic Information Systems
- Data analysis and Statistics in R Statistical Software

Tertiary education

- *2015 – 2019: Stellenbosch University, Stellenbosch, South Africa. Doctor of Philosophy (Botany)*
- *2013 – 2014: University of the Free State, Bloemfontein, South Africa. Magister Scientiae (Botany)*
- *2012: University of the Free State, Bloemfontein, South Africa. Bachelor of Science Honours (Botany) - cum laude*
- *2009 – 2011: University of the Free State, Bloemfontein, South Africa. Bachelor of Science (Chemistry with Physics and Biology) - cum laude*

Employment history

- *2011: Part-time demonstrator. Department of Plant Sciences, University of the Free State, Bloemfontein, South Africa*
- *2010: Part-time lab assistant. Department of Chemistry, University of the Free State, Bloemfontein, South Africa*
- *2007 – 2009: Shop Manager. Christian Tees, Brandwag Centre, Bloemfontein*

Certifications

- *SAGIC Invasive Species Consultant (Cape Town, South Africa), March 2016*
- *GIS Intermediate (NQF level 5): Hydrological modelling and terrain analysis using digital elevation models (University of the Free State, South Africa), 2014*
- *Good Laboratory Practice seminar presented by Merck Millipore South Africa, 2012*
- *Laboratory Safety seminar presented by Merck Millipore South Africa, 2012*

Appendix 3 Specialist Work Experience and References

WORK EXPERIENCES

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References

Gerhard Botha

ECOLOGICAL RELATED STUDIES AND SURVEYS

Date Completed	Project Description	Type of Assessment/Study	Client
2019	Sirius Three Solar PV Facility near Upington, Northern Cape	Ecological Assessment (Basic Assessment)	Aurora Power Solutions
2019	Sirius Four Solar PV Facility near Upington, Northern Cape	Ecological Assessment (Basic Assessment)	Aurora Power Solutions
2019	Lichtenburg 1 100MW Solar PV Facility, Lichtenburg, North-West Province	Ecological Assessment (Scoping and EIA Phase Assessments)	Atlantic Renewable Energy Partners
2019	Lichtenburg 2 100MW Solar PV Facility, Lichtenburg, North-West Province	Ecological Assessment (Scoping and EIA Phase Assessments)	Atlantic Renewable Energy Partners
2019	Lichtenburg 3 100MW Solar PV Facility, Lichtenburg, North-West Province	Ecological Assessment (Scoping and EIA Phase Assessments)	Atlantic Renewable Energy Partners
2019	Moeding Solar PV Facility near Vryburg, North-West Province	Ecological Assessment (Basic Assessment)	Moeding Solar
2019	Expansion of the Raumix Aliwal North Quarry, Eastern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	GreenMined
2018	Kruisvallei Hydroelectric 22kV Overhead Power Line, Clarens, Free State Province	Faunal and Flora Rescue and Protection Plan	Zevobuzz
2018	Kruisvallei Hydroelectric 22kV Overhead Power Line, Clarens, Free State Province	Fauna and Flora Pre-Construction Walk-Through Assessment	Zevobuzz
2018	Proposed Kruisvallei Hydroelectric Power Generation Scheme in the Ash River, Free State Province	Ecological Assessment (Basic Assessment)	Zevobuzz
2018	Proposed Zonnebloem Switching Station (132/22kV) and 2X Loop-in Loop-out Power Lines (132kV), Mpumalanga Province	Ecological Assessment (Basic Assessment)	Eskom
2018	Clayville Thermal Plant within the Clayville Industrial Area, Gauteng Province	Ecological Comments Letter	Savannah Environmental
2018	Iziduli Emoyeni Wind Farm near Bedford, Eastern Cape Province	Ecological Assessment (Re-assessment)	Emoyeni Wid Farm Renewable Energy
2018	Msenge Wind Farm near Bedford, Eastern Cape Province	Ecological Assessment (Re-assessment)	Amakhala Emoyeni Renewable Energy

2017	H2 Energy Power Station near Kwamhlanga, Mpumalanga Province	Ecological Assessment (Scoping and EIA phase assessments)	Eskom
2017	Karusa Wind Farm (Phase 1 of the Hidden Valley Wind Energy Facility near Sutherland, Northern Cape Province)	Ecological Assessment (Re-assessment)	ACED Renewables Hidden Valley
2017	Soetwater Wind Farm (Phase 2 of the Hidden Valley Wind Energy Facility near Sutherland, Northern Cape Province)	Ecological Assessment (Re-assessment)	ACED Renewables Hidden Valley
2017	S24G for the unlawful commencement or continuation of activities within a watercourse, Honeydew, Gauteng Province	Ecological Assessment	Savannah Environmental
2016 - 2017	Noupoort CSP Facility near Noupoort, Northern Cape Province	Ecological Assessment (Scoping and EIA phase assessments)	Cresco
2016	Buffels Solar 2 PV Facility near Orkney, North West Province	Ecological Assessment (Scoping and EIA phase assessments)	Kabi Solar
2016	Buffels Solar 1 PV Facility near Orkney, North West Province	Ecological Assessment (Scoping and EIA phase assessments)	Kabi Solar
2016	132kV Power Line and On-Site Substation for the Authorised Golden Valley II Wind Energy Facility near Bedford, Eastern Cape Province	Ecological Assessment (Basic Assessment)	Terra Wind Energy
2016	Kalahari CSP Facility: 132kV Ferrum–Kalahari–UNTU & 132kV Kathu IPP–Kathu 1 Overhead Power Lines, Kathu, Northern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	Kathu Solar Park
2016	Kalahari CSP Facility: Access Roads, Kathu, Northern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	Kathu Solar Park
2016	Karoshoek Solar Valley Development – Additional CSP Facility including tower infrastructure associated with authorised CSP Site 2 near Upington, Northern Cape Province	Ecological Assessment (Scoping Assessment)	Emvelo
2016	Karoshoek Solar Valley Development –Ilanga CSP 7 and 8 Facilities near Upington, Northern Cape Province	Ecological Assessment (Scoping Assessment)	Emvelo
2016	Karoshoek Solar Valley Development –Ilanga CSP 9 Facility near Upington, Northern Cape Province	Ecological Assessment (Scoping Assessment)	Emvelo
2016	Lehae Training Academy and Fire Station, Gauteng Province	Ecological Assessment	Savannah Environmental
2016	Metal Industrial Cluster and Associated Infrastructure near Kuruman, Northern Cape Province	Ecological Assessment (Scoping Assessment)	Northern Cape Department of Economic Development and Tourism
2016	Semonkong Wind Energy Facility near Semonkong, Maseru District, Lesotho	Ecological Pre-Feasibility Study	Savannah Environmental
2015 - 2016	Orkney Solar PV Facility near Orkney, North West Province	Ecological Assessment (Scoping and EIA phase assessments)	Genesis Eco-Energy
2015 - 2016	Woodhouse 1 and Woodhouse 2 PV Facilities near Vryburg, North West Province	Ecological Assessment (Scoping and EIA phase assessments)	Genesis Eco-Energy
2015	CAMCO Clean Energy 100kW PV Solar Facility, Thaba Eco Lodge near Johannesburg, Gauteng Province	Ecological Assessment (Basic Assessment)	CAMCO Clean Energy
2015	CAMCO Clean Energy 100kW PV Solar Facility, Thaba Eco Lodge near Johannesburg, Gauteng Province	Ecological Assessment (Basic Assessment)	CAMCO Clean Energy

2015	Sirius 1 Solar PV Project near Upington, Northern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	Aurora Power Solutions
2015	Sirius 2 Solar PV Project near Upington, Northern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	Aurora Power Solutions
2015	Sirius 1 Solar PV Project near Upington, Northern Cape Province	Invasive Plant Management Plan	Aurora Power Solutions
2015	Sirius 2 Solar PV Project near Upington, Northern Cape Province	Invasive Plant Management Plan	Aurora Power Solutions
2015	Sirius 1 Solar PV Project near Upington, Northern Cape Province	Plant Rehabilitation Management Plan	Aurora Power Solutions
2015	Sirius Phase 2 Solar PV Project near Upington, Northern Cape Province	Plant Rehabilitation Management Plan	Aurora Power Solutions
2015	Sirius 1 Solar PV Project near Upington, Northern Cape Province	Plant Rescue and Protection Plan	Aurora Power Solutions
2015	Sirius Phase 2 Solar PV Project near Upington, Northern Cape Province	Plant Rescue and Protection Plan	Aurora Power Solutions
2015	Expansion of the existing Komsberg Main Transmission Substation near Sutherland, Northern Cape Province	Ecological Assessment (Basic Assessment)	ESKOM
2015	Karusa Wind Farm near Sutherland, Northern Cape Province)	Invasive Plant Management Plan	ACED Renewables Hidden Valley
2015	Proposed Karusa Facility Substation and Ancillaries near Sutherland, Northern Cape Province	Ecological Assessment (Basic Assessment)	ACED Renewables Hidden Valley
2015	Eskom Karusa Switching Station and 132kV Double Circuit Overhead Power Line near Sutherland, Northern Cape Province	Ecological Assessment (Basic Assessment)	ESKOM
2015	Karusa Wind Farm near Sutherland, Northern Cape Province)	Plant Search and Rescue and Rehabilitation Management Plan	ACED Renewables Hidden Valley
2015	Karusa Wind Energy Facility near Sutherland, Northern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	ACED Renewables Hidden Valley
2015	Soetwater Facility Substation, 132kV Overhead Power Line and Ancillaries, near Sutherland, Northern Cape Province	Ecological Assessment (Basic Assessment)	ACED Renewables Hidden Valley
2015	Soetwater Wind Farm near Sutherland, Northern Cape Province)	Invasive Plant Management Plan	ACED Renewables Hidden Valley
2015	Soetwater Wind Energy Facility near Sutherland, Northern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	ACED Renewables Hidden Valley
2015	Soetwater Wind Farm near Sutherland, Northern Cape Province	Plant Search and Rescue and Rehabilitation Management Plan	ACED Renewables Hidden Valley
2015	Expansion of the existing Scottburgh quarry near Amandawe, KwaZulu-Natal	Botanical Assessment (for EIA)	GreenMined Environmental
2015	Expansion of the existing AFRIMAT quarry near Hluhluwe, KwaZulu-Natal	Botanical Assessment (for EIA)	GreenMined Environmental
2014	Tshepong 5MW PV facility within Harmony Gold's mining rights areas, Odendaalsrus	Ecological Assessment (Basic Assessment)	BBEnergy
2014	Nyala 5MW PV facility within Harmony Gold's mining rights areas, Odendaalsrus	Ecological Assessment (Basic Assessment)	BBEnergy
2014	Eland 5MW PV facility within Harmony Gold's mining rights areas, Odendaalsrus	Ecological Assessment (Basic Assessment)	BBEnergy
2014	Transalloys circulating fluidised bed power station near Emalahleni, Mpumalanga Province	Ecological Assessment (for EIA)	Trans-Alloys
2014	Umbani circulating fluidised bed power station near Kriel, Mpumalanga Province	Ecological Assessment (Scoping and EIA)	Eskom
2014	Gihon 75MW Solar Farm: Bela-Bela, Limpopo Province	Ecological Assessment (for EIA)	NETWORX Renewables

2014	Steelpoort Integration Project & Steelpoort to Wolwekraal 400kV Power Line	Fauna and Flora Pre-Construction Walk-Through Assessment	Eskom
2014	Audit of protected *Acacia erioloba* trees within the Assmang Wrenchville housing development footprint area	Botanical Audit	Eco-Care Consultancy
2014	Rehabilitation of the N1 National Road between Sydenham and Glen Lyon	Peer review of the ecological report	EKO Environmental
2014	Rehabilitation of the N6 National Road between Onze Rust and Bloemfontein	Peer review of the ecological report	EKO Environmental
2011	Illegally ploughed land on the Farm Wolwekop 2353, Bloemfontein	Vegetation Rehabilitation Plan	EnviroWorks
2011	Rocks Farm chicken broiler houses	Botanical Assessment (for EIA)	EnviroWorks
2011	Botshabelo 132 kV line	Ecological Assessment (for EIA)	CENTLEC
2011	De Aar Freight Transport Hub	Ecological Scoping and Feasibility Study	EnviroWorks
2011	The proposed establishment of the Tugela Ridge Eco Estate on the farm Kruisfontein, Bergville	Ecological Assessment (for EIA)	EnviroWorks
2010 - 2011	National long-haul optic fibre infrastructure network project, Bloemfontein to Beaufort West	Vegetation Rehabilitation Plan for illegally cleared areas	NEOTEL
2010 - 2011	National long-haul optic fibre infrastructure network project, Bloemfontein to Beaufort West	Invasive Plant Management Plan	NEOTEL
2010 - 2011	National long-haul optic fibre infrastructure network project, Bloemfontein to Beaufort West	Protected and Endangered Species Walk-Through Survey	NEOTEL
2011	Optic Fibre Infrastructure Network, Swartland Municipality	Botanical Assessment (for EIA) - Assisted Dr. Dave McDonald	Dark Fibre Africa
2011	Optic Fibre Infrastructure Network, City of Cape Town Municipality	Botanical Assessment (for EIA) - Assisted Dr. Dave McDonald	Dark Fibre Africa
2010	Construction of an icon at the southernmost tip of Africa, Agulhas National Park	Botanical Assessment (for EIA)	SANPARKS
2010	New boardwalk from Suiderstrand Gravel Road to Rasperpunt, Agulhas National Park	Botanical Assessment (for EIA)	SANPARKS
2010	Farm development for academic purposes (Maluti FET College) on the Farm Rosedale 107, Harrismith	Ecological Assessment (Screening and Feasibility Study)	Agri Development Solutions
2010	Basic Assessment: Barcelona 88/11kV substation and 88kV loop-in lines	Botanical Assessment (for EIA)	Eskom Distribution
2011	Illegally ploughed land on the Farm Wolwekop 2353, Bloemfontein	Vegetation Rehabilitation Plan	EnviroWorks

WETLAND DELINEATION AND HYDROLOGICAL ASSESSMENTS

Date Completed	Project Description	Type of Assessment/Study	Client
In progress	Steynsrus PV 1 & 2 Solar Energy Facilities near Steynsrus, Free State Province	Wetland Assessment	Cronimet Mining Power Solutions
2019	Lichtenburg 1 100MW Solar PV Facility, Lichtenburg, North-West Province	Surface Hydrological Assessment (Scoping and EIA Phase)	Atlantic Renewable Energy Partners
2019	Lichtenburg 2 100MW Solar PV Facility, Lichtenburg, North-West Province	Surface Hydrological Assessment (Scoping and EIA Phase)	Atlantic Renewable Energy Partners
2019	Lichtenburg 3 100MW Solar PV Facility, Lichtenburg, North-West Province	Surface Hydrological Assessment (Scoping and EIA Phase)	Atlantic Renewable Energy Partners
2019	Moeding Solar PV Facility near Vryburg, North-West Province	Wetland Assessment (Basic Assessment)	Moeding Solar
2018	Kruisvallei Hydroelectric 22kV Overhead Power Line, Clarens, Free State Province	Wetland Assessment (Basic Assessment	Zevobuzz
2017	Nyala 5MW PV facility within Harmony Gold's mining rights areas, Odendaalsrus	Wetland Assessment	BBEnergy

2017	Eland 5MW PV facility within Harmony Gold's mining rights areas, Odendaalsrus	Wetland Assessment	BBEnergy
2017	Olifantshoek 10MVA 132/11kV Substation and 31km Power Line	Surface Hydrological Assessment (Basic Assessment)	Eskom
2017	Expansion of the Elandspruit Quarry near Ladysmith, KwaZulu-Natal Province	Wetland Assessment	Raumix
2017	S24G for the unlawful commencement or continuation of activities within a watercourse, Honeydew, Gauteng Province	Aquatic Assessment & Flood Plain Delineation	Savannah Environmental
2017	Noupoort CSP Facility near Noupoort, Northern Cape Province	Surface Hydrological Assessment (EIA phase)	Cresco
2016	Wolmaransstad Municipality 75MW PV Solar Energy Facility in the North West Province	Wetland Assessment (Basic Assessment)	BlueWave Capital
2016	BlueWave 75MW PV Plant near Welkom Free State Province	Wetland Delineation	BlueWave Capital
2016	Harmony Solar Energy Facilities: Amendment of Pipeline and Overhead Power Line Route	Wetland Assessment (Basic Assessment)	BBEnergy

AVIFAUNAL ASSESSMENTS

Date Completed	Project Description	Type of Assessment/Study	Client
2019	Sirius Three Solar PV Facility near Upington, Northern Cape	Avifauna Assessment (Basic Assessment)	Aurora Power Solutions
2019	Sirius Four Solar PV Facility near Upington, Northern Cape	Avifauna Assessment (Basic Assessment)	Aurora Power Solutions
2019	Moeding Solar PV Facility near Vryburg, North-West Province	Avifauna Assessment (Basic Assessment)	Moeding Solar
2018	Proposed Zonnebloem Switching Station (132/22kV) and 2X Loop-in Loop-out Power Lines (132kV), Mpumalanga Province	Avifauna Assessment (Basic Assessment)	Eskom
2017	Olifantshoek 10MVA 132/11kV Substation and 31km Power Line	Avifauna Assessment (Basic Assessment)	Eskom
2016	TEWA Solar 1 Facility, east of Upington, Northern Cape Province	Wetland Assessment (Basic Assessment	Tewa Isitha Solar 1
2016	TEWA Solar 2 Facility, east of Upington, Northern Cape Province	Wetland Assessment	Tewa Isitha Solar 2

ENVIRONMENTAL IMPACT ASSESSMENT

- Barcelona 88/11kV substation and 88kV loop-in lines – BA (for Eskom).
- Thabong Bulk 132kV sub-transmission inter-connector line – EIA (for Eskom).
- Groenwater 45 000 unit chicken broiler farm – BA (for Areemeng Mmogo Cooperative).
- Optic Fibre Infrastructure Network, City of Cape Town Municipality – BA (for Dark Fibre Africa (Pty) Ltd).
- Optic Fibre Infrastructure Network, Swartland Municipality – BA (for Dark Fibre Africa).
- Construction and refurbishment of the existing 66kV network between Ruigtevallei Substation and Reddersburg Substation – EMP (for Eskom).
- Lower Kruisvallei Hydroelectric Power Scheme (Ash river) – EIA (for Kruisvallei Hydro (Pty) Ltd).
- Construction of egg hatchery and associated infrastructure – BA (For Supreme Poultry).

- Construction of the Klipplaatdrif flow gauging (Vaal river) – EMP (DWAF).

ENVIRONMENTAL COMPLIANCE AUDITING AND ECO

- National long haul optic fibre infrastructure network project, Bloemfontein to Laingsburg – ECO (for Enviroworks (Pty) Ltd.).
- National long haul optic fibre infrastructure network project, Wolmaransstad to Klerksdorp – ECO (for Enviroworks (Pty) Ltd.).
- Construction and refurbishment of the existing 66kV network between Ruigtevallei Substation and Reddersburg Substation – ECO (for Enviroworks (Pty) Ltd.).
- Construction and refurbishment of the Vredefort/Nooitgedacht 11kV power line – ECO (for Enviroworks (Pty) Ltd.).
- Mining of Dolerite (Stone Aggregate) by Raumix (Pty) Ltd. on a portion of Portion 0 of the farm Hillside 2830, Bloemfontein – ECO (for GreenMined Environmental (Pty) Ltd.).
- Construction of an Egg Production Facility by Bainsvlei Poultry (Pty) Ltd on Portions 9 & 10 of the farm, Mooivlakte, Bloemfontein – ECO (for Enviro-Niche Consulting (Pty) Ltd.).
- Environmental compliance audit and botanical account of Afrisam's premises in Bloemfontein – Environmental Compliance Auditing (for Enviroworks (Pty) Ltd.).

OTHER PROJECTS:

- Keeping and breeding of lions (*Panthera leo*) on the farm Maxico 135, Ficksburg – Management and Business Plan (for Enviroworks (Pty) Ltd.)
- Keeping and breeding of lions (*Panthera leo*) on the farm Mooihoek 292, Theunissen – Management and Business Plan (for Enviroworks (Pty) Ltd.)
- Keeping and breeding of wild dogs (*Lycaon pictus*) on the farm Mooihoek 292, Theunissen – Management and Business Plan (for Enviroworks (Pty) Ltd.)
- Existing underground and aboveground fuel storage tanks, TWK AGRI: Pongola – Environmental Management Plan (for TWK Agricultural Ltd).
- Existing underground fuel storage tanks on Erf 171, TWK AGRI: Amsterdam – Environmental Management Plan (for TWK Agricultural Ltd).
- Proposed storage of 14 000 L of fuel (diesel) aboveground on Erf 32, TWK AGRI: Carolina – Environmental Management Plan (for TWK Agricultural Ltd).
- Proposed storage of 23 000 L of fuel (diesel) above ground on Portion 10 of the Farm Oude Bosch, Humansdorp – Environmental Management Plan (for TWK Agricultural Ltd).
- Proposed storage of 16 000 L of fuel (diesel) aboveground at Panbult Depot – Environmental Management Plan (for TWK Agricultural Ltd).
- Existing underground fuel storage tanks, TWK AGRI: Mechanisation and Engineering, Piet Retief – Environmental Management Plan (for TWK Agricultural Ltd).
- Existing underground fuel storage tanks on Portion 38 of the Farm Lothair, TWK AGRI: Lothair –

Environmental Management Plan (for TWK Agricultural Ltd).

WORK EXPERIENCES

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Jan-Hendrik Keet, PhD

Publications

- Hirsch H, Allsopp MH, Canavan S, Cheek M, Geerts S, Geldenhuys CJ, Harding G, Hurley BP, Jones W, **Keet J-H**, Klein H, Ruwanza S, van Wilgen BW, Wingfield MJ, Richardson DM (**2019**) *Eucalyptus camaldulensis* in South Africa – past, present, future, *Transactions of the Royal Society of South Africa*, https://doi.org/10.1080/0035919X.2019.1669732.
- Le Roux JJ, Hui C, Castillo ML, Iriondo, JM, **Keet J-H**, Khapugin, AA, Médail F, Rejmánek M, Theron G, Yannelli FA, Hirsch H (**2019**) Recent anthropogenic plant extinctions differ in biodiversity hotspots and coldspots. *Current Biology*, https://doi.org/10.1016/j.cub.2019.07.063.
- **Keet J-H**, Ellis A G, Hui C, Le Roux JJ (**2019**) Strong spatial and temporal turnover of soil bacterial communities in South Africa's hyperdiverse fynbos biome. *Soil Biology and Biochemistry* **136:** 107541, https://doi.org/10.1016/j.soilbio.2019.107541.
- Le Roux JJ, Ellis AG, Van Zyl L-M, Hosking ND, **Keet J-H**, Yannelli F (**2018**) Importance of soil legacy effects and successful mutualistic interactions during Australian acacia invasions in nutrient-poor environments. *Journal of Ecology* **105**(6): 2071-2081, https://doi.org/10.1111/1365-2745.1296.
- **Keet J-H**, Ellis A G, Hui C, Le Roux JJ (**2017**) Legume–rhizobium symbiotic promiscuity and effectiveness do not affect plant invasiveness. *Annals of Botany* **119**(8): 1319-1331, https://doi.org/10.1093/aob/mcx028.
- Le Roux JJ, **Keet J-H**, Mutiti B, Ellis AG (**2017**) Cultivation may not dramatically alter rhizobial community diversity or structure associated with rooibos tea (*Aspalathus linearis* Burm.f.) in South Africa. *South African Journal of Botany* **110**: 87-96, https://doi.org/10.1016/j.sajb.2017.01.014.
- Le Roux JJ, Hui C, **Keet J-H**, Ellis AG (**2017**) Co-introduction vs ecological fitting as pathways to the establishment of effective mutualisms during biological invasions. *New Phytologist* **215**:1354–1360. https://doi.org/10.1111/nph.14593.
- Nsikani M, Novoa A, Van Wilgen B, **Keet J-H**, Gaertner M (**2017**) *Acacia saligna*'s soil legacy effects persist up to ten years after clearing: Implications for ecological restoration. *Austral Ecology* **42**(8): 880-889, https://doi.org/10.1111/aec.12515.

- **Keet J-H**, Cindi D, Du Preez PJ (**2016**) Assessing the invasiveness of *Berberis aristata* and *B. julianae* (Berberidaceae) in South Africa: management options and legal recommendations. *South African Journal of Botany* **105**: 299-28, https://doi.org/10.1016/j.sajb.2016.04.012.

Conferences

- 46th South African Association of Botanists conference (Qwa-Qwa, South Africa), January 2020, ***Alnus glutinosa* (L.) Gaertn. [Black Alder]: *an emerging invader in South Africa***
- International Association for Food Protection (IAFP; Louisville, Kentucky, USA), July 2019.
- Ecological Society of America Conference, (New Orleans, Louisiana, USA), August 2018 **Invasive legumes dramatically impact soil bacterial community structures but not function**
- Legumes for Life Workshop (Stellenbosch, South Africa), May 2018 **Legume-rhizobium symbiotic promiscuity and effectiveness do not affect plant invasiveness**
- Fynbos Forum Conference (Swellendam, South Africa), July 2017 **Assessing the impacts of invasive legumes on soil conditions and microbial community composition in a biodiversity hotspot**
- 43rd South African Association of Botanists Conference (Cape Town, South Africa), January 2017, **Legume-rhizobium symbiotic promiscuity and effectiveness do not affect plant invasiveness** *Best PhD presentation*
- 43rd Annual Research Symposium on the Management of Biological Invasions Conference (Worcester, South Africa), May 2016, **Legume-rhizobium symbiotic promiscuity does not determine plant invasiveness**
- Evolutionary dynamics of tree invasions: drivers, dimensions, and implications for management (Stellenbosch, South Africa), November 2015
- Neobiota: 8th International Conference on Biological Invasions (Antalya, Turkey), November 2014, **Assessing the threat and potential for management of Berberis spp. (Berberidaceae) in South Africa**
- 42nd Annual Symposium on the Management of Invasive Alien Plants (Karridene Beach Hotel, Durban, South Africa)
- XXth Association for the Taxonomic Study of the Flora of Tropical Africa International Conference (Stellenbosch, South Africa), January 2014
- 41st Annual Symposium on the Management of Invasive Alien Plants (Cape St. Francis, South Africa), May 2013

EIA and other surveys

- Specialist Invasive Alien Plant Species Report: Prepared for: Mpact Corrugated, Kuils River (Western Cape), July 2019
- Proposed Township development, Country view, Gauteng: Biodiversity Impact Assessment (Flora) – Specialist Report prepared for Zone Land Solutions (PTY) Ltd, July 2015
- Colenso Anthracite Coal Mining and Power Station Project: Biodiversity Impact Assessment (Flora) – Specialist Report prepared for Zone Land Solutions (PTY) Ltd, July 2015