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ECOLOGY & BIODIVERSITY

DICOMA PV FACILITY AND ASSOCIATED INFRASTRUCTURE, NORTH WEST PROVINCE

ECOLOGY AND FRESHWATER RESOURCE ASSESSMENT: SCOPING PHASE

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DICOMA PV FACILITY AND ASSOCIATED INFRASTRUCTUR, NORTH WEST PROVINCE

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I. DECLARATION OF CONSULTANTS INDEPENDENCE

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

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Field of expertise: Fauna & flora, terrestrial biodiversity, wetland ecology, aquatic and wetland, aquatic biomonitoring, and wetland habitat evaluations. BSc (Hons) Zoology and Botany, MSc Botany (Phytosociology) from 2011 to present.

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1. INTRODUCTION

Client

Dicoma PV (Pty) Ltd.

Project

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

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. 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:

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.2 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.2 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

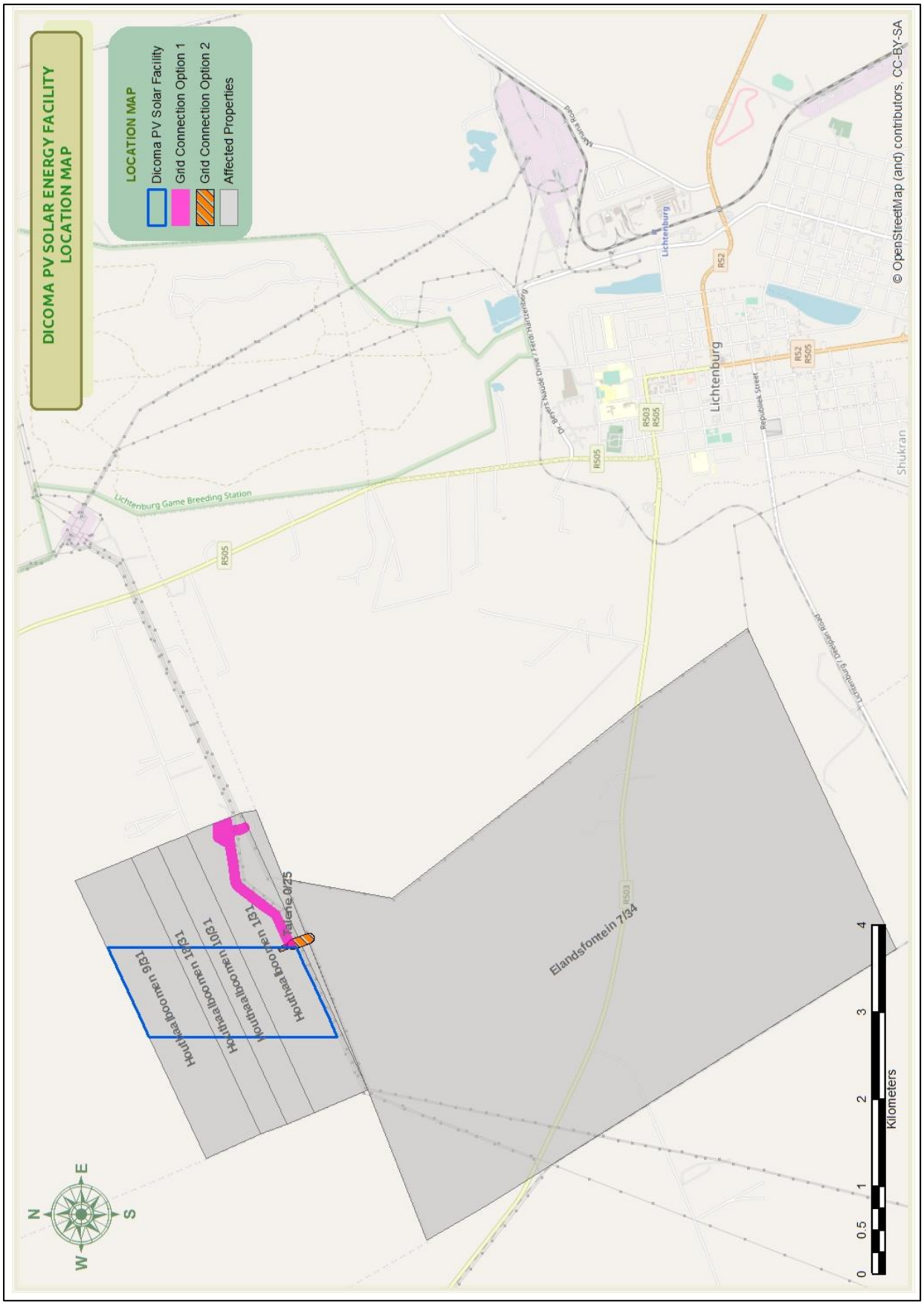

Figure 1: Proposed location of the Dicoma PV Solar Energy Facility

Terms of reference

To conduct an ecological and freshwater resource desktop study, for a scoping assessment, of the target areas where the establishment of the solar energy facility and associated infrastructure (including two grid connections options) is proposed to be located and provide a professional opinion on ecological issues pertaining to the target area to aid in future decisions regarding the proposed project.

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.

Assumptions, Limitations and Gaps in the Information Presented

The following limitations and assumptions apply to this assessment:

» This report deals exclusively with a defined area and the extent of aquatic and terrestrial habitat/ecosystems in that area.
» Information used to inform the assessment was limited to desktop data and GIS coverage's available for the province and district municipality at the time of the assessment as well as available existing specialist studies undertaken within the region.

Relevant legislation: Terrestrial Biodiversity

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

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 Ordinances accompanied by all amendments is regarded by the North West Department of Economic Development, Environment, Conservation and Tourism (DEDECT) as the legally binding, provincial documents, providing regulations, guidelines and procedures with the aim of protecting game and fish, the conservation of flora and fauna and the destruction of problematic (vermin and invasive) species.

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;
» The National Water Act 36 of 1998
» General Authorisations (GAs): As promulgated under the National Water Act and published under GNR 398 of 26 March 2004.
» National Forest Act 1998 / NFA (No 84 of 1998);
» National Veld and Forest Fire Act (Act No. 101 of 1998); and
» Conservation of Agricultural Resources Act / CARA (Act No. 43 of 1983) and amendments.

International

» Convention on International Trade in Endangered Species of Fauna and Flora (CITES);
» The Convention on Biological Diversity;
» The Convention on the Conservation of Migratory Species of Wild Animals; and
» The RAMSAR Convention.

Relevant legislation: Freshwater/Aquatic Resources

The link between ecological integrity of freshwater resources and their continued provision of valuable ecosystem goods and services to burgeoning populations is well-recognised, both globally and nationally (Rivers-Moore et al., 2007). In response to the importance of freshwater aquatic resources, protection of wetlands and rivers has been campaigned at national and international levels. A strong legislative framework which backs up South Africa's obligations to numerous international conservation agreements creates the necessary enabling legal framework for the protection of freshwater resources in the country. Relevant environmental legislation pertaining to the protection and use of aquatic ecosystems (i.e. wetlands and rivers) in South Africa has been summarized below.

South African Constitution 108 of 1996

» Section 24 of Chapter 2 of the Bill of Rights No. 108 of 1996 states that everyone has the right to:
  (a) to an environment that is not harmful to their health or well-being; and
  (b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that—
    (i) prevent pollution and ecological degradation;
    (i) promote conservation; and
    (ii) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

National Environmental Management Act 107 of 1998

» Wetlands and other watercourses defined in the NWA are also protected in the National Environmental Management Act (Act 107 of 1998), (NEMA). The act lists several activities that require authorisation before they can be implemented. NEMA lists various activities that require authorisation when located within 32 m or less from the edge of a wetland or other watercourse type.

National Water Act (Act No. 36 of 1998)

According to the National Water Act (Act No. 36 of 1998), a water resource is defined as: "a watercourse, surface water, estuary, or aquifer. A watercourse in turn refers to
  (a) a river or spring;
  (b) a natural channel in which water flows regularly or intermittently;
  (c) a wetland, lake or dam into which, or from which, water flows; and
  (d) any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse. Reference to a watercourse includes, where relevant, its bed and banks."

A wetland is defined as: "land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances support or would support vegetation typically adapted to life in saturated soil."

Chapter 4 of the Act deals with the regulation of the use of water and the requirements for controlled activities, general authorisations, and licenses. In general, a water use must be licensed unless: it is listed in Schedule 1 of the Act as an existing lawful water use, or is permissible under a general authorisation, or if a responsible authority waives the need for a license.

According to the Department of Water and Sanitation (DWS), any activity that falls within the temporary zone of a wetland or the 1:100 year floodline (whichever is greater) qualifies as a Section 21 water use activity (depending on the use) and will thus require either a general authorization or Water Use License (WUL). According to the NWA, an application for a WUL should be submitted to the DWS if any of the above activities are to be undertaken.

Section 21 of the National Water Act (NWA Act No. 36 of 1998) covers the following activities, which might be applicable to the proposed project. According to Section 21 of the NWA and in relation to the river ecosystem, the following activity is considered a use, and therefore requires a water use license:

21 (c) impeding or diverting the flow of water in a watercourse;
21 (i) altering the bed, banks, course or characteristics of a watercourse;

In terms of Section 22 (1), a person may only undertake the abovementioned water uses if it is appropriately authorised:

22(1) A person may only use water
(a) without a licence
(i) if that water use is permissible under Schedule 1;
(ii) if that water use is permissible as a continuation of an existing lawful use; or
(iii) if that water use is permissible in terms of a general authorisation issued under section 39;
(b) if the water use is authorised by a licence under this Act; or
(c) if the responsible authority has dispensed with a licence requirement under subsection (3).

Other pieces of legislation that may also be of some relevance to freshwater resources include:

» The National Forests Act No. 84 of 1998;
» The Natural Heritage Resources Act No. 25 of 1999;
» The National Environmental Management: Protected Areas Act No. 57 of 2003;

» Minerals and Petroleum Resources Development Act No. 28 of 2002;

2. METHODOLOGY

GIS (Mapping/Spatial Analysis)

Data sources from the literature and GIS spatial information have been 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.

Additional existing data layers that will be incorporated into the scoping phase assessment, in order to determine important (sensitive) terrestrial and freshwater entities are summarised below in Table 1:

Table 1: Data coverages used to inform the ecological and freshwater resource 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 National Land-Cover (from 20-meter multi-seasonal Sentinel 2 satellite imagery)	Shows the land-use and disturbances/transformations within and around the impacted zone.	DEA (2018)
	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)

	DWA Eco-regions (GIS Coverage)	Understand the regional biophysical context in which water resources within the study area occur	DWA (2005)
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 North West (GIS Coverage)	Determination of provincial terrestrial and aquatic conservation priorities and biodiversity buffers.	NW-READ (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)
	Strategic Water Source Areas for Surface Water (SWSA-sw) (GIS Coverage)	Shows the location of the development area relative to areas that contribute significantly to the overall water supply of the country	CSIR (2017)

Habitat and Floristic Analysis (Literature Study)

The Botanical Database of Southern Africa (BODATSA) have been consulted in order to obtain a list of species recorded within the area. This species list will provide an indication of the potential diversity expected within the area, the potential presence of range restricted species and other Species of Conservation Concern (SCC). The Red List of South African Plants website (SANBI, 2016) will also utilized to provide the most current account of the national status of flora. Based on this analysis of available floristic literature, as well as the identification and delineation of habitat units, a list of SCC likely to occur within the project site will be generated.

Additional information regarding ecosystems, vegetation types, and SCC will include the following sources:

» The Vegetation of South Africa, Lesotho and Swaziland (Mucina & Rutherford, The Vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19., 2018);
» Grassland Ecosystem Guidelines: landscape interpretation for planners and managers (SANBI, 2013); and
» Red List of South African Plants (Raimondo, et al., 2009; SANBI, 2016).

Faunal Analysis (Literature Study)

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 2626AA, 2625BB, 2525DD and 2526CC quatre 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).

Freshwater Resources (Literature Study)

The assessment was initiated with a survey of the pertinent literature, past reports and the various conservation plans that exist for the study region. The desktop delineation of all freshwater resources (rivers / streams and wetlands) within 500m (DWS regulated area) of the proposed project area was undertaken by analysing available 10m contour lines and colour aerial photography supplemented by Google Earth™ imagery where more up to date imagery was needed. Digitization and mapping were undertaken using ArcGis software. All of the mapped freshwater resources were then broadly subdivided into distinct resource units (i.e. classified as either riverine or wetland systems / habitat). This was undertaken based on aerial photographic analysis and professional experience in working in the region.

Following the desktop identification and mapping exercise, freshwater resource features will be assigned preliminary 'likelihood of impact' ratings based on the likelihood that activities associated with the proposed development will result in measurable direct or indirect changes to the mapped watercourse units within 500m of the proposed development. Each freshwater resource feature was ascribed a qualitative 'impact potential' rating according to the ratings and descriptions provided in Table 2, below.

Table 2: Preliminary risk ratings for the mapped wetland units including rationale.

Likelihood of Impact Rating	Description of Rating Guidelines
High	These resources are likely to require impact assessment and a Water Use License in terms of Section 21 (c) & (i) of the National Water Act for the following reasons: » resources located within the footprint of the proposed development activity and will definitely be impacted by the project; and/or » resources located within 15m upstream and/or upslope of the proposed development activity and trigger requirements for Environmental Authorisation according to the NEMA: EIA regulations; and/or » resources located within 15m or downslope of the development and trigger requirements for Environmental Authorisation according to the NEMA: EIA regulations; and/or » resources located downstream within the following parameters: • within 15m downstream of a low risk development; • within 50m downstream of a moderate risk development; and/or

	• within 100m downstream of a high risk development e.g. mining large industrial land uses
Moderate	These resources may require impact assessment and a Water Use License in terms of Section 21 (c) & (i) of the National Water Act for the following reasons: » resources located within 32m but greater than 15m upstream, upslope or downslope of the proposed development; and/or » resources located within a range at which they are likely to incur indirect impacts associated with the development (such as water pollution, sedimentation and erosion) based on development land use intensity and development area. » This is generally resources located downstream within the following parameters: • within 32m downstream of a low risk development; • within 100m downstream of a moderate risk development; and/or • within 500m downstream of a high-risk development (note that the extent of the affected area downstream could be greater than 500m for high risk developments or developments that have extensive water quality and flow impacts e.g. dams / abstraction and treatment plants);
Low	These resources are unlikely to require impact assessment or Water Use License in terms of Section 21 (c) & (i) of the National Water Act for the following reasons: » resources located a distance upstream, upslope or downslope (>32m) of the proposed development and which are unlikely to be impacted by the development project; and/or » resources located downstream but well beyond the range at which they are likely to incur impacts associated with the development (such as water pollution, sedimentation and erosion). This is generally resources located downstream within the following parameters: • greater than 32m downstream of a low risk development; • greater than 100m downstream of a moderate risk development; and/or • greater than 500m downstream of a high-risk development (note that the extent of the affected area downstream could be greater than 500m for high risk developments or developments that have extensive water quality and flow impacts e.g. dams / abstraction and treatment plants);
Very Low	These resources will not require impact assessment or a Water Use License in terms of Section 21 (c) & (i) of the National Water Act for the following reasons: » resources located within another adjacent sub-catchment and which will not be impacted by the development in any way, shape or form.

Criteria used to Assess the Site Sensitivity during the Scoping Phase

The broad-scale scoping phase ecological sensitivity map of the site was produced by integrating the available ecological and biodiversity information available in the literature and various spatial databases (e.g. SIBIS, BGIS). The ecological sensitivity of the different units identified in the mapping procedure was rated according to the following scale:

Table 3: 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	▪ CBA 1 areas ▪ Remaining areas of vegetation type listed in Draft Ecosystem List of NEM:BA as Critically Endangered,

Sensitivity	Factors contributing to sensitivity	Examples of qualifying features
	▪ 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).	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 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,	▪ CBA 2 "critical biodiversity areas". ▪ Confirmed habitat where species of conservation concern could potentially occur (habitat is suitable, but no confirmed records). ▪ 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.

Sensitivity	Factors contributing to sensitivity	Examples of qualifying features
	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)	▪ 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, food production, raw materials, genetic resources, cultural value).	▪ CBA 2 "corridor areas", ESA 1 and ESA2. ▪ Habitat with moderate diversity (richness or turnover). ▪ Suspected habitat for species of conservation concern.
Low	Degraded or disturbed indigenous natural vegetation No Natural habitat remaining	

*** Please not that this is only a preliminary ecological sensitivity map, and the sensitivity assessment and mapping will be finalised during the EIA phase.**

Scoping Phase Impact Assessment

The Scoping Phase Impact Assessment will include:

» a description of the environment that may be affected by the activity and the manner in which the environment may be affected by the proposed project;
» a description and evaluation of environmental issues and potential impacts (including direct, indirect, cumulative impacts and residual risks) that have been identified
» Direct, indirect, cumulative impacts and residual risks of the identified issues must be evaluated within the Scoping Report in terms of the following criteria:
  - the nature, which shall include a description of what causes the effect, what will be affected and how it will be affected, for each impact anticipated;
  - the extent, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development), regional, national or international. See Table on the next page.
» a statement regarding the potential significance of the identified issues based on the evaluation of the issues/impacts
» a comparative evaluation of the identified feasible alternatives, and **nomination of a preferred alternative** for consideration in the EIA phase
» Identification of potentially significant impacts **to be assessed** within the EIA phase and details of the methodology to be adopted in assessing these impacts. This should be detailed enough to include within the **Plan of Study for EIA** and must include a **description of the proposed method** of assessing the potential environmental impacts associated with the project. This must also include any gaps in knowledge at this point of the study and further recommendations for the EIA Phase. Consideration of areas that would constitute "acceptable and defendable loss" should be included in this discussion.

Example of Impact table summarising the evaluation of Potential Impacts Associated with the Construction of the Facility at the Scoping phase

Impacts

Description of the expected impacts. Areas anticipated to be affected.

Desktop Sensitivity Analysis of the Site:

Sensitivity analysis in terms of the impacts expected. Discuss areas of high concern.

Issue	**Nature of Impact**	**Extent of Impact**	**No-Go Areas**
i.e. Disturbance to and loss of indigenous natural vegetation	Discussion of the consequences of the construction of the facility to the issue/impact considered in column 1.	i.e. Local/Regional/ National	No-Go areas would include the larger drainage lines, and Duneveld.

Gaps in knowledge & recommendations for further study

»

3. THE IMPORTANCE OF BIODIVERSITY AND CONSERVATION

The term 'Biodiversity' is used to describe the wide variety of plant and animal species occurring in their natural environment or 'habitat'. Biodiversity encompasses not only 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; and keeping our biodiversity intact is vital for ensuring the on-going provision of ecosystem services, such as the production of clean water through good catchment management. 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 (Driver et al., 2012). 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 (Driver et al.,2012). 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 climatic change. Loss of biodiversity puts aspects of our economy and quality of life at risk and reduces socioeconomic options for future generations as well. In essence, then, sustainable development is not possible without it.

4. CONSERVATION AND FUNCTIONAL IMPORTANCE OF AQUATIC ECOSYSTEMS

Water affects every activity and aspiration of human society and sustains all ecosystems. "Freshwater ecosystems" refer to all inland water bodies whether fresh or saline, including rivers, lakes, wetlands, sub-surface waters, and estuaries (Driver et al., 2011). South Africa's freshwater ecosystems are diverse, ranging from sub-tropical in the north-eastern part of the country, to semi-arid and arid in the interior, to the cool and temperate rivers of the fynbos. Wetlands and rivers form a fascinating and essential part of our natural heritage and are often referred to as the "kidneys" and "arteries" of our living landscapes and this is particularly true in semi-arid countries such as South Africa (Nel et al., 2013). Rivers and their associated riparian zones are vital for supplying freshwater (South Africa's most scarce natural resource) and are important in providing additional biophysical, social, cultural, economic, and aesthetic services (Nel et al., 2013). The health of our rivers and wetlands is measured by the diversity and health of the species we share these resources with. Healthy river ecosystems can increase resilience to the impacts of climate change, by allowing ecosystems and species to adapt as naturally as possible to the changes and by buffering human settlements and activities from the impacts of extreme weather events (Nel et al., 2013). Freshwater ecosystems are likely to be particularly hard hit by rising temperatures and shifting rainfall patterns, and yet healthy, intact freshwater ecosystems

are vital for maintaining resilience to climate change and mitigating its impact on human wellbeing by helping to maintain a consistent supply of water and for reducing flood risk and mitigating the impact of flash floods. We, therefore, need to be mindful of the fact that without the integrity of our natural river systems, there will be no sustained long-term economic growth or life (DEA et al., 2013).

Freshwater ecosystems, including rivers and wetlands, are also particularly vulnerable to anthropogenic or human activities, which can often lead to irreversible damage or longer-term, gradual/cumulative changes to freshwater resources and associated aquatic ecosystems. Since channelled systems such as rivers, streams, and drainage lines are generally located at the lowest point in the landscape; they are often the "receivers" of wastes, sediment, and pollutants transported via surface water runoff as well as subsurface water movement (Driver et al., 2011). This combined with the strong connectivity of freshwater ecosystems means that they are highly susceptible to upstream, downstream, and upland impacts, including changes to water quality and quantity as well as changes to aquatic habitat & biota (Driver et al., 2011). South Africa's freshwater ecosystems have been mapped and classified into National Freshwater Ecosystem Priority Areas (NFEPAs). This work shows that 60% of our river ecosystems are threatened and 23% are critically endangered. The situation for wetlands is even worse: 65% of our wetland types are threatened, and 48% are critically endangered (Driver et al., 2011). Recent studies reveal that less than one-third of South Africa's main rivers are considered to be in an ecologically 'natural' state, with the principal threat to freshwater systems being human activities, including river regulation, followed by catchment transformation (Rivers-Moore & Goodman, 2009). South Africa's freshwater fauna also display high levels of threat: at least one-third of freshwater fish indigenous to South Africa are reported as threatened, and a recent southern African study on the conservation status of major freshwater-dependent taxonomic groups (fishes, molluscs, dragonflies, crabs, and vascular plants) reported far higher levels of threat in South Africa than in the rest of the region (Darwall *et al*., 2009). Clearly, urgent attention is required to ensure that representative natural examples of the different ecosystems that make up the natural heritage of this country for current and future generations to come. The degradation of South African rivers and wetlands is a concern now recognized by Government as requiring urgent action and the protection of freshwater resources, including rivers and wetlands, is considered fundamental to the sustainable management of South Africa's water resources in the context of the reconstruction and development of the country.

5. DESKTOP ECOLOGICAL ANALYSIS

Land use and Land Cover

The South African Land-Cover dataset (2018) were queried as part of the desktop study (Figure 4). Land-cover is a critical information component for a wide range of regional and local planning and management activities, especially in terms of resource conservation and environmental monitoring.

The 20m resolution, raster format South African National Land-Cover 2018 (SANLC 2018) dataset has been generated from automated mapping models (as opposed to conventional image classification procedures), using multi-seasonal 20m resolution Sentinel 2 satellite imagery. The imagery used represents the full temporal range of available imagery acquired by Sentinel 2 during the period 01 January 2018 to 31 December 2018.

The automated land-cover mapping models and associated procedures utilise both cloud-based image archives and cloud-based geo-data computing capabilities; although the final compilation and merging of the different land-cover and land-use information components (i.e. water, mining extent, forest plantations etc.), has been completed in a conventional desk-top environment, using automated modelling capabilities within commercial mapping software.

The SANLC 2018 dataset represents the full spatial extent of South Africa, plus 100 meters into neighbouring countries, and 10 kms into coastal waters.

The overall map accuracy for the SANLC 2018 dataset, calculated from 6570 reference points, is 90.14%.

The land-cover legend and associated information content within the SANLC 2018 dataset is based primarily on the new gazetted land-cover classification standard (SANS 19144-2)4, but with modifications to ensure, as far as possible, comparability and compatibility with the legend and information content associated with the previous 1990 and 2013-14 South African National Land-Cover (SANLC) datasets.

According to this dataset approximately 90% of the entire project/development site is located within natural grassland primarily used for livestock grazing (cattle), whist around 10% of the project site comprise of open to dense woodland bare areas (Figure 3).

Due to the relatively large scale of the map 1:50 000 and the fact that this land cover map was compiled back in 2018, variations in the land-use and vegetation cover may be present or may have changed of a period of time. As such, current (and historical) available areal and satellite imagery was analysed at a much closer elevation, of between 770 and 3.5km and were furthermore ground proved during an initial site screening assessment (6th to 8th of July 2012).

The results of this spatial analysis (ground proved) were as follows, and are illustrated in Figure 5:

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.

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 30% 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 3) and stone piles that have been removed from the cultivated areas (Figure 2). 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 2: An example of a stone pile/heap.

Figure 3 (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.

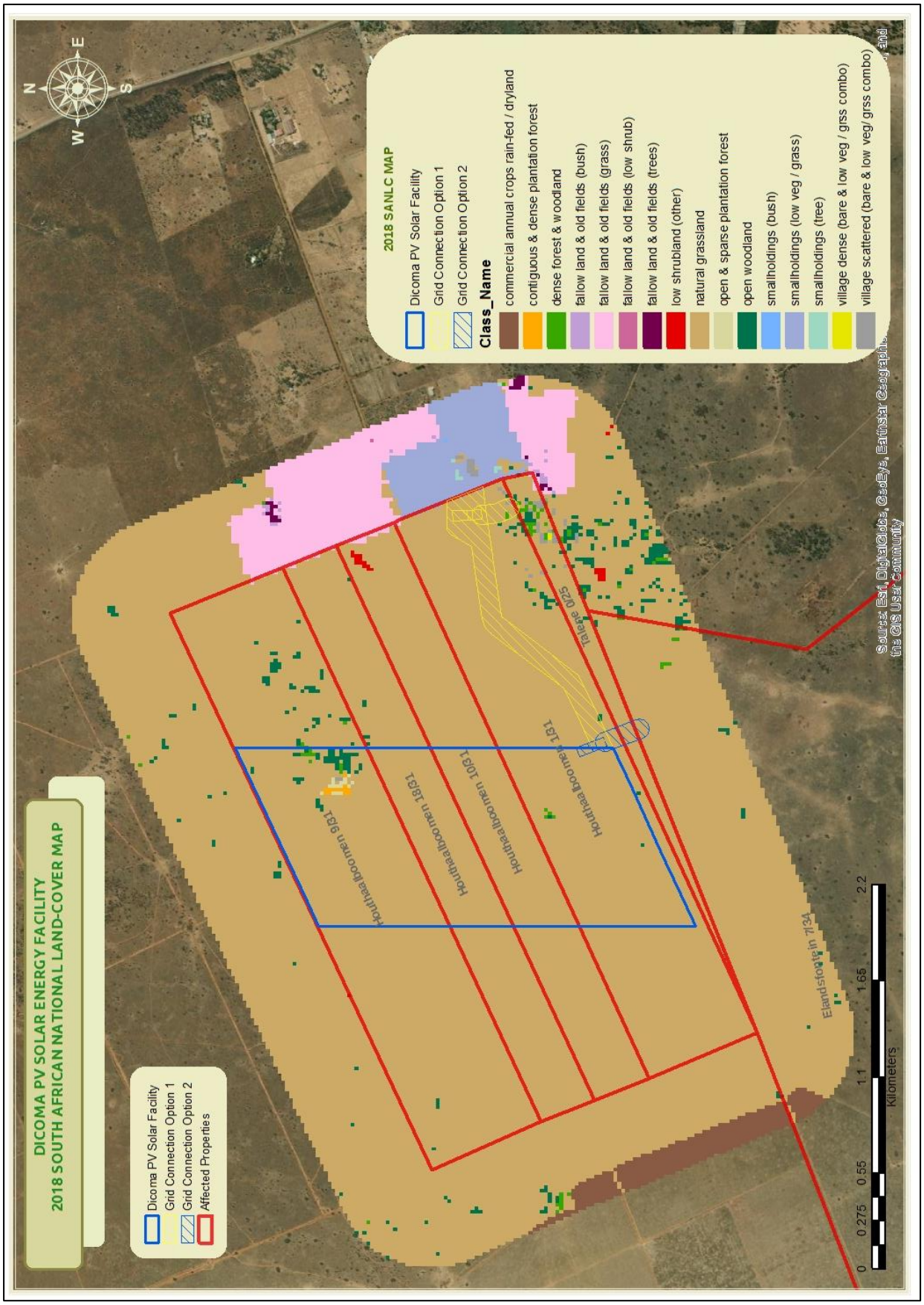

Figure 4: 2018 South African National Land-Use Map.

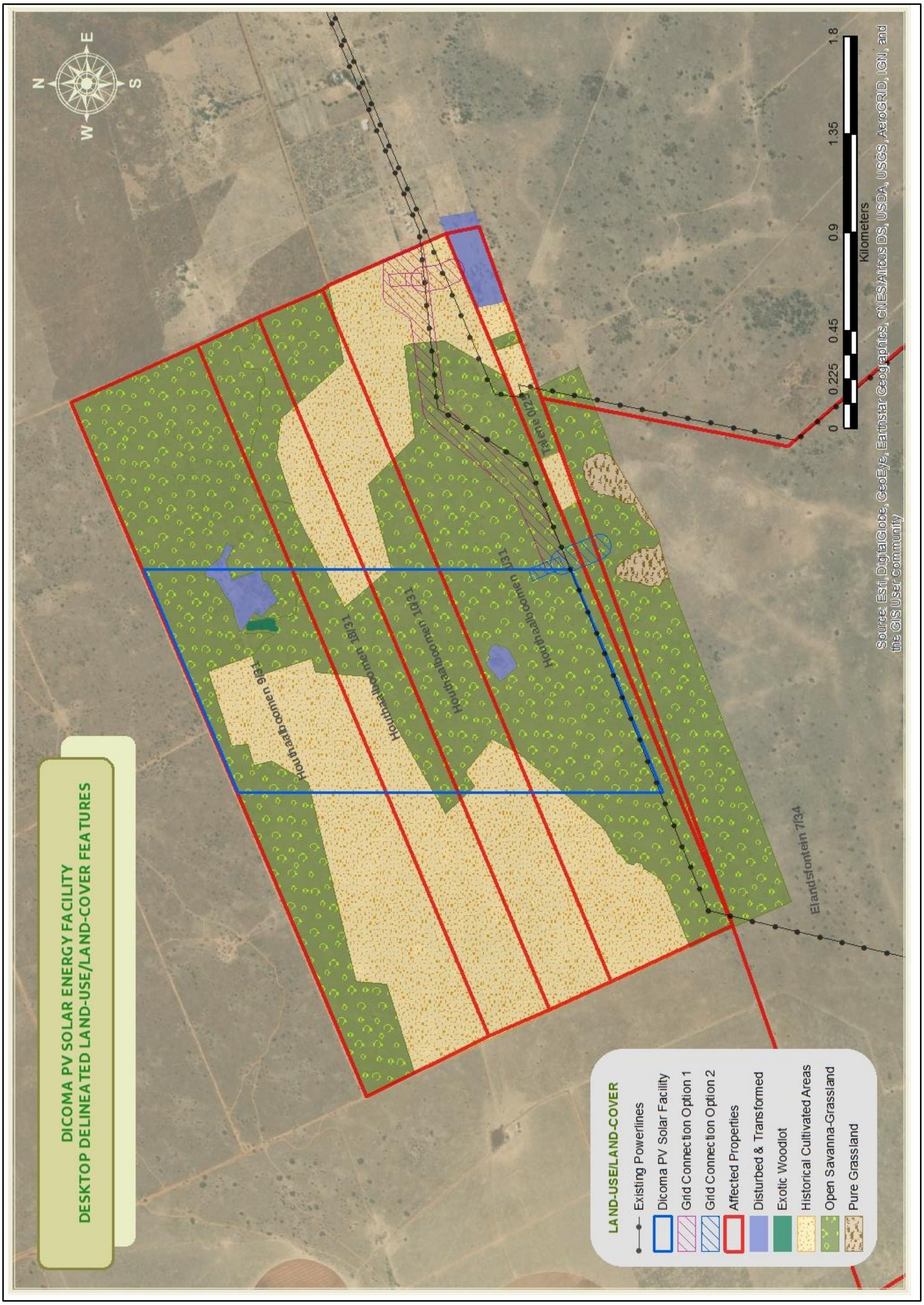

Figure 5: Desktop delineated land-cover features.

Regional/Local Biophysical Setting

A summary of the biophysical features and the setting of the project site and surroundings are summarised in Table 4.

Table 4: 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 (%)
	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.		CSIR, 2011
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	

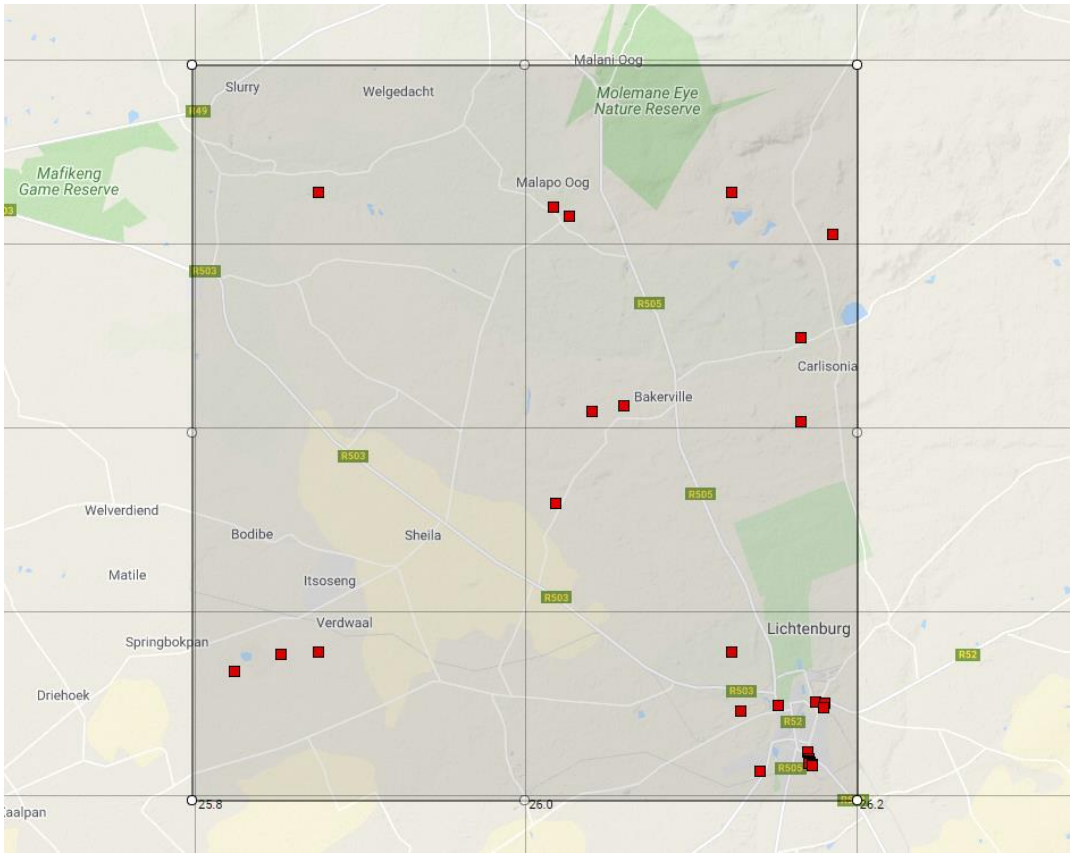

Figure 6: Extracted area and sample locations from POSA. Extracted data was used to compile a plant species list of species that may potentially occur within the project site and provide an indication of potential conservation important species that may be found within the area.

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 5).

Table 5: 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

National Protected Areas Expansion Strategy

Focus areas for land-based protected area expansion are large, intact, and unfragmented areas of high importance for biodiversity representation and ecological persistence, suitable for the creation or expansion of large protected areas. Focus Areas (FA) 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 freshwater ecosystems. These areas should not be seen as future boundaries of protected areas, as in many cases only a portion of a particular focus area would be required to meet the protected area targets set in the NPAES.

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 7). This development will not impact any FAs or impact the future conservation potential of nearby FAs.

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 68km 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.

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 8).

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 Mm^3 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, H_2CO_3), 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 km^2, 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. This potential impact will be assessed during the EIA phase and will be accompanied with the necessary mitigation measures.

National Level of Conservation Priorities (Threatened Ecosystems)

The vegetation types of South Africa have been categorised according to their conservation status which is, in turn, assessed according to the degree of transformation and rates of conservation. The status of a habitat or vegetation type is based on how much of its original area still remains intact relative to various thresholds. On a national scale these thresholds are, as depicted in the table below, determined by the best available scientific approaches (Driver *et al*. 2005). The level at which an ecosystem becomes Critically Endangered differs from one ecosystem to another and varies from 16% to 36% (Driver *et al*. 2005).

Table 6: Determining ecosystem status (from Driver et al. 2005). *BT = biodiversity target (the minimum conservation requirement.

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

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), lists national vegetation types that are afforded protection on the basis of rates of transformation. The threshold for listing in this legislation is higher than in the scientific literature, which means there are fewer ecosystems listed in the National Ecosystem List versus in the scientific literature.

Table 7: Conservation status of the vegetation type occurring in and around the study area.

Vegetation Type	Target (%)	Conserved (%)	Transformed (%)	Conservation Status	
				Driver *et al*., 2005; Mucina & Rutherford, 2006	National Ecosystem List (NEM:BA)
Carletonville Dolomite Grassland	24%	1.8%	23.9%	Vulnerable	Not Listed

According to current layout the entire SEF footprint is located within the Least Concerned Carletonville Dolomite Grassland (Figures 7 and 11).

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 Vulnerable by Mucina and Rutherford (2012) but is 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 7 and Figure 7).

The presence, extent and condition of the remaining natural grasslands will be determined and assessed during the EIA phase. Furthermore, the potential impact of the development on this vegetation types and its attributed conservation target will be assessed (in isolation and cumulative with other similar projects) during the EIA phase. Due to the fact that this vegetation unit still comprise of large 'natural' (untransformed) areas and due to the relatively small extent of the SEF footprint, this development will not likely have an impact on the conservation status of this vegetation type.

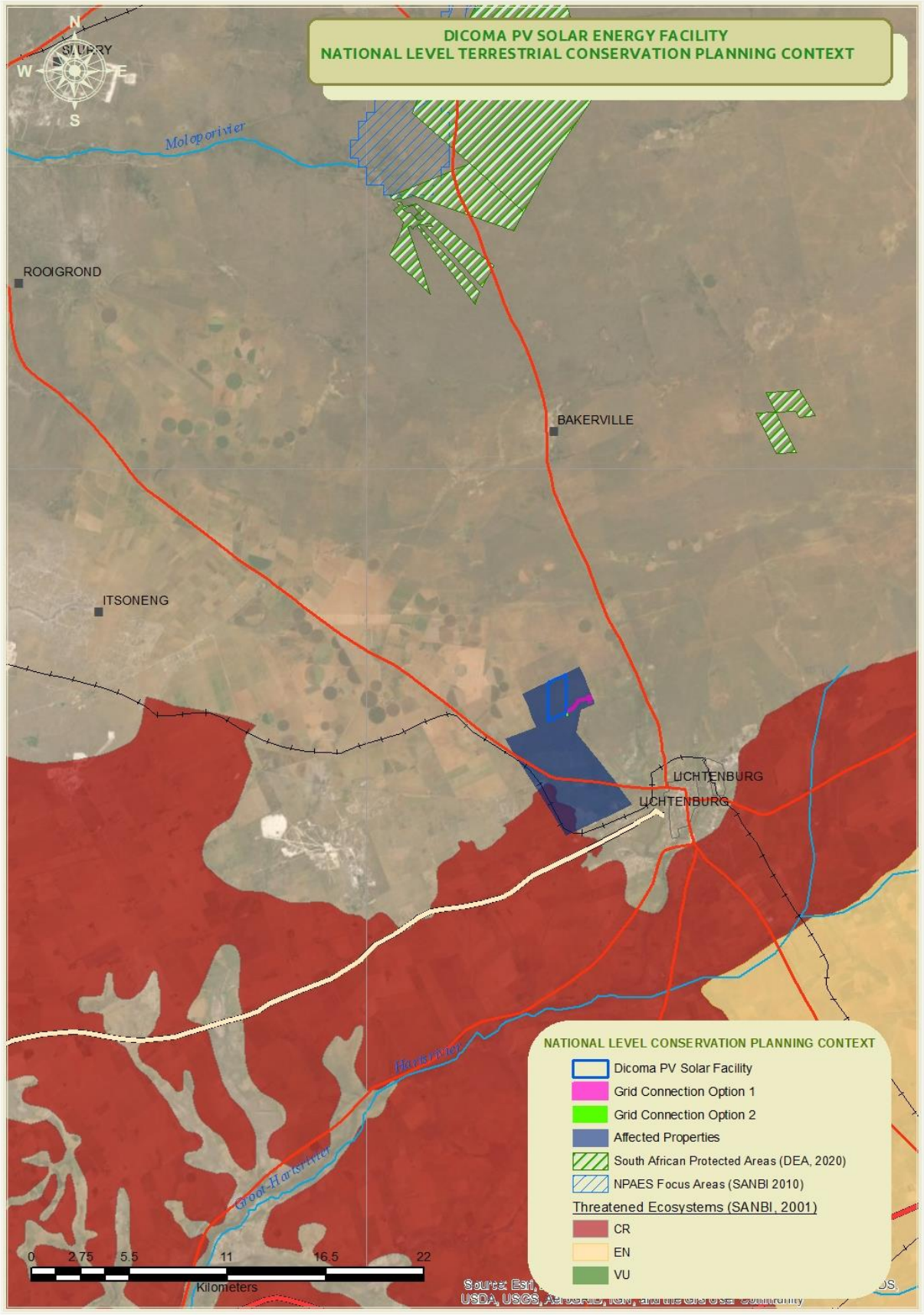

Figure 7: National Level Terrestrial Conservation Planning Context

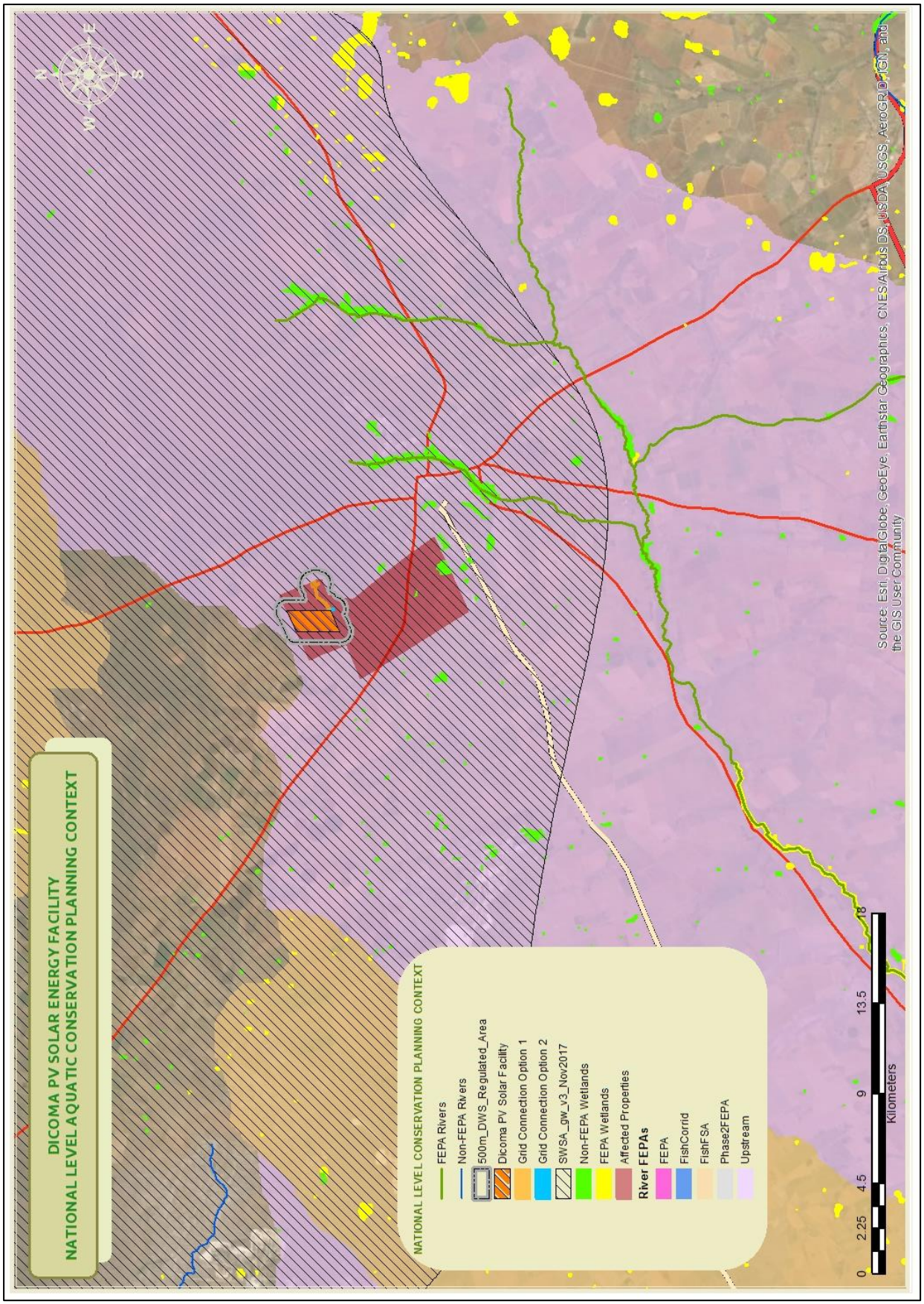

Figure 8: National Level Aquatic Conservation Planning Context.

Critical Biodiversity Areas and Broad Scale Ecological Processes

The SEF footprint falls within the planning domain of the North West Province Biodiversity Conservation Assessment which maps Terrestrial and Aquatic Critical Biodiversity Areas and Ecological Support Areas within the North West Province. 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 10).

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 8).

Table 8: 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 9).

Table 9: 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

Desktop description 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. 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. This potential impact will be assessed during the EIA phase and will be accompanied with the necessary mitigation measures.

Description of status and condition of Critical Biodiversity Areas within the study area following an initial Screening Site Survey/Inspection.

A site visit of the ESA areas falling within the proposed farm portions was conducted on the 10th to 12th of June 2021. The purpose of the site visit was to determine the status, condition and capabilities of these areas 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:

» This site visit was a relative high-level visit 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 was conducted during the inactive, dry season and as such most of the plants and animals were in a dormant or inactive state. However, due the above average late autumn rainfall the area still contained enough identifiable plant material above ground (including geophytes) and animal activity, in order for this sit visit to serve its purpose.

The following observations regarding the CBAs within the study area were made during the site visit

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 and an open parkland type of savanna to the 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.

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 8) 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 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 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.

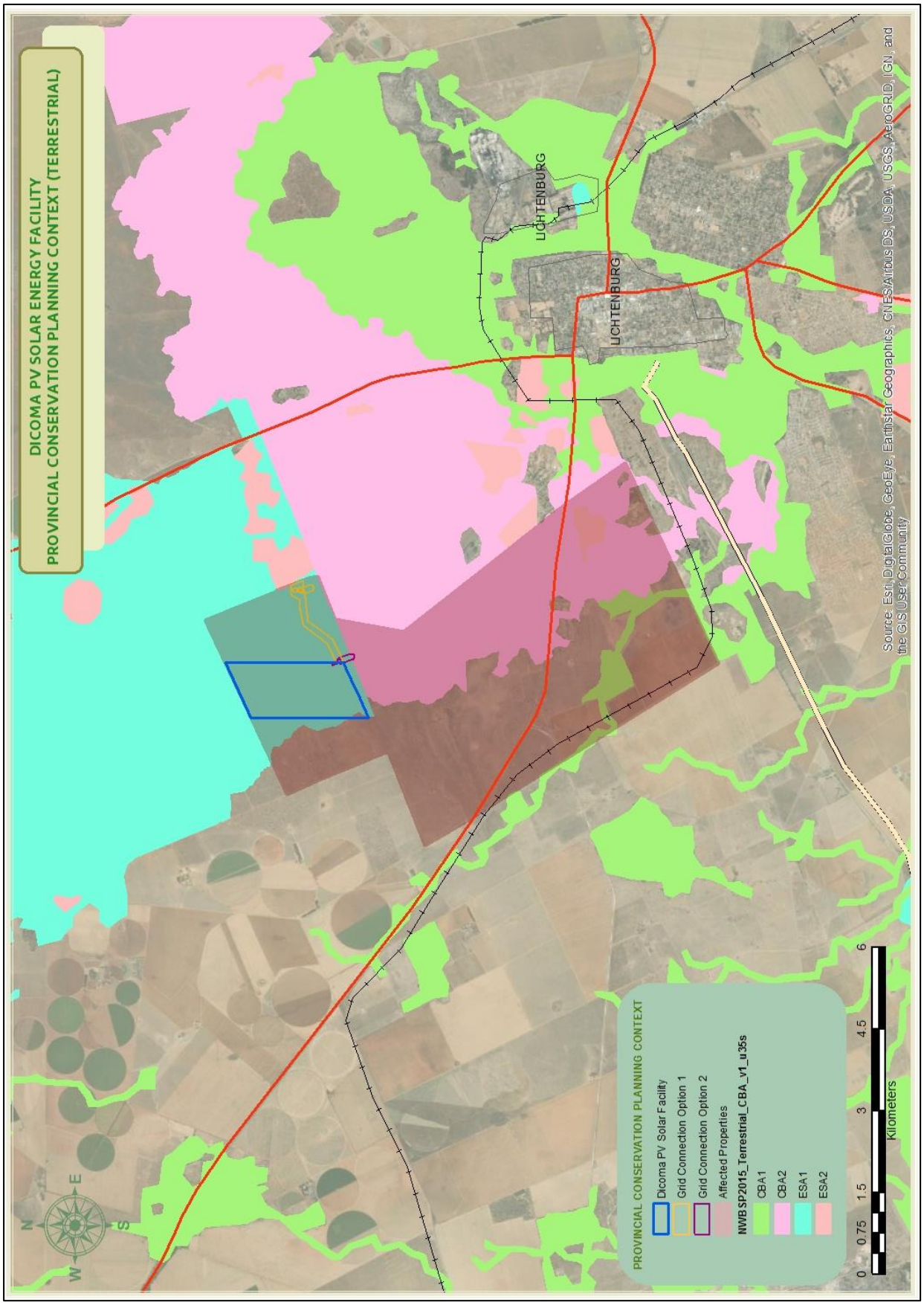

Figure 9: Provincial Level Conservation Planning Context – Terrestrial CBA Map (North West Province Biodiversity Conservation Assessment).

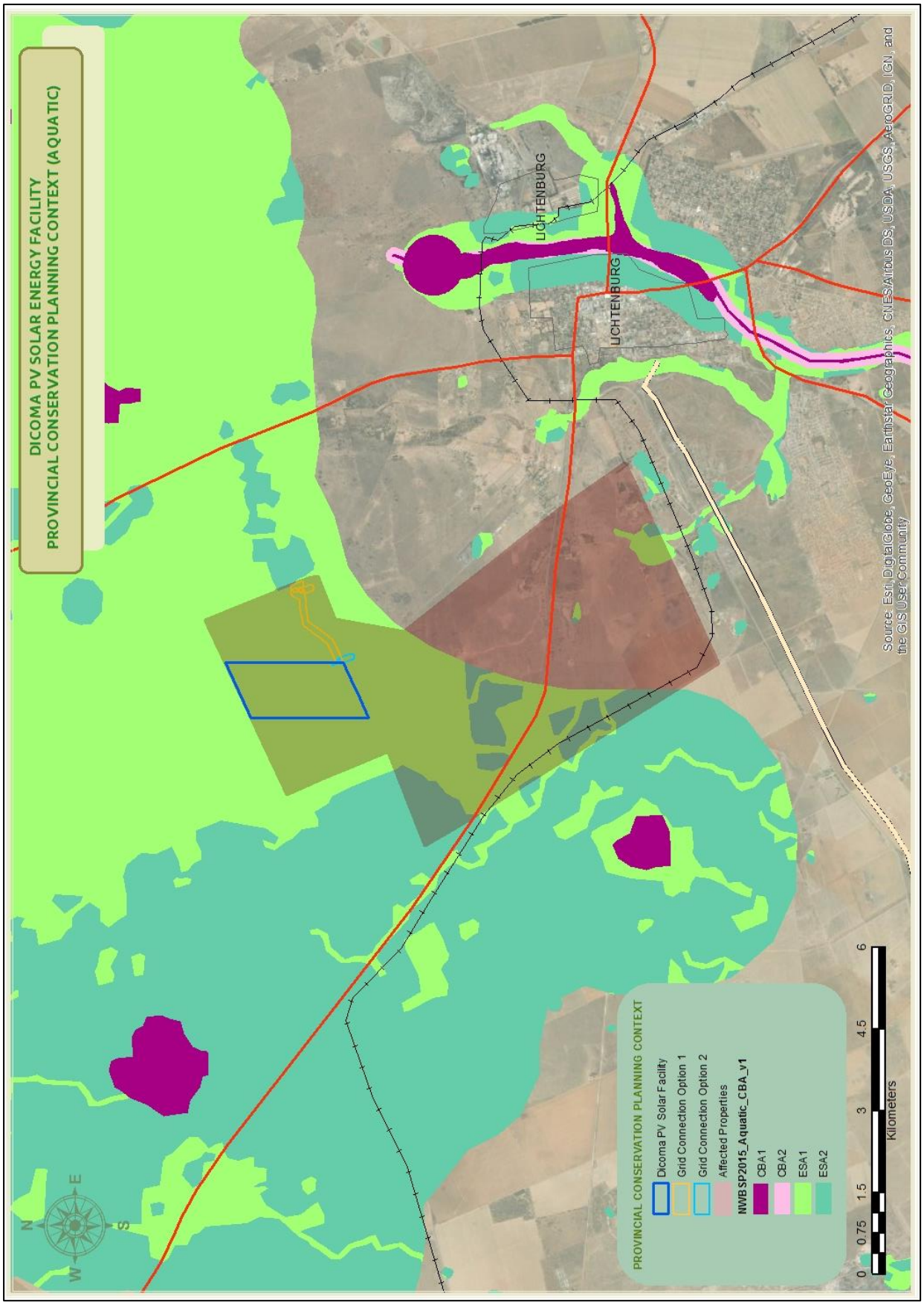

Figure 10: Provincial Level Conservation Planning Context – Aquatic CBA Map (North West Province Biodiversity Conservation Assessment).

Terrestrial Ecological Scoping Assessment

Vegetation Overview

Broad Vegetation Types

The overall project area is situated within the grassland biome. This biome is centrally located in southern Africa, and adjoins all except the desert, fynbos and succulent Karoo biomes (Mucina & Rutherford, 2006). Major macroclimatic traits that characterise the grassland biome include:

» Seasonal precipitation; and
» The minimum temperatures in winter (Mucina & Rutherford, 2006).

The grassland biome is found chiefly on the high central plateau of South Africa, and the inland areas of KwaZulu-Natal and the Eastern Cape. The topography is flat and rolling but includes the escarpment itself. Altitude varies from near sea level to 2 850 m above sea level.

Grasslands are dominated by a single layer of grasses. The amount of cover depends on rainfall and the degree of grazing. The grassland biome experiences summer rainfall and dry winters with frost (and fire), which are unfavourable for tree growth. Thus, trees are typically absent, except in a few localized habitats. Geophytes (bulbs) are often abundant. Frosts, fire and grazing maintain the grass dominance and prevent the establishment of trees.

The grassland biome comprises many different vegetation types. The entirety of the SEF footprint is located within the Carletonville Dolomite Grassland vegetation type (Gh15) according to Mucina & Rutherford (2006) (Figure 11).

A. Carletonville Dolomite Grassland

The distribution of the vegetation type is mostly found within the North-West Province extending into Gauteng and a small portion of the Free State Province. This vegetation type is mostly associated with the Potchefstroom, Ventersdorp and Carletonville regions, extending westwards to the vicinity of Ottoshoop, but also occurring as far east as Centurion and Bapsfontein in Gauteng Province. This vegetation type 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 amplectans, Themeda triandra, Eragrostis chloromelas, Setaria sphacelata*, and *Heteropogon contortus*. Prominent forbs and low shrubs include *Acalypha angustata, Dicoma 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.

Important Plant Taxa

Important plant taxa are those species that have a high abundance, a frequent occurrence or are prominent in the landscape within a particular vegetation type (Mucina & Rutherford, 2006). The following species are important in the Carletonville Dolomite Grassaland.

Graminoids: *Aristida congesta, Brachiaria serrata, Cynodon dactylon, Digitaria tricholaenoides, Hiheteropogon ampletens, Eragrostis chloromelas, E. racemosa, Heteropogon contortus, Loudetia simplex, Schizachyrium sanguineum, Setaria sphacelata, Themeda triandra, Alloteropsis semilata subsp. eckloniana, Andropogon schirensis, Aristida canescens, A. diffusa, Bewsia bifola, Bulbostylis burchellii, Cymbopogon caesius, Elinonurus muticus, Eragrostis curvula, E. gummiflua, E. plantana, Eustachys paspaloides, Hyparrhenia hirta, Melinis nerviglumis, M. repens subsp. repens, Monocymbium ceresiiforme, Panicum coloratum, Pogonarthria squarrosa, Trichoneura grandiglumis, Triraphis andropogonoides, Tristachya leucothrix, T. rehmannii* (Mucina & Rutherford, 2006).

Herbs: *Acalypha angustata, Chamaecrista mimosoides, Euphorbia inaequilatera, Crabbea angustifolia, Dianthus mooiensis, Dicoma anomala, Helichrysum caespititium, H. miconiifolium, H. nudifolium var. nudifolium, Ipomoea ommaneyi, Justicia anagalloides, Kohautia amatymbica, Kyphocarpa angustifolia, Ophrestia oblongifolia, Pollichia campestris, Senecio coronatus, Hillardia oligocephala*

Geophytic Herbs: *Boophane disticha (Declining – Red List), Habenaria mossii* (Mucina & Rutherford, 2006).

Succulent Herb: *Tripteris aghillana var. integrifolia* (Mucina & Rutherford, 2006).

Low Shrubs: *Anthospermum rigidum subsp. pumilum, Indigofera comosa, Pygmaethamnus zeyheri var. rogersii, Searsia magaliesmontana, Tylosema esculentum, Ziziphus zeyheriana* (Mucina & Rutherford, 2006).

Geoxylic Suffrutex: *Elephantorrhiza elephantina, Parinari capensis subsp. capensis* (Mucina & Rutherford, 2006).

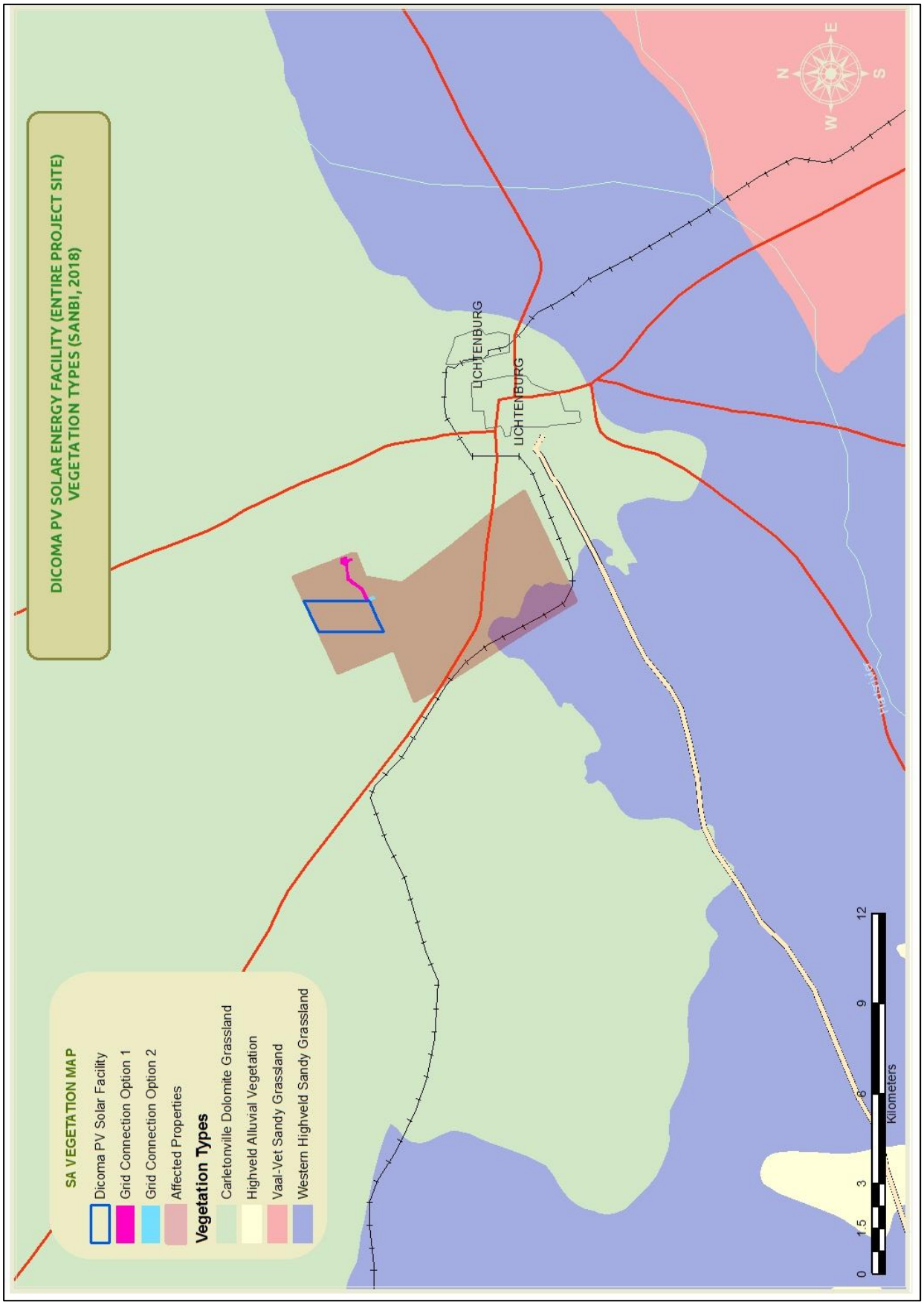

Figure 11: Vegetation Types (SANBI, 2018).

Plant Species of Conservation Concern (Plant SCC)

Based on the Plants of Southern Africa (BODATSA-POSA, 2021) database, 453 plant species are expected to occur in the area. Figure 6 shows the extent of the grid that was used to compile the expected species list based on the Plants of Southern Africa (BODATSA-POSA, 2021) database. The list of expected plant species is provided in Appendix 1. Of the 453 - plant species, three are listed Red Data species whilst 16 South African Endemic species have been recorded within the region (Table 10). Furthermore, according to the generated species list, 12 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 10).

During the screening site survey four provincially protected plant species were confirmed (*Hypoxis hemerocallidea, Boophone disticha, Schizocarphus nervosus* and *Delosperma floribundum*) whist a few Vachelia erioloba (national protected tree) were also confirmed. No plant SCC were confirmed during the site visit (Table 10).

The site was conducted during the inactive, dry season and as such most of the plants and animals were in a dormant or inactive state. However, due the above average late autumn rainfall most of the plant species contained identifiable material. However, some of the smaller geophytes and inconspicuous forbs that may occur within the area are difficult to identify outside of their active growing and flowering periods and as such the second site visit (EIA phase site visit) will coincide within this period (between November and March).

Table 10: 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	Screening Site Visit	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

Species	STATUS	BODATSA-POSA, 2021	Strohbach, 2013	Screening Site Visit	Likelihood of Occurrence
Crinum macowanii	Protected	X	X		High
Brachystelma foetidum	Protected	X			High
Pelargonium dolomiticum	Protected	X			Moderate
Pelargonium sidoides	Protected	X			High
Habenaria epipactidea	Protected	X			Low
Acacia erioloba	Protected	X	X	X	Confirmed
Boophone disticha	Protected	X	X	X	Confirmed
Schizocarphus nervosus	Protected	X		X	Confirmed
Hypoxis hemerocallidea	Protected	X	X	X	Confirmed
Delosperma floribundum	Protected	X	X	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 screening site visit, 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 screening site visit, 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 small herbaceous species can be difficult

to identify outside of their flowering season and a second site visit (EIA phase site visit) should be conducted within the flowering period.

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 screening site visit, 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 and as such a second site visit (EIA phase site visit) should be conducted within the active growing season.

Faunal Overview

Mammals

The IUCN Red List Spatial Data lists 84 mammal species that could be expected to occur within the vicinity of the project site (Appendix 2). Of these species, 12 are medium to large conservation dependant species, such as *Diceros bicornis* (Hook-lipped Rhinoceros) and *Equus quagga* (Plains Zebra) that, in South Africa, are generally restricted to protected areas such as game reserves. These species are not expected to occur in the project site and are removed from the expected SCC list. Of the remaining 72 small- to medium sized mammal species, ten (10) are listed as being of conservation concern on a regional or global basis (Table 8).

According to Skinner & Chimimba (2005) and Apps (2012) the potential diversity of mammals within the region is slightly higher high with as many as 98 terrestrial mammals potentially occurring within the area. Of the 98 mammals that have a distribution that includes the study area, 77 are known to occur in QDSs 2625BB, 2626AA, 2525DD and 2526CC (MammalMap, 2021). Of the species that have a distribution that includes the study area, 11 species are regarded as mammal SCC (refer to Table 11).

The list of potential species includes:

- Five (5) that are listed as Vulnerable (VU) on a regional basis; and
- Nine (6) that are listed as Near Threatened (NT) on a regional scale.

There are several factors which will reduce the actual number of species present with the study area. This includes the largely homogenous nature of the project site, the fractured landscape, surrounding agricultural practices (especially cultivation), the presence of large roads and other anthropogenic activities. Due to these factors it is expected that the diversity within the study area itself will be moderate to low.

A number of antelope species have been recorded by the ADU (Animal Demographic Unit) within the QDSs. Most of these antelope species are confined by fences and occur only where farmers have introduced them or allow them to persist and should be considered as part of the farming system rather than as wildlife per se. Some of these South African indigenous antelope species do not have a natural distribution within the specific region but as mentioned have been introduced by farmers. Such antelope species include; Blue Wildebeest (*Connochaetes taurinus*), Grey Rhebok (*Pelea capreolus*), Mountain Reedbuck (*Redunca fulvorufula*) Red Hartebeest (*Alcelaphus buselaphus*), Impala (*Aepyceros melampus* subsp. *melampus*) and African Savanna Buffalo (*Syncerus caffer*). As in the case of the IUCN generated species list, these medium to large conservation dependant species have been omitted. Both Duiker (*Sylvicapra grimm*ia) and Steenbok (*Raphicerus campestris)* are adaptable species that are able to tolerate high levels of human activity and are not likely to be highly sensitive to the disturbance associated with the development.

During the screening site survey, no mammal SCC were confirmed within the project site.

Table 11: 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	
Anonyx capensis	Cape Clawless Otter	NT	NT	Low
Atelerix frontalis	South African Hedgehog	NT	LC	High
Felis nigripes	Black-footed Cat	VU	VU	Low
Hydrictis maculicollis	Spotted-necked Otter	VU	NT	Low
Leptailurus serval	Serval	NT	LC	Moderate
Mystromys albicaudatus	White-tailed Rat	VU	EN	Moderate
Crocidura mariquensis	Swamp Musk Shrew	NT	DD	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 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 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 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 high.

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.

Reptiles

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 a*l. (2014) a total of 71 terrestrial reptilian species may be found within the region. According to both resources, none of these species are listed red data species or significantly range restricted (reptile SCC). However, one species is nationally protected (TOPS) namely; the Southern African Python (*Python natalensis).*

Of the 71 reptilian species that have a distribution that includes the study area, 28 are known to occur in QDSs 2625BB, 2626AA, 2525DD and 2526CC (ReptileMap, 2021), and

includes the Southern African Python (TOPS). Furthermore, of these species recorded within the relevant QDSs, 13 species are endemic/ near endemic to South Africa.

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.

Indeed, during the screening site survey, only three reptile species were recorded, with none of these species regarded as SCC. This very low diversity can however be attributed to the time of the inspection, as most reptiles are inactive during the colder, drier months. Even though, it is expected that slightly more reptilian species will be recorded during the warmer, wetter months (summer to early autumn), it is still expected that diversity will be quite low.

Amphibians

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. According to both resources, one amphibian species of conservation concern could be present within the region where suitable habitat is present namely *Pyxicephalus adspersus* (Giant Bullfrog).

> The Giant Bull Frog (*Pyxicephalus adspersus*) is a species of conservation concern that may possibly occur in the region. The Giant Bull Frog is listed as near threatened on a regional scale. It is a species of drier savannahs. It is fossorial for most of the year, remaining buried in cocoons. They emerge at the start of the rains, and breed in shallow, temporary waters in pools, pans and ditches (IUCN, 2017). Due to the absence of wetland and aquatic habitats, it is highly unlikely that this species will inhabit the project site.

Of the 21 amphibian species that have a distribution that includes the study area, only 12 are known to occur in QDSs 2625BB, 2626AA, 2525DD and 2526CC (FrogMap, 2018). No amphibian SCC were recorded within the relevant QDSs.

Due to the relatively homogenous nature of the project site, the absence of freshwater resource features, it is expected that the diversity within the study area itself will be very low.

No amphibian species were recorded during the screening site-visit.

Freshwater Resource Scoping Assessment

Desktop Freshwater Resource Description and Delineation

The study area is situated within the Lower Vaal Water Management Area (WMA) 10, Quaternary Catchment C31A (Harts River Catchment) and Ecoregion 11.01 (Highveld Ecoregion). The Lower Vaal WMA is located downstream of Bloemhof Dam and upstream of Douglas Weir. It extends to the headwaters of the Harts, Molopo and Kuruman River in the north and the Vaal River Downstream of Bloemhof Dam in the south. It covers a catchment area of 51 543km^2. It lies in the North West and Northern Cape Provinces, with the south-eastern corner in the Free State, and borders on Botswana to the north, as well as on the Crocodile (West) and Marico, Middle Vaal, Upper Orange and Lower Orange water management areas. Major rivers in this WMA include the Molopo, Harts, Dry Harts, Kuruman and Vaal River. As a result of the low rainfall, flat topography and sandy soils occur over much of the WMA, and little usable surface runoff is generated in the WMA.

The study area is situated within the C31A Quaternary Catchment which forms part of the headwater region of the Harts River and Klein Harts River (tributary of the Harts River). The study area is situated approximately 7.4 km north-west of the Klein Harts River and other tributaries of the Harts River, which forms the most important surface hydrological feature of the region. The Harts River flows mostly in a south-westerly direction, mostly through gradual to flat areas, for approximately 320 km, before terminating into the Vaal River (approximately 100 km above the confluence of the Vaal- and Orange Rivers). Major tributaries of the Harts River include the Klein Harts-, Groot Harts- and Droë Harts River. The only lake and wetland of note is at Baberspan in the upper Harts River catchment which has been given Ramsar status as a wildlife conservation area.

Major impacts include agricultural return flows, flow regulation for irrigation use, and water quality related problems due to urbanization, and agriculture (DWA, 2012). Water use within the Harts River Catchment is dominated by irrigation, which represents 84% of the local requirements for water. About 4% of the requirements is for urban and industrial use, 3.5% for rural domestic supplies and stock watering, with only 8.3% being transferred out of the catchment. The quality of surface water in the Harts and Vaal Rivers is highly impacted upon by irrigation return flows as well as by water use in the Upper and Middle Vaal water management areas, which limits the usability of water in the lower reaches of these rivers. Water in the Harts River downstream of the Vaalharts irrigation scheme is of exceptional high salinity as a result of saline leachate from the irrigation fields (± 1100 mg/l salinity).

Generally surface water within the Lichtenburg area is scarce with very few of the watercourses or pans having perennial water.

A summary of the Present Ecological State (PES), Ecological Importance (EI), Ecological Sensitivity (ES) and current impacts on the affected Sub-Quaternary Reach (SQR) as well as immediate surrounding SQRs is presented in Table 12 (DWS, 2014). The Desktop PES of the relevant SQR (C31A-01176: un-named tributary of the Harts River) is seriously modified (E Category) and a loss of natural habitat, biota and basic ecosystem functions have extensively occurred (loss of between 69 – 80%). According to the DWS (2014), the water quality (WQ), potential flow characteristics as well as instream and riparian habitats are seriously impacted on by agriculture, instream dams, urban, effluent and Waste Water Treatment Works (WWTW). The EI of C31A-01176 is Low due to the presence of only 16 species (riparian, wetland and aquatic species) in this sub-quaternary catchment with no conservation important species. The main habitats for these species include an incised channel with surface flows, grassy edges and seepage wetlands (enhanced by effluent and storm water). The size of stream, morphology and geomorphic habitat units determine the ES. The watercourse of C31A-01176 has a Low ES Mean Class Rating and a High sensitivity to modified flow conditions and water level changes (DWS, 2014). The degree of flow change will elicit a particular level of response and the smaller streams are usually more sensitive i.e. rapid loss of useable habitats as flows decrease.

Table 12: Summary of the affected Sub-Quaternary Reach (SQR) Ecostatus and impacts as well as the Ecostatus and impacts for the surrounding SQRs.

Sub-Quaternary Reach	SQR Name[1]	PES[2]	EI[3]	ES[4]	Sensitivity to Modified Flow/Water Level Changes	Current Impacts
C31A-01176	Un-Named	E Serious Modification	Low	Low	High	Agriculture, instream dams, urban, effluent
C31A-01176	Klein-Harts	C Moderately Modified	Moderate	Moderate	High	Agriculture, abstraction for irrigation, roads, weirs
C31A-01326	Harts	C Moderately Modified	Moderate	Moderate	High	Agriculture, abstraction for irrigation, instream dams, return flows
C31A-01275	Harts	C Moderately Modified	High	High	High	Agriculture, roads, urban, return flows

[1] SQR: Sub-Quaternary Reach
[2] PES: Present Ecological Status
[3] EI: Ecological Importance
[4] ES: Ecological Sensitivity

According to Partridge *et al*. (2010) the project site is situated within the Highveld Geomorphic Province (Sub-Province North-Western Highveld). The Highveld Geomorphic Province is an extensive grassland region occupying the eastern interior plateau and is mostly drained by the tributaries of the Vaal River. South of the Vaal River the province is underlain by near-horizontal Karoo strata (intruded by dolerite dykes and sills). Much of the province is, gently undulating and is dominated by the late Cretaceous African erosion surface, which remains intact on many of the broad interfluves (Partridge & Maud, 1987). The dominant drainage direction is westerly, partly because of the influence of the pre-Karoo topography, and partly because of warping along the Griqualand–Transvaal axis, whose activity was largely contemporaneous with uplift of the Ciskei–Swaziland axis (Partridge & Maud, 1987). The shallow, open valleys reflect minor incision in the early Miocene Post-African I cycle. Many of the Highveld rivers have incised their channel beds to just below the bedrock surface and are strongly influenced by the relationship between the softer Karoo shales and sandstones and the position and breaching of dolerite sills and dykes (Tooth *et al.,* 2004). Meandering patterns are typical within the sandstones and shales (above local hydraulic barriers usually dolerite dykes and sills), while straight channels occur where the rivers breach the dolerite (Tooth *et al.,* 2002, 2004).

Characteristics of this province are numerous palaeodrainage features in the form of gravel bars (many now forming low ridges that host alluvial diamonds) and dry valleys occupied by lines of pans. These are frequent, especially in the northwest where they represent right-bank tributaries of the palaeo-Vaal River (Marshall, 1988; 1990). In some areas, there are so many pans that they have redirected the original drainage into contiguous, small endoreic basins.

The sub-Province North-western Highveld is drained by north-bank Vaal River tributaries. The rivers (Waterval, Blesbokspruit, Mooi, Skoonspruit, Bamboespruit, Harts, Dry Harts, Molopo and Vaal River main stem) flow in valleys with broad and wide cross-sectional profiles and flat to medium slopes so that the sediment storage surrogate descriptors are predominantly BF[5] and WM[6]. There is a clear east to west trend, with an increase in valley cross-sectional profile widths and a relating increase in slope in that direction. With the exception of the Waterval and Molopo rivers (which have logarithmic BFCs[7]) and the Mooi and Dry Harts rivers (which are characterised by exponential BFCs), the rivers have moderately concave longitudinal profiles and linear BFCs.

Wetlands within the region are, as previously mentioned, mostly depression (pan) wetlands within the relatively flat plains where a slight change in geomorphology and underlying geology may result in the collection of water and saturated soil conditions. Most of the pans are endorheic. The more undulating and steeper slopes to the north and south contain

[5] Sediment storage descriptors: BF (Broad Valley and Flat Slope) = High to medium sediment storage class
[6] Sediment storage descriptors: WM (Wide Valley and Medium Slope) = High to medium sediment storage class
[7] Macro-reach Best Fit Curve: BFCs = Broad Valley and Flat Slope with a Concave profile.

a higher diversity of wetland types due to the greater variation in geomorphology resulting in different drainage systems. Seepages are a common feature along the steeper slopes where the underlying bedrock is typically near the surface. Most of these seepages are typically groundwater fed. Benchlands or discrete areas of mostly level or nearly level high ground, interrupting the surrounding steeper slopes, typically contain wetland flats which are usually groundwater fed. Channelled valley-bottom wetlands are typically associated with the higher reaches and tributaries of the watercourses whilst some floodplain wetlands are associated with the lower and more gradual reaches of the Harts River and associated tributaries.

As mentioned, in terms of the NFEPA (2011) and the NBAs 2018 National Wetlands Map 5 no wetlands or watercourse features are located within the project site as well as within the 500m regulated area.

Following a desktop mapping exercise and a screening site-visit it was confirmed that no freshwater resource features are located within the project site or within close proximity to the site.

No surface 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.

Scoping Phase Sensitivity Analysis

The following sensitivity map (Figure 12) has been compiled following an analysis of all available Geo-spatial information and a screening survey of the development site. This is only a preliminary map and information obtained during the site visit in the EIA Phase will be used to fine-tune the map.

Medium Sensitivity

» Natural to Near-natural Open Savanna Grassland: All natural, intact grassland areas that is classified as ESA1. The vegetation of these grasslands provides soil stability, are valuable grazing, increase infiltration of precipitation and contribute to the maintenance of pollinator populations within the area. These grasslands may potentially be suitable for the presence of SCC (fauna and flora).

Medium-Low Sensitivity

» Re-established grassland on historical cultivated areas: These are historically transformed areas located within the ESA1 and which are now covered by a stable plagio-climax grassland (mostly indigenous gras and forb species). Re-establishment of mostly indigenous vegetation have been allowed to such an extent that the vegetation can now provide most of the functions and services associated with a natural grassland. These areas are also potential suitable habitat for some SCC (Flora and Fauna).

Low Sensitivity

» All transformed and disturbed area: This includes access roads and disturbed road shoulders, farm roads, fire breaks, trampled and overgrazed grasslands, recently cultivated areas, homesteads, woodlots etc.

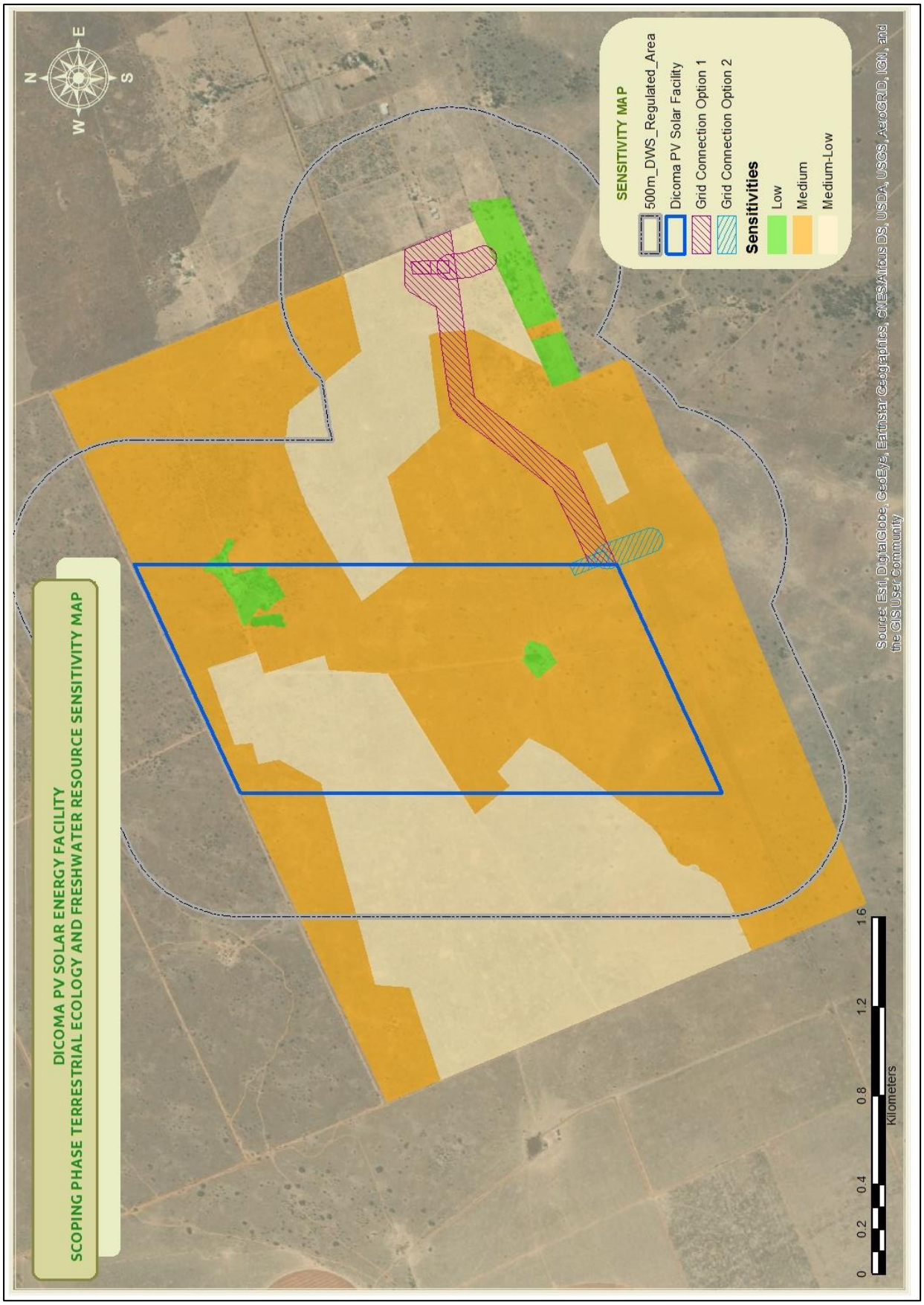

Figure 12: Scoping Phase Terrestrial Ecology and Freshwater Resource Sensitivity Map.

6. SCOPING PHASE IMPACT ASSESSMENT

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 capacity of extreme weather events by vegetation expected.	More variable and less intense overall shading. More stable and denser vegetation cover expected, smaller reduction of 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.

Ecological Impact Assessment

Expected impacts of the proposed development will mostly be focused on the vegetation and supporting substrate. Possible impacts could also be expected on bird species or small mammals and invertebrates. Potential expected impacts on the biodiversity are listed below, but it must be stressed that this evaluation is preliminary and based on desktop information and will only be finalised after a field study of the area in the EIA phase.

Terrestrial Ecological Impacts Assessment

Overview of the most significant impacts of the proposed development

» *Impacts on vegetation and protected plant species*

At Vegetation Level:

As mentioned above the most likely and significant impact will be on the vegetation. The proposed development may lead to direct loss of vegetation. Consequences of the impact occurring may include:

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

At species level:

Even though only one species of conservation concern (SCC) have been previously recorded within the region, there is a potential for SCC to occur within the development footprint due to suitable habitat. Such species are especially vulnerable to infrastructure development due to the fact that they cannot move out of the path of the construction activities but are also affected by overall loss of habitat. SCC (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 plant 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 individuals 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 affected species.

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

The impacts can be largely mitigated through avoidance of potential sensitive areas and listed species by allowing a minimum clearance of vegetation (restricted to the absolute necessary areas) etc.

» *Direct Faunal impacts*

Faunal species will primarily be affected by the overall loss of habitat. Increased levels of noise, pollution, disturbance 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 killed. 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 would also potentially occur with resident fauna within the facility after construction.

SCC (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, 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 area of occupancy of affected species; and
- loss of genetic variation within affected species

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

Disturbance of faunal species can be maintained to a minimum and low significance by implanting effective mitigation measures.

» *Soil erosion and associated degradation of ecosystems*

Soil erosion is a frequent risk associated with the development of PV facilities on account of the vegetation clearing and disturbance associated with the construction phase of the development and may continue occurring throughout the operational phase. Service roads and panels will generate an increase in runoff during intense rainfall events and may exaggerate the effects of erosion. These eroded materials may enter the nearby streams and rivers and may potentially impact these systems through siltation and change in chemistry and turbidity of the water.

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

» *Alien Plant Invasions*

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

- further loss and displacement of indigenous vegetation;
- change in vegetation structure leading to a change in various habitat characteristics;
- change in plant species composition;
- change in soil chemistry properties;
- loss of sensitive habitats;
- 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;
- hydrological impacts due to increased transpiration and runoff; and
- impairment of wetland function.

Although the potential severity of this impact may be high, it can be easily mitigated through regular alien control.

» *Impacts on Ecological Support Areas and Broad-Scale Ecological Processes* In terms of Terrestrial CBAs a small portion of the Solar PV footprint (along the eastern boundary) is located within an T_ESA1, whilst most of the grid infrastructure options are located within the T_ESA1. 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. In terms of Aquatic CBAs the entire development footprint (PV Solar and grid connection) is located within an A_ ESA1. This ESA1 is associated with the Bo-Molopo Karst Belt and is regarded as an important recharge area.			
Issue	**Nature of Impact during the <u>Construction Phase</u>**	**Extent of Impact**	**No-Go Areas**
Disturbance to and loss of indigenous natural vegetation.	Construction of infrastructure will lead to direct loss of vegetation, causing a localised or more extensive reduction in the overall extent of vegetation. Consequences of the clearing and loss of indigenous semi – to near-natural vegetation occurring may include: » Increased vulnerability of remaining vegetation to future disturbance, including extreme climatic events; » General loss of habitat for sensitive fauna and flora species; » Loss in variation within sensitive habitats due to loss of portions of it; » General reduction in biodiversity; » Increased fragmentation (depending on the location of the impact) and associated reduced viability of species populations; » Alteration of the habitat suitable for plant populations by altering surface structure. This will change species composition and associated species interactions;	Local	No "no-go' areas so far identified.

	» Disturbance to processes maintaining biodiversity and ecosystem goods and services; and » Loss of ecosystem goods and services.		
Disturbance or loss of threatened/protected plants.	SCC could potentially occur in the study area. Flora is affected by an overall loss or alteration of habitat and due to its limited ability to extend or change its distribution range. In the case of SCC, a loss of a population or individuals could lead to a direct change in the conservation status of the species, possibly extinction. This may arise if the proposed infrastructure is located where it will impact on such individuals or populations. Consequences of this may include: » Fragmentation and decline of populations of affected species; » Reduction in the area of occupancy of affected species; » Loss of genetic variation within affected species; » Alteration of the habitat suitable for plant associations by altering of the surface structure. This will change species composition and associated species interactions and species ability to persist; and » Future extinction debt of particular species of flora and fauna. These may all lead to a negative change in conservation status of the affected species, which implies a reduction in the chance of survival of the species.	Local	No "no-go' areas so far identified. SCC species have a distribution that include the study area and may potentially occur within the study area; the issue requires further investigation in the EIA phase. During the EIA Phase areas containing SCC may be identified and these areas will subsequently be upgraded to a higher sensitivity and will be accompanied with additional mitigation measures to avoid any potential detrimental impacts.

Loss of habitat for fauna species of conservation concern.	Fauna species of conservation concern are indirectly affected primarily by a loss of or alteration of habitat and associated resources. Animals are mobile and, in most cases, can move away from a potential threat, unless they are bound to a specific habitat that is also spatially limited and will be negatively impacted by a development. Nevertheless, the proposed development will reduce the extent of habitat available to fauna. For any 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 suitable habitat, population, or individuals could lead to a direct change in the conservation status of the species. This may arise if the proposed infrastructure is located where it will impact on such individuals or populations or the habitat that they depend on. Consequences may include: » Loss of populations of affected species; » Reduction in area of occupancy of affected species; » Loss of genetic variation within affected species; and » Future extinction debt of a particular species. There are a number of red data species that have been recorded for the wider area within which the study area is located. Their presence and the necessity to keep	Local	No "no-go" areas so far identified. During the EIA Phase natural and undisturbed grassland features containing conservation important faunal populations may be identified which will subsequently be upgraded to a higher sensitivity and will be accompanied with additional mitigation measures to avoid any potential detrimental impacts.

	their habitats intact in the study area needs to be confirmed during a field survey in the EIA phase.		
Disturbance to migration routes and associated impacts to species populations.	Site preparation and construction activities may interfere with the current migration routes of fauna species. This may lead to: » Reduced ability of species to move between breeding and foraging grounds, reducing breeding success rates; » Reduced genetic variation due to reduced interaction amongst individuals or populations as a result of fragmentation effects caused by the proposed developments	Site and surroundings	No "no-go: areas have been identified up to date.
Impact on Critical Biodiversity Areas.	Development within the ESA1 may negatively impact biodiversity and the ecological functioning of the ESA.	Local and Regional	No "no-go: areas have been identified up to date.
Establishment and spread of declared weeds and alien invader plants.	Major factors contributing to invasion by alien invader plants include excessive disturbance to vegetation, creating a window of opportunity for the establishment of alien invasive species. In addition, regenerative material of alien invasive species may be introduced to the site by machinery traversing through areas with such plants or materials that may contain regenerative materials of such species. Consequences of the establishment and spread of invasive plants include: » Loss of indigenous vegetation; » Change in vegetation structure leading to change in or loss of various habitat characteristics; » Change in plant species composition; » Altered and reduced food resources for fauna;	Local and Regional	No "no-go" areas have been identified to date but the potential for alien invasive species present in or around the study area is regarded as moderate. A number of alien invasive species have been recorded in the wider area according to the SANBI database. The extent to which the site contains alien plants will be determined in the EIA phase through detailed investigation and field-survey.

	» Change in soil chemical properties; » 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; » Hydrological impacts due to increased transpiration and runoff; » Increased production and associated dispersal potential of alien invasive plants, especially to lower-lying wetland areas, and » Impairment of wetland function.		

Gaps in knowledge & recommendations for further study

» The initial desk-top investigation of the study area indicates that a few protected and red-data species as well as sensitive habitats potentially occur on the site. However, once the final layout has been designed in accordance to findings of a field investigation, the likelihood that the development will compromise the survival of any species of conservation concern is expected to be limited.

» **Plant species of conservation concern will only be identifiable during the growing season; thus any field survey of vegetation should only commence from November and be completed by April.**

» Although previous collection records from the area exist, the study area itself may not have been previously surveyed and there may be additional species that have not yet been captured in the existing species databases for the area. A detailed ecological survey and sensitivity assessment will be undertaken during the EIA phase.

Issue	**Nature of Impact during the <u>Operational Phase</u>**	**Extent of Impact**	**No-Go Areas**
Disturbance or loss of indigenous natural vegetation.	PV panels create large areas of altered surface characteristics, rainfall interception patterns, and intense shade that will not be tolerated by most of the species present on site, as these have evolved with a high daily irradiance. Consequently, it can be expected that within the Solar Energy Facility development footprint, the species composition	Local	No "no-go' areas so far identified.

	and topsoil characteristics will change significantly. No equivalent experiments have been undertaken in similar environments up to date, thus the nature and density of vegetation that may persist cannot be predicted at this stage. A sparser or less stable vegetation beneath the PV panels, together with the altered surface and runoff characteristics may lead to: » Increased vulnerability of the remaining vegetation to future disturbance, including erosion; » General loss or significant alteration of habitats for sensitive species; » Loss in variation within sensitive habitats due to a loss of portions of it; » General reduction in biodiversity; » Increased fragmentation (depending on location of impact); » Future extinction debt of a particular species; » Disturbance to processes maintaining biodiversity and ecosystem goods and services; and » Loss of ecosystem goods and services.		
Altered runoff patterns due to rainfall interception by PV panels and compacted areas.	The PV panels create large surfaces of rainfall interception, where rainfall is collected and concentrated at the edges from where it then moves onto the ground in larger, concentrated quantities as opposed to small drops being directly intercepted and raindrop impact dispersed by vegetation, then absorbed by the ground. This	Site and surroundings	No "no-go" areas regarding high risk erodible soils have been identified to date. This must be verified during a detailed investigation and field-survey as part of the EIA phase

	may lead to a localised increase in runoff during rainfall events, which may result in localised accelerated erosion. Likewise, access roads and areas where soils have been compacted during construction will have a low rainfall infiltration rate, hence creating more localised runoff from those surfaces. Runoff will thus have to be monitored and channelled where necessary to prevent erosion over larger areas.		
Establishment and spread of declared weeds and alien invader plants.	The envisaged altered vegetation cover after construction and during the operation phase of the proposed development will create a window of opportunity for the establishment of alien invasive species. In addition, regenerative material of alien invasive species may be introduced to the site by machinery or persons traversing through areas with such plants or materials that may contain regenerative materials of such species. Consequences of the establishment and spread of invasive plants include: » Loss of indigenous vegetation or change in vegetation structure leading to an even more significant change in or loss of various habitat characteristics; » Loss of plant resources available to fauna; » Change in soil chemical properties; » Loss or fragmentation of sensitive or restricted habitats;	Local to regional	No "no-go" areas have been identified to date but the potential for alien invasive species present in or around the study area is regarded as moderate. A number of alien invasive species have been recorded in the wider area according to the SANBI database. The extent to which the site contains alien plants will be determined in the EIA phase through detailed investigation and field-survey.

	» Loss or disturbance to individuals of rare, endangered, endemic and/or protected species; » Change in flammability of vegetation, depending on alien species; » Hydrological impacts due to increased transpiration and runoff; » Increased production and associated dispersal potential of alien invasive plants		

Gaps in knowledge & recommendations for further study

» The largest opportunity for mitigating any negative impacts exists during the design phase, if layouts adhere to the findings and recommendations of detailed field studies and investigations carried out during the EIA phase.
» Limited knowledge does, however exist on the potential and ease with which vegetation can be re-established after construction given the variable rainfall regime of the region; which species would be able to persist in the altered environment on and around the proposed development; and what effect this altered species composition and –density will have on ecosystem intactness and –functionality.
» Regular monitoring of a minimum set of environmental parameters throughout the operational phase, coupled with an adaptive environmental management program, will thus be essential to prevent any environmental degradation and any cumulative effects of the development beyond its periphery.

The significance of the proposed development in terms of Duration, Magnitude, Probability as well as cumulative impacts

» Most of the above-mentioned impacts are probable, although the extent, duration, and magnitude of these impacts can be minimalised to levels where these impacts can be regarded as low significance by having the necessary mitigation measures implemented. By exclusion of certain sensitive areas from the development footprint area, the probability of some of these above-mentioned impacts occurring within these habitats can be avoided.
» The duration of the project is expected to be long term (~20-25 years) and subsequently most of the impacts are also expected to be long term. However, some impacts are expected to be of short term and confined to the construction phase. For example, the disturbance of some animal species will be confined to the construction phase and as human movement decreases during the operation phase some species may return to the site. Furthermore, impacts such as erosion and invasion of alien invasive species, with effective mitigation measures including regular monitoring in place, can be retained to a medium to short duration although monitoring and implementation of mitigation measures will have to be implemented throughout the lifespan of the proposed development.

- Although most impacts associated with the proposed development are expected to be local, affecting mainly the immediate environment, the potential does exist for some impacts to be exacerbated and even spread outside the development footprint area if left unattended, eventually posing a potential threat to important environmental processes and functionality. Impacts that may potentially pose a threat to the magnitude and duration, if left unattended or not mitigated accordingly, include invasion by invasive alien species, soil erosion, significant disturbance and alteration of important wetland habitats and watercourses.
- The most significant cumulative impact that the proposed development will have is the potential impact on Broad-Scale Ecological possesses and the impact on Ecological Support Areas.

7. PLAN OF STUDY FOR EIA

The plan of study for the detailed EIA-phase of the project was informed by this scoping report and the preliminary ecological constraints and development implications highlighted under Section 6 of this ecological scoping report.

Based on the results obtained from this scoping assessment (including a screening site visit), it was confirmed that no surface freshwater resource features are located within the 500m DWS regulated area and as such any further investigation/assessments will not be necessary (during the EIA phase).

Subsequently the focus of the EIA Phase Ecological and Biodiversity Assessment will be on all terrestrial features. This Terrestrial Biodiversity (Fauna and Flora and Terrestrial Habitat) Assessment will be conducted in accordance with the protocols and procedures (3(a-d)) as set out in Section 24(5)(a) and (h) of the National Environmental Act, 1998, which has been gazetted on 10 January 2020.

Furthermore, the Terrestrial Biodiversity (Fauna and Flora) Impact Assessment will be undertaken in accordance with the Species Environmental Assessment Best Practice Guidelines.

Plan of Study for Detailed Terrestrial Ecological Assessment

- Detailed baseline field survey to assess baseline terrestrial vegetation status, species composition, condition and importance, with a focus on mapping and assessing untransformed grassland vegetation and habitat. A key distinction will be made between primary and secondary vegetation communities, and the representatives of any remaining intact grassland vegetation communities by comparison with known reference state/composition.
- Baseline vegetation surveys to include an assessment of faunal SCC which will need to be documented and GPS coordinates taken for species encountered in the field.
- The focus of faunal surveys should be on assessing habitat condition and requirements for key mammal and herpetofaunal species and documenting the presence and location of any SCC in the field.
- Identification and assessment of the estimated significance of key ecological impacts to vegetation, plant species and fauna.
- Confirm any fatal flaws from a terrestrial ecological perspective to inform planning and layout of development proposed.
- Assess the need and desirability for terrestrial biodiversity offsets (where necessary) and provide preliminary recommendations.
-

Recommendations in terms of impact mitigation and management aimed at reducing impacts significant in line with the principles of the 'mitigation hierarchy', including possible biodiversity buffer zones, development realignments, onsite controls (Best Management Practices: BMPs) and initial post-development rehabilitation requirements (i.e. conceptual terrestrial habitat rehabilitation strategy).

8. CONCLUSION AND RECOMMENDATIONS

The study area falls within the Carletonville Dolomite Grassland which is not listed as threatened.

Nkurenkuru Ecology and Biodiversity undertook an initial Ecological Scoping Phase Assessment, to inform the requirements for the EIA, which entailed undertaking an initial desktop investigation and a screening site visit (10-12 June 2021) in order to compile a scoping report (i.e. this document). The intention of this scoping process is to identify the key ecological issues that are likely to be of most importance during the EIA and eliminate those that are of little concern, thus focusing the detailed EIA phase of the ecological/wetland assessments.

A preliminary ecological and surface hydrological sensitivity map of the site has been compiled through this desk-top scoping study (refer to Figure 12). After completion of the field study in the EIA phase of the process, areas with high sensitivity, based on confirmed localised species composition and habitat configuration, will be identified and mapped.

The preliminary sensitive areas identified, are as follow:

Medium Sensitivity

» Natural to Near-natural Open Savanna Grassland: All natural, intact grassland areas that is classified as ESA1. The vegetation of these grasslands provides soil stability, are valuable grazing, increase infiltration of precipitation and contribute to the maintenance of pollinator populations within the area. These grasslands may potentially be suitable for the presence of SCC (fauna and flora).

Medium-Low Sensitivity

» Re-established grassland on historical cultivated areas: These are historically transformed areas located within the ESA1 and which are now covered by a stable plagio-climax grassland (mostly indigenous gras and forb species). Re-establishment of mostly indigenous vegetation have been allowed to such an extent that the vegetation can now provide most of the functions and services associated with a

natural grassland. These areas are also potential suitable habitat for some SCC (Flora and Fauna).

Low Sensitivity

» All transformed and disturbed area: This includes access roads and disturbed road shoulders, farm roads, fire breaks, trampled and overgrazed grasslands, recently cultivated areas, homesteads, woodlots etc.

Overall, no significant ecological as well as surface hydrological flaws that could pose a problem to the proposed PV Facility development were identified during the scoping phase assessment; this will however, be confirmed during a detailed field study of the vegetation of the area.

No surface freshwater resource features are located within the 500m DWS regulated area and as such any further investigation/assessments will not be necessary (during the EIA phase). Subsequently the focus of the EIA Phase Ecological and Biodiversity Assessment will be on all terrestrial features.

The most significant potential impacts expected to occur with the development 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.
» A loss of portions of potential sensitive habitats, should the ecological state and conservation value of the vegetation, as well as the presence of protected plant species be found to be significant during the EIA field study. Such study will also reveal possible changes in the species composition and thus erosion protection by vegetation (and erosion risks) that will occur as the result of long-term shading by the planned PV arrays.
» 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.

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10. APPENDICES

Appendix 1: Listed Plant Species

List of plant species of conservation concern which are known to occur in the vicinity of study area. The list is derived from the POSA website (*NE – Note Evaluated).

Colours Relate as follow:

- Protected according to National Forest Act 1998 / NFA (No 84 of 1998).
- Protected according to The Transvaal Nature Conservation Ordinance (No. 12 of 1983), and
- Protected according to The Bophuthatswana Nature Conservation Act (Act 3 of 1973).

FAMILY	SPECIES	GROWTH FROM	STATUS
Acanthaceae	*Dicoma macrostegia*	Herb	
Acanthaceae	*Blepharis angusta*	Herb	Endemic
Acanthaceae	*Blepharis squarrosa*	Herb	Endemic
Acanthaceae	*Crabbea angustifolia*	Herb	Endemic
Agavaceae	*Chlorophytum cooperi*	Geophyte	
Agavaceae	*Chlorophytum sp.*	Geophyte	
Aizoaceae	*Delosperma sp.*	Succulent Herb	
Aizoaceae	*Drosanthemum sp.*	Succulent Herb	
Aizoaceae	*Nananthus vittatus*	Succulent Herb	Endemic & Data Deficient
Amaranthaceae	*Aerva leucura*	Herb	
Amaranthaceae	*Hermbstaedtia odorata*	Herb	
Amaranthaceae	*Kyphocarpa angustifolia*	Herb	
Amaryllidaceae	*Crinum graminicola*	Geophyte	
Amaryllidaceae	*Crinum macowanii*	Geophyte	Declining
Amaryllidaceae	*Boophone disticha*	Geophyte	Declining
Anacardiaceae	*Ozoroa paniculosa*	Tree	
Anacardiaceae	*Schinus molle*	Tree	Invasive
Anacardiaceae	*Searsia pyroides*	Tree	
Apiaceae	*Deverra burchellii*	Shrub	
Apiaceae	*Pastinaca sativa*	Herb	Naturalized
Apocynaceae	*Brachystelma foetidum*	Geophyte	
Apocynaceae	*Brachystelma incanum*	Geophyte	Vulnerable
Apocynaceae	*Brachystelma foetidum*	Geophyte	
Apocynaceae	*Cynanchum virens*	Climbing Herb	
Apocynaceae	*Gomphocarpus fruticosus*	Herb	
Apocynaceae	*Pentarrhinum insipidum*	Climbing Shrub	
Apocynaceae	*Raphionacme hirsuta*	Geophyte	
Asparagaceae	*Asparagus laricinus*	Shrub	
Asphodelaceae	*Bulbine abyssinica*	Geophyte	
Asphodelaceae	*Bulbine frutescens*	Geophyte	
Asphodelaceae	*Bulbine narcissifolia*	Geophyte	
Asphodelaceae	*Trachyandra burkei*	Geophyte	
Asphodelaceae	*Trachyandra laxa*	Succulent Herb	
Asteraceae	*Anthemis cotula*	Herb	Naturalized
Asteraceae	*Arctotis venusta*	Herb	
Asteraceae	*Berkheya onopordifolia*	Herb	
Asteraceae	*Berkheya pinnatifida*	Herb	
Asteraceae	*Chrysocoma ciliata*	Herb	
Asteraceae	*Chrysocoma obtusata*	Herb	
Asteraceae	*Cirsium vulgare*	Herb	Invasive

Asteraceae	*Dicoma anomala*	Herb	
Asteraceae	*Felicia muricata*	Dwarf Shrub	
Asteraceae	*Flaveria bidentis*	Herb	Invasive
Asteraceae	*Geigeria aspera*	Herb	
Asteraceae	*Geigeria brevifolia*	Herb	
Asteraceae	*Geigeria burkei*	Dwarf Shrub	
Asteraceae	*Gnaphalium filagopsis*	Herb	
Asteraceae	*Helichrysum callicomum*	Herb	
Asteraceae	*Helichrysum harveyanum*	Herb	
Asteraceae	*Helichrysum nudifolium*	Herb	
Asteraceae	*Litogyne gariepina*	Herb	
Asteraceae	*Nicolasia stenoptera*	Herb	
Asteraceae	*Nidorella hottentotica*	Herb	
Asteraceae	*Nidorella resedifolia*	Herb	
Asteraceae	*Nolletia ciliaris*	Herb	
Asteraceae	*Osteospermum muricatum*	Herb	
Asteraceae	*Osteospermum scariosum*	Herb	
Asteraceae	*Senecio digitalifolius*	Herb	
Asteraceae	*Senecio sp.*	Herb	
Asteraceae	*Tarchonanthus parvicapitulatus*	Shrub	
Asteraceae	*Ursinia nana*	Herb	
Asteraceae	*Xanthium spinosum*	Herb	Invasive
Boraginaceae	*Cynoglossum austroafricanum*	Herb	
Boraginaceae	*Cynoglossum lanceolatum*	Herb	
Boraginaceae	*Ehretia alba*	Shrub	
Boraginaceae	*Trichodesma angustifolium*	Herb	
Brassicaceae	*Cleome conrathii*	Herb	Near Threatened
Cactaceae	*Cylindropuntia imbricata*	Succulent Shrub	Invasive
Campanulaceae	*Wahlenbergia denticulata*	Herb	
Cannabaceae	*Cannabis sativa*	Herb	Naturalized
Caryophyllaceae	*Dianthus mooiensis*	Herb	Endemic
Caryophyllaceae	*Pollichia campestris*	Herb	
Caryophyllaceae	*Silene undulata*	Herb	
Celastraceae	*Gymnosporia buxifolia*	Shrub	
Chrysobalanaceae	*Parinari capensis*	Geosuffrutex	
Cleomaceae	*Cleome maculata*	Herb	
Commelinaceae	*Commelina africana*	Herb	
Commelinaceae	*Commelina livingstonii*	Herb	
Commelinaceae	*Cyanotis speciosa*	Herb	
Convolvulaceae	*Convolvulus ocellatus*	Herb	
Convolvulaceae	*Convolvulus thunbergii*	Herb	
Convolvulaceae	*Falkia oblonga*	Herb	

Convolvulaceae	*Ipomoea bathycolpos*	Herb	Endemic
Convolvulaceae	*Ipomoea oblongata*	Succulent Herb	
Convolvulaceae	*Ipomoea obscura*	Herb	
Crassulaceae	*Crassula lanceolata*	Succulent Herb	
Crassulaceae	*Crassula natans*	Succulent Herb	Endemic
Cucurbitaceae	*Acanthosicyos naudinianus*	Succulent Herb	
Cucurbitaceae	*Coccinia sessilifolia*	Climbing Herb	
Cucurbitaceae	*Cucumis myriocarpus*	Herb	
Cucurbitaceae	*Cucumis zeyheri*	Herb	
Cyperaceae	*Abildgaardia ovata*	Herb	
Cyperaceae	*Bulbostylis burchellii*	Graminoid	
Cyperaceae	*Cyperus congestus*	Graminoid	
Cyperaceae	*Cyperus marginatus*	Graminoid	
Cyperaceae	*Cyperus rubicundus*	Graminoid	
Cyperaceae	*Cyperus sexangularis*	Graminoid	
Cyperaceae	*Cyperus sp.*	Graminoid	
Cyperaceae	*Fuirena pubescens*	Graminoid	
Cyperaceae	*Kyllinga alba*	Graminoid	
Dipsacaceae	*Scabiosa columbaria*	Herb	
Ebenaceae	*Diospyros austro-africana*	Shrub	
Ebenaceae	*Diospyros lycioides*	Tree	
Elatinaceae	*Bergia decumbens*	Dwarf Shrub	
Euphorbiaceae	*Euphorbia inaequilatera*	Herb	
Fabaceae	*Acalypha caperonioides var. caperonioides*	Herb	Data Deficient
Fabaceae	*Caesalpinia gilliesii*	Shrub	Invasive
Fabaceae	*Chamaecrista biensis*	Herb	
Fabaceae	*Eriosema salignum*	Herb	
Fabaceae	*Gleditsia triacanthos*	Tree	Invasive
Fabaceae	*Indigastrum costatum*	Herb	
Fabaceae	*Indigastrum parviflorum*	Herb	
Fabaceae	*Indigofera heterotricha*	Dwarf Shrub	
Fabaceae	*Indigofera oxytropis*	Herb	
Fabaceae	*Leobordea divaricata*	Herb	
Fabaceae	*Leobordea hirsuta*	Herb	Endemic
Fabaceae	*Lessertia frutescens*	Herb	Data Deficient
Fabaceae	*Medicago laciniata*	Herb	Naturalized
Fabaceae	*Melilotus albus*	Herb	Naturalized
Fabaceae	*Ophrestia oblongifolia*	Herb	
Fabaceae	*Pearsonia cajanifolia*	Dwarf Shrub	Endemic
Fabaceae	*Rhynchosia monophylla*	Herb	
Fabaceae	*Senegalia hereroensis*	Tree	
Fabaceae	*Tephrosia lupinifolia*	Herb	

Fabaceae	*Trifolium africanum*	Herb	
Fabaceae	*Vachellia erioloba*	Tree	Declining
Fabaceae	*Vachellia hebeclada*	Shrub	
Fabaceae	*Vachellia karroo*	Tree	
Fabaceae	*Vigna unguiculata*	Climbing Herb	
Fabaceae	*Zornia milneana*	Herb	
Gentianaceae	*Chironia palustris*	Herb	
Geraniaceae	*Monsonia burkeana*	Herb	
Geraniaceae	*Pelargonium dolomiticum*	Dwarf Shrub	Endemic
Geraniaceae	*Pelargonium sidoides*	Herb	Declining
Hyacinthaceae	*Albuca prasina*	Geophyte	Endemic
Hyacinthaceae	*Dipcadi marlothii*	Herb	
Hyacinthaceae	*Dipcadi viride*	Herb	
Hypoxidaceae	*Hypoxis hemerocallidea*	Geophyte	Declining
Iridaceae	*Gladiolus elliotii*	Geophyte	
Iridaceae	*Gladiolus permeabilis*	Geophyte	
Iridaceae	*Gladiolus sp.*	Geophyte	
Iridaceae	*Moraea pallida*	Geophyte	
Iridaceae	*Tritonia nelsonii*	Geophyte	
Lamiaceae	*Acrotome inflata*	Herb	
Lamiaceae	*Mentha aquatica*	Herb	Invasive
Lamiaceae	*Plectranthus neochilus*	Herb	
Lamiaceae	*Salvia radula*	Herb	
Lamiaceae	*Salvia runcinata*	Herb	
Lamiaceae	*Salvia stenophylla*	Herb	Endemic
Lamiaceae	*Stachys spathulata*	Herb	
Lamiaceae	*Teucrium trifidum*	Herb	
Lobeliaceae	*Cyphia stenopetala*	Herb	
Lobeliaceae	*Lobelia erinus*	Herb	
Lobeliaceae	*Lobelia thermalis*	Herb	
Malvaceae	*Corchorus asplenifolius*	Herb	
Malvaceae	*Grewia flava*	Shrub	
Malvaceae	*Hermannia stellulata*	Herb	
Malvaceae	*Hermannia tomentosa*	Herb	
Malvaceae	*Hibiscus trionum*	Herb	Naturalized
Malvaceae	*Pavonia burchellii*	Herb	
Malvaceae	*Sida chrysantha*	Herb	
Malvaceae	*Sida cordifolia*	Herb	
Malvaceae	*Triumfetta sonderi*	Herb	Endemic
Marsileaceae	*Marsilea macrocarpa*	Herb	
Meliaceae	*Melia azedarach*	Tree	Invasive
Menispermaceae	*Antizoma angustifolia*	Climbing Shrub	

Myrtaceae	*Eucalyptus sideroxylon*	Tree	Invasive
Nyctaginaceae	*Commicarpus pentandrus*	Scrambling Herb	
Oleaceae	*Olea europaea*	Tree	
Onagraceae	*Epilobium hirsutum*	Herb	
Onagraceae	*Oenothera glazioviana*	Herb	Naturalized
Onagraceae	*Oenothera rosea*	Herb	Naturalized
Orchidaceae	*Habenaria epipactidea*	Geophyte	
Orobanchaceae	*Cycnium adonense*	Parasitic Herb	
Orobanchaceae	*Striga elegans*	Parasitic Herb	
Orobanchaceae	*Striga gesnerioides*	Parasitic Herb	
Plantaginaceae	*Plantago lanceolata*	Herb	Naturalized
Poaceae	*Andropogon schirensis*	Graminoid	
Poaceae	*Anthephora pubescens*	Graminoid	
Poaceae	*Aristida canescens*	Graminoid	
Poaceae	*Aristida congesta*	Graminoid	
Poaceae	*Aristida diffusa*	Graminoid	
Poaceae	*Aristida scabrivalvis*	Graminoid	
Poaceae	*Aristida stipitata*	Graminoid	
Poaceae	*Aristida vestita*	Graminoid	
Poaceae	*Brachiaria marlothii*	Graminoid	
Poaceae	*Brachiaria nigropedata*	Graminoid	
Poaceae	*Brachiaria serrata*	Graminoid	
Poaceae	*Calamagrostis epigejos*	Graminoid	
Poaceae	*Chloris virgata*	Graminoid	
Poaceae	*Chrysopogon serrulatus*	Graminoid	
Poaceae	*Cymbopogon caesius*	Graminoid	
Poaceae	*Cymbopogon pospischilii*	Graminoid	
Poaceae	*Cynodon dactylon*	Graminoid	
Poaceae	*Digitaria eriantha*	Graminoid	
Poaceae	*Digitaria sanguinalis*	Graminoid	Naturalized
Poaceae	*Diheteropogon amplectens*	Graminoid	
Poaceae	*Echinochloa holubii*	Graminoid	
Poaceae	*Elionurus muticus*	Graminoid	
Poaceae	*Eragrostis barbinodis*	Graminoid	
Poaceae	*Eragrostis biflora*	Graminoid	
Poaceae	*Eragrostis chloromelas*	Graminoid	
Poaceae	*Eragrostis curvula*	Graminoid	
Poaceae	*Eragrostis gummiflua*	Graminoid	
Poaceae	*Eragrostis micrantha*	Graminoid	
Poaceae	*Eragrostis plana*	Graminoid	
Poaceae	*Eragrostis pseudobtusa (x)*	Graminoid	Endemic
Poaceae	*Eragrostis sp.*	Graminoid	

Poaceae	*Eragrostis superba*	Graminoid	
Poaceae	*Eragrostis trichophora*	Graminoid	
Poaceae	*Eustachys paspaloides*	Graminoid	
Poaceae	*Fingerhuthia africana*	Graminoid	
Poaceae	*Heteropogon contortus*	Graminoid	
Poaceae	*Hyparrhenia filipendula*	Graminoid	
Poaceae	*Hyparrhenia hirta*	Graminoid	
Poaceae	*Leersia denudata*	Graminoid	
Poaceae	*Leptochloa fusca*	Graminoid	
Poaceae	*Loudetia simplex*	Graminoid	
Poaceae	*Melinis repens*	Graminoid	
Poaceae	*Microchloa caffra*	Graminoid	
Poaceae	*Microchloa kunthii*	Graminoid	
Poaceae	*Oropetium capense*	Graminoid	
Poaceae	*Panicum coloratum*	Graminoid	
Poaceae	*Panicum stapfianum*	Graminoid	
Poaceae	*Paspalum dilatatum*	Graminoid	Naturalized
Poaceae	*Phragmites australis*	Graminoid	
Poaceae	*Pogonarthria squarrosa*	Graminoid	
Poaceae	*Schizachyrium sanguineum*	Graminoid	
Poaceae	*Setaria incrassata*	Graminoid	
Poaceae	*Setaria nigrirostris*	Graminoid	
Poaceae	*Setaria sp.*	Graminoid	
Poaceae	*Setaria sphacelata*	Graminoid	
Poaceae	*Sporobolus festivus*	Graminoid	
Poaceae	*Sporobolus fimbriatus*	Graminoid	
Poaceae	*Stipagrostis uniplumis*	Graminoid	
Poaceae	*Themeda triandra*	Graminoid	
Poaceae	*Tragus berteronianus*	Graminoid	
Poaceae	*Tragus racemosus*	Graminoid	
Poaceae	*Trichoneura grandiglumis*	Graminoid	
Poaceae	*Triraphis andropogonoides*	Graminoid	
Poaceae	*Triraphis schinzii*	Graminoid	
Poaceae	*Urelytrum agropyroides*	Graminoid	
Poaceae	*Urochloa brachyura*	Graminoid	
Poaceae	*Urochloa panicoides*	Graminoid	
Polygalaceae	*Polygala gracilenta*	Herb	
Polygalaceae	*Polygala hottentotta*	Dwarf Shrub	
Polygalaceae	*Polygala producta*	Dwarf Shrub	
Polygalaceae	*Polygala rehmannii*	Herb	
Polygonaceae	*Oxygonum dregeanum*	Herb	
Polygonaceae	*Rumex lanceolatus*	Herb	

Potamogetonaceae	*Potamogeton pectinatus*	Herb	
Pteridaceae	*Pellaea calomelanos*	Pteridophyte	
Ranunculaceae	*Clematis brachiata*	Climbing Shrub	
Ranunculaceae	*Ranunculus multifidus*	Herb	
Rhamnaceae	*Ziziphus mucronata*	Tree	
Rhamnaceae	*Ziziphus zeyheriana*	Geosuffrutex	
Ricciaceae	*Riccia albolimbata*	Herb	
Ricciaceae	*Riccia argenteolimbata*	Bryophyte	
Rubiaceae	*Anthospermum rigidum*	Bryophyte	
Rubiaceae	*Breonadia sp.*	Tree	
Rubiaceae	*Galium capense*	Herb	
Rubiaceae	*Kohautia amatymbica*	Herb	
Rubiaceae	*Kohautia caespitosa*	Herb	
Rubiaceae	*Pachystigma pygmaeum*	Dwarf Shrub	
Rubiaceae	*Pygmaeothamnus zeyheri*	Geosuffrutex	
Rubiaceae	*Rubia petiolaris*	Scrambling Herb	
Santalaceae	*Viscum verrucosum*	Parasitic Shrub	
Scrophulariaceae	*Chaenostoma patrioticum*	Herb	
Scrophulariaceae	*Jamesbrittenia atropurpurea*	Herb	
Scrophulariaceae	*Nemesia fruticans*	Herb	
Scrophulariaceae	*Selago densiflora*	Herb	
Scrophulariaceae	*Selago sp.*	Herb	
Solanaceae	*Lycium cinereum*	Dwarf Shrub	Weed
Solanaceae	*Lycium hirsutum*	Dwarf Shrub	
Solanaceae	*Solanum campylacanthum*	Herb	
Solanaceae	*Solanum lichtensteinii*	Dwarf Shrub	
Ulmaceae	*Celtis africana*	Tree	
Verbenaceae	*Chascanum adenostachyum*	Herb	
Verbenaceae	*Chascanum pinnatifidum*	Herb	
Verbenaceae	*Lantana rugosa*	Shrub	
Verbenaceae	*Lippia scaberrima*	Shrub	
Verbenaceae	*Verbena bonariensis*	Herb	Invasive
Zygophyllaceae	*Tribulus terrestris*	Herb	Weed

Appendix 2. List of Mammals

List of Mammals which may potentially occur within the surrounding area. Taxonomy notes are derived from Skinner & Chimimba (2005), while conservation status is according to the IUCN 2010.

Colours Relate as follow:

- » Protected according to The Transvaal Nature Conservation Ordinance (No. 12 of 1983); Schedule 2 – Protected Game (Section 15(1)(a)) and Schedule 4 – Protected Wild Animals (Section 15(1)(c)), and
- » Protected according to The Bophuthatswana Nature Conservation Act (Act 3 of 1973); Schedule 1 – Protected Game.
- » Protected according to The Bophuthatswana Nature Conservation Act (Act 3 of 1973); Schedule 2 – Ordinary Game.
- » National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004); Threatened or Protected Species Regulations
- Endangered Species
- Vulnerable Species
- Protected Species

Likelihood Rating: 1=Confirmed; 2=Likely; 3=Moderate; 4=Unlikely & 5= May occur as a managed population

Scientific Name	Common Name	IUCN Status	Regional Status	Likelihood	ADU Database
MACROSCLEDIDEA (ELEPHANT SHREWS): SPECIES: 2 CONSERVATION IMPORTANT SPECIES: 0					
Elephantulus myurus	Eastern Rock Sengi	LC	LC	3	X
Elephantulus brachyrhynchus	Short-snouted Sengi	LC	LC	2	
TUBULENTATA: SPECIES: 1 CONSERVATION IMPORTANT SPECIES: 1					
Orycteropus afer	Aardvark	LC	LC	3	X
HYRACOIDEA (HYRAXES) SPECIES: 1 CONSERVATION IMPORTANT SPECIES: 0					
Procavia capensis	Rock Hyrax	LC	LC	4	

LAGOMORPHA (HARES AND RABBITS): SPECIES: 3 CONSERVATION IMPORTANT SPECIES: 2					
Pronolagus randensis	Jameson's Red Rock Rabbit	LC	LC	4	
Lepus capensis	Cape Hare	LC	LC	3	X
Lepus victoriae	Savanna Hare	LC	LC	2	X
RODENTIA (RODENTS): SPECIES: 29 CONSERVATION IMPORTANT SPECIES: 1					
Cryptomys hottentotus	African Mole Rat	LC	LC	2	X
Hystrix africaeaustralis	Cape Porcupine	LC	LC	2	X
Pedetes capensis	Springhare	LC	LC	2	X
Xerus inauris	South African Ground Squirrel	LC	LC	2	X
Paraxerus cepapi	Tree Squirrel	LC	LC	4	
Graphiurus microtis	Small-eared Dormouse		LC	3	
Graphiurus platyops	Rock Dormouse	DD	LC	2	
Graphiurus murinus	Woodland Dormouse	LC	LC	2	
Thryonomys swinderianus	Greater Cane-rat	LC	LC	4	
Rhabdomys pumilio	Four-striped Grass Mouse	LC	LC	2	X
Rhabdomys dilectus	Mesic Four-striped Grass Mouse	LC	LC	2	X
Lemniscomys rosalia	Single-striped Grass Mouse	DD	LC	2	X
Mus minutoides	Pygmy Mouse	LC	LC	2	
Mus indutus	Desert Pygmy Mouse	LC	LC	3	
Mastomys coucha	Southern Multimammate Mouse	LC	LC	2	X
Mastomys natalensis	Natal Multimammate Mouse	LC	LC	3	
Aethomys ineptus	Tete Veld Rat	LC	LC	2	X
Aethomys chrysophilus	Red Veld Rat	LC	LC	2	
Micaelamys namaquensis	Namaqua Rock Mouse	LC	LC	2	X
Desmodillus auricularis	Cape Short-tailed Gerbil	LC	LC	2	
Gerbilliscus leucogaster	Bushveld Gerbil	DD	LC	2	X
Gerbilliscus brantsii	Highveld Gerbil	LC	LC	3	X
Mystromys albicaudatus	White-tailed Mouse	EN	VU	2	
Saccostamus campestris	Pouched Mouse	LC	LC	2	
Thallomys paedulcus	Acacia Tree Rat	LC	LC	3	x
Malacothrix typica	Large-eared Mouse	LC	LC	2	

Otomys angoniensis	Angoni Vlei Rat	LC	LC	4	
Dendromus melanotis	Grey Climbing Mouse	LC	LC	2	X
Steatomys krebsii	Krebs's Fat Mouse	LC	LC	4	
PRIMATES SPECIES: 3 CONSERVATION IMPORTANT SPECIES: 1					
Papio ursinus	Chacma Baboon	LC	LC	3	
Cercopithecus aethiops	Vervet Monkey	LC	LC	3	X
Galago moholi	Southern Lesser Galago	LC	LC	3	
EULIPOTYPHLA (SHREWS): SPECIES: 5 CONSERVATION IMPORTANT SPECIES: 1					
Myosorex varius	Forest Shrew	DD	LC	3	
Crocidura cyanea	Reddish-Grey Musk Shrew	DD	LC	2	
Crocidura hirta	Lesser Red Musk Shrew	DD	LC	2	
Suncus varilla	Lesser Dwarf Shrew	DD	LC	3	
Crocidura mariquensis	Swamp Musk Shrew	DD	NT	4	X
ERINACEOMORPHA (HEDGEHOG) SPECIES: 1 CONSERVATION IMPORTANT SPECIES: 1					
Atelerix frontalis	South African Hedgehog	NT	NT	2	
PHILODOTA (PANGOLINS) SPECIES: 1 CONSERVATION IMPORTANT SPECIES: 1					
Smutsia temminckii	Ground Pangolin	VU	VU	3	
CARNIVORA: SPECIES: 24 CONSERVATION IMPORTANT SPECIES: 11					
Proteles cristatus	Aardwolf	LC	LC	2	
Crocuta crocuta	Spotted Hyaena	NT	NT	4	
Hyaena brunnea	Brown Hyaena	NT	NT	4	
Caracal caracal	Caracal	LC	LC	3	
Leptailurus serval	Serval	LC	NT	3	X
Felis silvestris	African Wild Cat	LC	LC	2	
Felis nigripes	Black-footed cat	VU	VU	3	
Genetta genetta	Small-spotted genet	LC	LC	3	

Genetta maculata	Rusty-spotted genet	LC	LC	4	
Panthera pardus	Leopard	VU	VU	4	
Suricata suricatta	Meerkat	LC	LC	2	X
Mellivora capensis	Honey Badger	NT	LC	3	
Atilax paludinosus	Marsh Mongoose	LC	LC	4	X
Cynictis penicillata	Yellow Mongoose	LC	LC	2	X
Galerella sanguinea	Slender Mongoose	LC	LC	2	X
Ichneumia albicauda	White-tailed Mongoose	LC	LC	4	
Vulpes chama	Cape Fox	LC	LC	3	
Canis mesomelas	Black-backed Jackal	LC	LC	2	X
Otocyon megalotis	Bat-eared Fox	LC	LC	2	
Aonyx capensis	Cape Clawless Otter	NT	NT	4	
Lutra maculicolis	Spotted-necked Otter	NT	VU	4	
Poecilogale albinucha	African Striped Weasel	DD	NT	3	
Ictonyx striatus	Striped Polecat	LC	LC	2	
Mungos mungo	Banded Mongoose	LC	LC	4	
RUMANANTIA & PERISSODACTYLA (UNGULATES): SPECIES: 18 CONSERVATION IMPORTANT SPECIES: 17					
Connochaetes gnou	Black Wildebeest	LC	LC	5	X
Connochaetes taurinus	Blue Wildebeest	LC	LC	5	
Alcelaphus caama	Red Hartebeest	LC	LC	5	
Aepyceros melampus	Impala	LC	LC	5	X
Damaliscus pygargus phillipsi	Blesbok	LC	LC	5	X
Equus quagga	Plains Zebra	LC	LC	5	X
Syncerus caffer	African Savanna Buffalo	LC	LC	5	X
Tragelaphus strepsiceros	Greater Kudu	LC	LC	3	X
Tragelaphus sylvaticus	Bushbuck	LC	LC	5	X
Oryx gazelle	Gemsbok	LC	LC	5	X
Redunca fulvorufula	Mountain Reedbuck	LC	EN	5	X
Redunca arundinum	Southern Reedbuck	LC	LC	5	X
Tragelaphus oryx	Eland	LC	LC	5	X
Pelea capreolus	Grey Rhebok	LC	NT	5	X

Sylvicapra grimmia	Common Duiker	LC	LC	2	X
Antidorcas marsupialis	Springbok	LC	LC	5	X
Raphicerus campestris	Steenbok	LC	LC	2	X
**Elephurus davidianus*	Pere David's Deer	CE	LC	5	X
PIGS & HOGS (SUIDAE) SPECIES: 2 CONSERVATION IMPORTANT SPECIES: 1					
Phacochoerus africanus	Common Warthog	LC	LC	5	X
**Sus scrofa*	Wild Boar			5	X
CHIROPTERA (BATS) SPECIES: 8 CONSERVATION IMPORTANT SPECIES: 3					
Neoromicia capensis	Cape Serotine Bat	LC	LC	2	
Tadarida aegyptiaca	Egyptian Free-tailed Bat	LC	LC	2	
Nycteris thebaica	Egyptian Slit-faced Bat	LC	LC	2	
Miniopterus natalensis	Natal long-fingered Bat	NT	NT	3	
Rhinolophus clivosus	Geoffroy's Horseshoe Bat	LC	NT	3	
Rhinolophus darlingi	Darling's Horseshoe Bat	LC	NT	2	
Pipistrellus rusticus	Rusty Pipestrelle	LC	LC	2	
Scotophilus dinganii	Yellow-bellied House Bat	LC	LC	2	

Appendix 3. List of Reptiles.

List of Reptiles which may potentially occur within the greater area. Taxonomy notes are derived from Branch (1998) and Bates *et al*. (2014), while conservation status is according to Bates *et al*. (2014). List of reptiles which are known from the 2626AA and 2526CC Quarter Degree Squares, according to the SARCA database are also provided.

Colours Relate as follow:

» National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004); Threatened or Protected Species Regulations

- Endangered Species
- Vulnerable Species
- Protected Species

Likelihood Rating: 1=Confirmed; 2=Likely; 3=Moderate; 4=Unlikely & 5= May occur as a managed population

Species	Common Name	Threat Status Regional	Endemism	Likelihood	ADU Database
Pelomedusidae Species:1 Conservation Important Species:0 Endemic & Near Endemic Species:0					
Pelomedusa subrufa	Marsh Terrapin	LC		3	
Testudinidae Species:4 Conservation Important Species:0 Endemic & Near Endemic Species:1					
Kinixys lobatsiana	Lobatse Hinged-Back Tortoise	LC	N-E	4	
Kinixys spekii	Speke's Hinged-Back Tortoise	LC		3	
Stigmochelys pardalis	Leopard Tortoise	LC		4	
Psammobates oculifer	Serrated Tent Tortoise	LC		3	X
Gekkonidae Species:7 Conservation Important Species:0 Endemic & Near Endemic Species:2					
Chondrodactylus turneri	Turner's Gecko	LC		2	
Hemidactylus mabouia	Common Tropical House Gecko	LC		2	
Homopholis wahlbergii	Wahlberg's Velvet Gecko	LC		3	

Lygodactylus capensis capensis	Common Dwarf Gecko	LC		2	X
Lygodactylus nigropunctatus	Black-Spotted Dwarf Gecko	LC	E	2	
Pachydactylus affinis	Transvaal Thick-toed Gecko	LC	E	3	
Pachydactylus capensis	Cape Thick-toed Gecko	LC		2	
Amphisbaenidae Species:1 Conservation Important Species:0 Endemic & Near Endemic Species:1					
Monopeltis capensis	Cape Worm Lizard	LC	N-E	4	
Lacertidae Species:4 Conservation Important Species:0 Endemic & Near Endemic Species:0					
Meroles squamulosus	Savanna Lizard	LC		3	
Nucras holubi	Holub's Sandveld Lizard	LC		2	
Nucras intertexta	Spotted Sandveld Lizard	LC		4	
Pedioplanis lineoocellata lineoocellata	Spotted Sand Lizard	LC		2	
Cordylidae Species:2 Conservation Important Species:0 Endemic & Near Endemic Species:1					
Cordylus jonesii	Jones' Girdled Lizard	LC		4	
Cordylus vittifer	Transvaal Girdled Lizard	LC	N-E	3	X
Gerrhosauridae Species:1 Conservation Important Species:0 Endemic & Near Endemic Species:0					
Gerrhosaurus flavigularis	Yellow-throated Plated Lizard	LC		2	
Scincidae Species:8 Conservation Important Species:0 Endemic & Near Endemic Species:1					
Acontias gracilicauda	Thin-tailed Legless Skink	LC	E	3	
Acontias occidentalis	Savanna Legless Skink	LC		4	
Afroablepharus wahlbergii	Wahlberg's Snake-eyed Skink	LC		2	
Mochlus sundevallii sundevallii	Sundevall's Writhing Skink	LC		4	
Trachylepis capensis	Cape Skink	LC		2	X
Trachylepis punctatissima	Speckled Rock Skink	LC		2	X
Trachylepis punctulata	Speckled Sand Skink	LC		4	
Trachylepis varia	Variable Skink	LC		2	
Varanidae Species:2 Conservation Important Species:0					

Endemic & Near Endemic Species:0					
Varanus albigularis albigularis	Southern Rock Monitor	LC		2	
Varanus niloticus	Nile Monitor	LC		4	
Chamaeleonidae					
Chamaeleo dilepis dilepis	Common Flap-neck Chameleon	LC		2	
Agamidae Species:3 Conservation Important Species:0 Endemic & Near Endemic Species:2					
Agama aculeate distanti	Eastern Ground Agama	LC	E	2	
Agama atra	Southern Rock Agama	LC	N-E	2	
Acanthocercus atricollis atricollis	Southern Tree Agama	LC		4	
Typhlopidae Species:2 Conservation Important Species:0 Endemic & Near Endemic Species:1					
Afrotyphlops bibronii	Bibron's Blind Snake	LC	N-E	3	
Rhinotyphlops lalandei	Delalande's Beaked Blind Snake	LC		3	
Leptotyphlopidae Species:1 Conservation Important Species:0 Endemic & Near Endemic Species:0					
Leptotyphlops scutifrons	Peter's Thread Snake	LC		2	
Pythonidae Species:1 Conservation Important Species:0 Endemic & Near Endemic Species:0					
Python natalensis	Southern African Python	LC		4	
Viperidae Species:3 Conservation Important Species:0 Endemic & Near Endemic Species:0					
Bitis arietans arietans	Puff Adder	LC		2	
Bitis caudalis	Horned Adder	LC		4	
Causus rhombeatus	Rhombic Night Adder	LC		4	
Lamprophiidae Species:15 Conservation Important Species:0 Endemic & Near Endemic Species:2					
Aparallactus capensis	Black-headed Centipede-eater	LC		3	
Atractaspis bibronii	Bibron's Stiletto Snake	LC		3	
Boaedon capensis	Common House Snake	LC		2	
Lamprphis aurora	Aurora Snake	LC	E	2	
Lycodonomorphus rufulus	Brown Water Snake	LC		4	

Lycophidion capense capense	Cape Wolf Snake	LC		2	
Psammophis angolensis	Dwarf Sand Snake	LC		3	
Psammophis brevirostris	Short-snouted Grass Snake	LC		2	
Psammophis subtaeniatus	Western Yellow-bellied Sand Snake	LC		2	
Psammophis trinasalis	Fork-marked Sand Snake	LC		3	X
Psammophylax rhombeatus rhombeatus	Spotted Grass Snake	LC		2	
Psammophylax tritaeniatus	Striped Grass Snake	LC		2	
Prosymna bivittata	Tow-striped Shovel-snout	LC		4	
Prosymna sudevallii	Sundevall's Shovel-snout	LC	N-E	3	
Pseudaspis cana	Mole Snake	LC		2	
Elapidae Species:7 Conservation Important Species:0 Endemic & Near Endemic Species:1					
Aspidelaps scutatus scutatus	Common Shield Cobra	LC		4	
Dendroaspis polylepis	Black Mamba	LC		4	
Elapsoidea sundevallii media	Sundevall's Grater Snake	LC		3	
Hemachatus haemachatus	Rinkhals	LC	N-E	3	
Naja annulifera	Snouted Cobra	LC		2	
Naja mossambica	Mozambique Spitting Cobra	LC		3	
Naja nivea	Cape Cobra	LC		2	X
Colubridae Species:8 Conservation Important Species:0 Endemic & Near Endemic Species:1					
Crotaphopeltis hotamboeia	Red-lipped Snake	LC		4	
Dasypeltis scabra	Rhombic Egg-eater	LC		2	X
Dispholidus typus	Boomslang	LC		3	
Philthamnus hoplogaster	Southeastern Green Snake	LC		4	
Philothamnus natalensis occidentalis	Western Natal Green Snake	LC	E	4	
Philthamnus semivariegatus	Spotted Bush Snake	LC		2	
Telescopus semiannulatus semiannulatus	Eastern Tiger Snake	LC		3	
Thelotornis capensis capensis	Southern Twig Snake	LC		4	

Appendix 4. List of Amphibians.

List of Amphibians which may potentially occur within the greater area. Taxonomy notes are derived from Du Preez & Carruthers (2009) and Minter *et al*. (2004), while conservation status is according to Minter *et al*. (2004). List of reptiles which are known from the 2626AA and 2526CC Quarter Degree Squares, according to the SARCA database are also provided.

Colours Relate as follow:

» National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004); Threatened or Protected Species Regulations

- Endangered Species
- Vulnerable Species
- Protected Species

Likelihood Rating: 1=Confirmed; 2=Likely; 3=Moderate; 4=Unlikely & 5= May occur as a managed population

Species	Common Name	Threat Status Regional	Likelihood	ADU Database
BREVICIPITIDAE (RAIN FROGS) Species:1 Conservation Important Species:0				
Breviceps adspersus adspersus	Bushveld Rain Frog	LC	4	X
BUFONIDAE (TYPICAL TOADS, PYGMY TOADS & RED TOADS) Species:6 Conservation Important Species:0				
Amietophrynus gutturalis	Guttural Toad	LC	3	X
Amietophrynus poweri	Western Olive Toad	LC	3	X
Amietophrynus rangeri	Raucous Toad	LC	4	
Poyntonophrynus fenoulheti	Northern Pygmy Toad	LC	2	
Poyntonophrynus vertebralis	Southern Pygmy Toad	LC	3	
Schismaderma carens	Red Toad	LC	3	X
HYPEROLIIDAE (KASSINAS) Species:1 Conservation Important Species:0				
Kassina senegalensis	Bubbling Kassina	LC	3	X
MYCROHYLIDAE (RUBBER FROGS) Species:1 Conservation Important Species:0				
Phrynomantis bifasciatus	Banded Rubber Frog	LC	2	
PHRYNOBATRACHIDAE (PUDDLE FROGS) Species:1 Conservation Important Species:0				
Phrynobatrachus natalensis	Snoring Puddle Frog	LC	3	

PIPIDAE (PLATANNAS) Species:1 Conservation Important Species:0				
Xenopus laevis	Common Platanna	LC	4	X
PYXICEPHALIDAE (CACOS, RIVER FROGS) Species:9 Conservation Important Species:1				
Cacosternum boettgeri	Boettger's Caco	LC	2	X
Amietia quecketti	Common River Frog	LC	4	X
Amietia fuscigula	Cape River Frog	LC	4	
Pyxicephalus adspersus	Giant Bullfrog	NT	3	
Strongylopus fasciatus	Striped Stream Frog	LC	4	X
Tomopterna cryptotis	Tremolo Sand Frog	LC	2	X
Tomopterna krugerensis	Knocking Sand Frog	LC	4	
Tomopterna natalensis	Natal Sand Frog	LC	3	
Tomopterna tandyi	Tandy's Sand Frog	LC	2	
PTYCHADENIDAE (GRASS FROG) Species:1 Conservation Important Species:0				
Ptychadena anchietae	Plain Grass Frog	LC	3	X

Appendix 5. Specialist CV.

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

Appendix 6. Specialist's Work Experience and References

WORK EXPERIENCES

&

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).