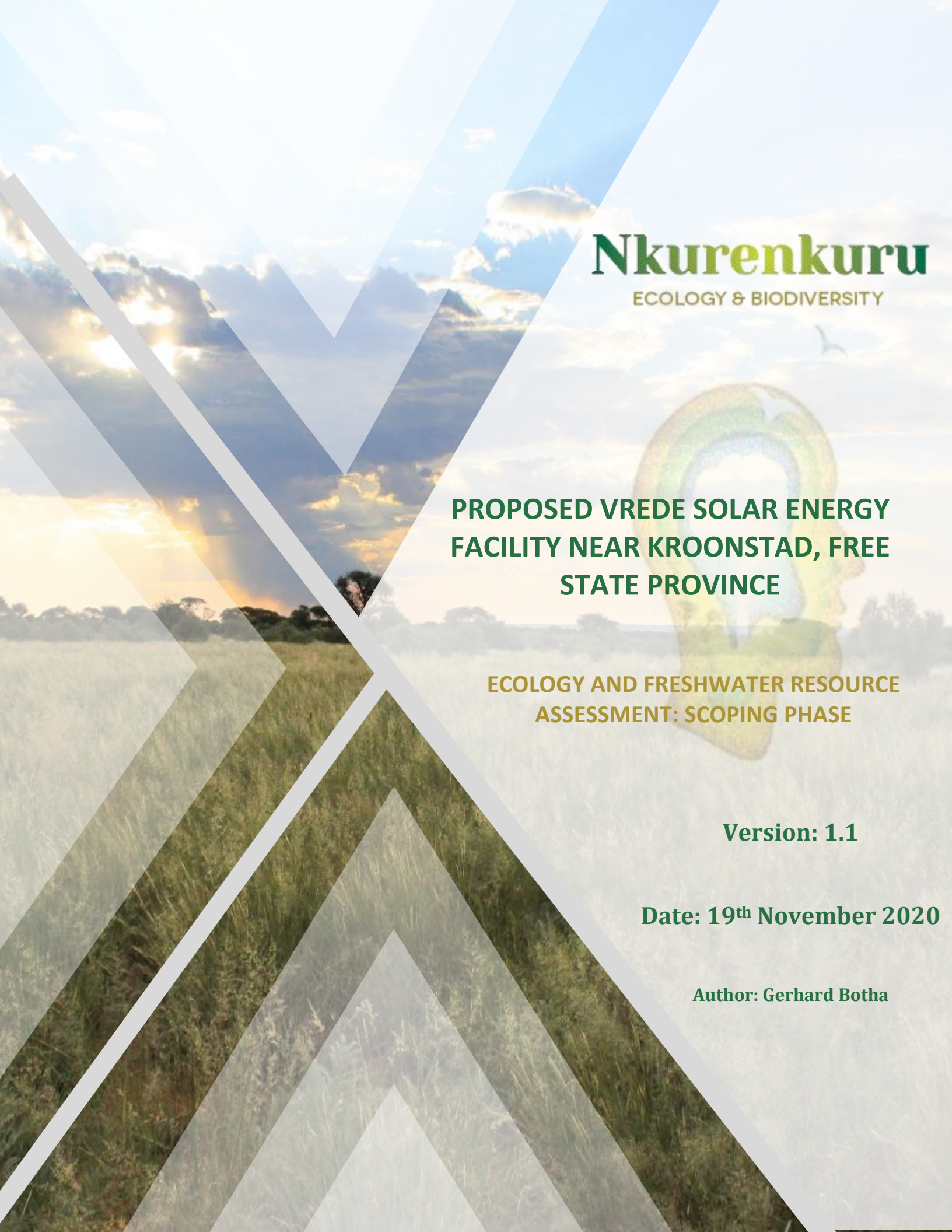

Nkurenkuru
ECOLOGY & BIODIVERSITY

PROPOSED VREDE SOLAR ENERGY FACILITY NEAR KROONSTAD, FREE STATE PROVINCE

ECOLOGY AND FRESHWATER RESOURCE ASSESSMENT: SCOPING PHASE

Version: 1.1

Date: 19th November 2020

Author: Gerhard Botha

PROPOSED VREDE SOLAR ENERGY FACILITY NEAR KROONSTAD, FREE STATE PROVINCE

Report Title: Ecological and Feshwater Resource Assessment: Scoping Phase

Authors: Mr. Gerhard Botha

Project Name: Proposed Vrede Solar Energy Facility near Kroonstad, Free State Province

Status of report: Version 1.1

Date: 19th November 2020

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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.

REPORT AUTHORS

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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.

November 2020

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

PROPOSED VREDE SOLAR ENERGY FACILITY NEAR KROONSTAD, FREE STATE PROVINCE

ECOLOGY AND FRESHWATER RESOURCE ASSESSMENT: SCOPING PHASE

1. INTRODUCTION

Client

ENERTRAG South Africa (Pty) Ltd.

Project

Savannah Environmental (Pty) Ltd. on behalf of South Africa Mainstream Renewable Power Developments (Pty) Ltd.

Proposed Activity

South Africa Mainstream Renewable Power Developments (Pty) Ltd is proposing the construction and operation of the 100 MWac Vrede Photovoltaic (PV) Solar Energy Facility (SEF), Battery Energy Storage System (BESS) and associated infrastructure located near the town of Kroonstad in the Moqhaka Local Municipality (Fezile Dabi District) of the Free State Province of South Africa (Figure 1). The total size of the project area is approximately 538hawhilst the development area itself will cover 279ha.

The properties investigated include:
» Remaining extent of the farm Vrede No. 1152 (main & grid site);
» Portion 1 of the farm Uitval No. 1104 (main site);
» Remaining Extent of the farm Gesukkel No. 1153 (grid site); and
» Remaining Extent of the farm Geduld No. 1156 (grid site).

The Vrede SEF is proposed on the following properties:
» Remaining extent of the farm Vrede No. 1152; and
» Portion 1 of the farm Uitval No. 1104.

The grid connection infrastructure is proposed on the following properties:
» Remaining extent of the farm Vrede No. 1152;

» Remaining Extent of the farm Gesukkel No. 1153; and
» Remaining Extent of the farm Geduld No. 1156.

*** Please take not that even though the proposed grid connection have been mentioned above, the assessment of this infrastructure will be done in a separate Environmental Basic Assessment Report. This Environmental Scoping Report deals exclusively with the SEF and associated components.**

As mentioned, the proposed SEF is envisaged to have a generating capacity of up to 100MW and would include the following infrastructure:

» Solar Arrays:
  - Solar Panel Technology - Mono and/or Bifacial Photovoltaic (PV) Modules;
  - Mounting System Technology – single axis tracking, dual axis tracking or fixed axis tracking PV;
  - Underground cabling (up to 33kV)
  - Centralised inverter stations or string inverters; Power Transformers;
» Building Infrastructure
  - Offices;
  - Operational control centre;
  - Operation and Maintenance Area / Warehouse / workshop;
  - Ablution facilities;
  - Battery Energy Storage Facility;
  - Substation building.
» Electrical Infrastructure
  - 33/132kV onsite substation including associated equipment and infrastructure
  - Underground cabling and overhead power lines (up to 33kV)
» Associated Infrastructure:
» Access roads and Internal gravel roads;
  - Fencing and lighting;
  - Lightning protection
  - Permanente laydown area;
  - Temporary construction camp and laydown area;
  - Telecommunication infrastructure;
  - Stormwater channels; and water pipelines.

Access to the SEF will be via the S172 gravel road which links the farming area with the P99/1 route.

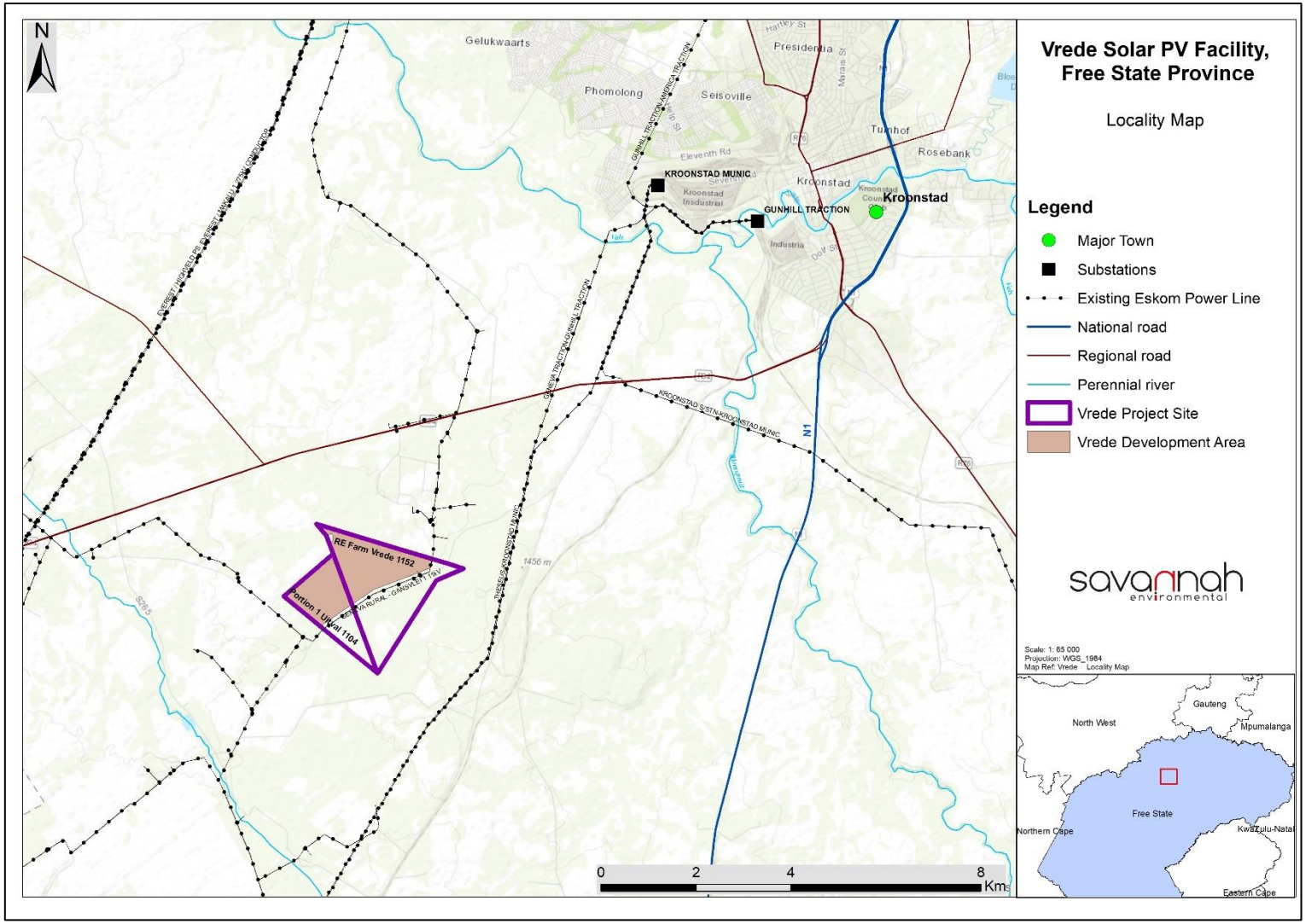


Figure 1: Proposed location of the Vrede SEF (compiled and provided by Savannah Environmental (Pty) Ltd.)

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 is proposed to be located (entire project site with emphasis on the proposed development area) and provide a professional opinion on ecological issues pertaining to the target area to aid in future decisions regarding the proposed project.

The assessment of the proposed grid connection infrastructure will be done in a separate Environmental Basic Assessment Report. Subsequently, this Environmental Scoping Report deals exclusively with the SEF and associated components.

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

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

Provincial

» The Free State Nature Conservation Bill, 2007

The above-mentioned Nature Conservation Bill accompanied by all amendments is regarded by the Free State Department: Economic, Small Business Development, Tourism and Environmental Affairs (DESTEA) 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.

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 have 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)
	Free State Province Land-Cover (from SPOT5 Satellite imagery circa 2009)	Shows the land-use and disturbances/transformations within and around the impacted zone.	DETEA (2009)
	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 Fee State (GIS Coverage)	Determination of provincial terrestrial conservation priorities and biodiversity buffers.	DESTEA (2015)
	SAPAD – South Africa Protected Areas Database (GIS Coverage)	Shows the location of protected areas within the region	http://egis.environment.gov.za DEA (2020)
	SACAD – South Africa Conservation Areas Database (GIS Coverage)	Shows the location of conservation areas within the region	http://egis.environment.gov.za DEA (2020)
	Strategic Water Source Areas for Surface Water (SWSA-sw) (GIS Coverage)	Shows the location of the development area relative to areas that contribute significantly	CSIR (2017)

		to the overall water supply of the country	

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 herpetofaunal 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 2727CA, 2727CC, 2727CB and 2727CD 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 site 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.

*** Please not that these delineated hydrological features will be confirmed, updated where necessary, and assessed during the EIA phase**

Following the desktop identification and mapping exercise, freshwater resource features were 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 ▪ 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).	▪ CBA 1 areas ▪ Remaining areas of vegetation type listed in Draft Ecosystem List of NEM:BA as Critically Endangered, Endangered, or Vulnerable. ▪ Protected forest patches. ▪ Confirmed presence of populations of species of conservation concern (Critically Endangered, Endangered, Vulnerable & Rare)

Sensitivity	Factors contributing to sensitivity	Examples of qualifying features
	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).	
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, 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)	▪ 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. ▪ 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	▪ CBA 2 "corridor areas", ESA 1 and ESA2. ▪ Habitat with moderate diversity (richness or turnover).

Sensitivity	Factors contributing to sensitivity	Examples of qualifying features
	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).	▪ 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 Free State Province Land-Cover dataset (2009) were queried as part of the desktop study (Figure 3). 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 Free State Province Land-Cover dataset I a digital, seamless, vegetation and land-cover map of the entire Free State Province, suitable for 1:50 000 scale (or coarser) GIS modelling applications. This dataset was developed using 2009 SPOT5 satellite imagery. Furthermore, this vegetation and land-cover dataset is compatible with the latest South African land-cover classification standards. In addition to the land-cover data, a comprehensive set of digital aerial reference photographs, acquired as part of the land-cover map accuracy verification field survey process has been supplied as a geo-referenced GIS database. Please take note that this land-cover map was compiled in 2009 and land-use and land-cover may have changed within the next decade or so, however this spatial data still provide a good basis to work form and to obtain an indication of the primary land use within an area. For example, the areas indicated as cultivated commercial dryland haven't been ploughed and cultivated for the past 15 years as indicated by the land owner.

According to this dataset approximately 39% of the entire project site is located on old historical cultivated fields, whist approximately 53% of the project site can be regarded as a natural form of grassland. Furthermore, approximately 18.04% of the project site is covered by wetlands and riparian vegetation.

In terms of the SEF development area, more than half of the area (53%) is located within old historically cultivated lands, whilst 45% is classified as grassland. Approximately 4.2ha (1.5%) of the total development site comprises of wetland (non-pan) habitats.

Due to the relatively large scale of the map 1:50 000 and the fact that this land cover map was compiled back in 2009, 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.

The results of this spatial analysis were as follows, and are illustrated in Figure 4:

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.

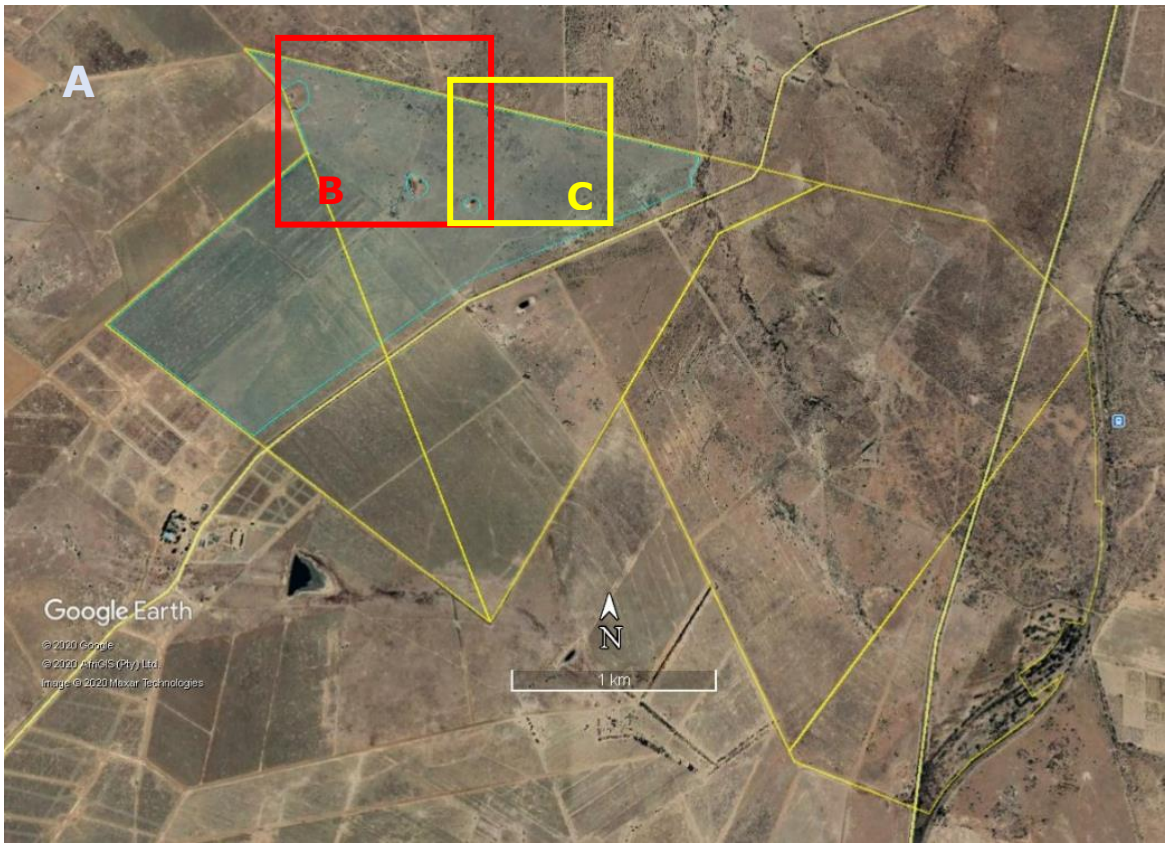
The affected properties are predominantly used for agricultural purposes, mainly cultivation of maize and sunflower, and to a lesser extent for livestock farming (predominantly cattle). Game farming have also become much more prominent within the region over the last decade (wide variety of game species including rare antelope and big game such as buffalo).

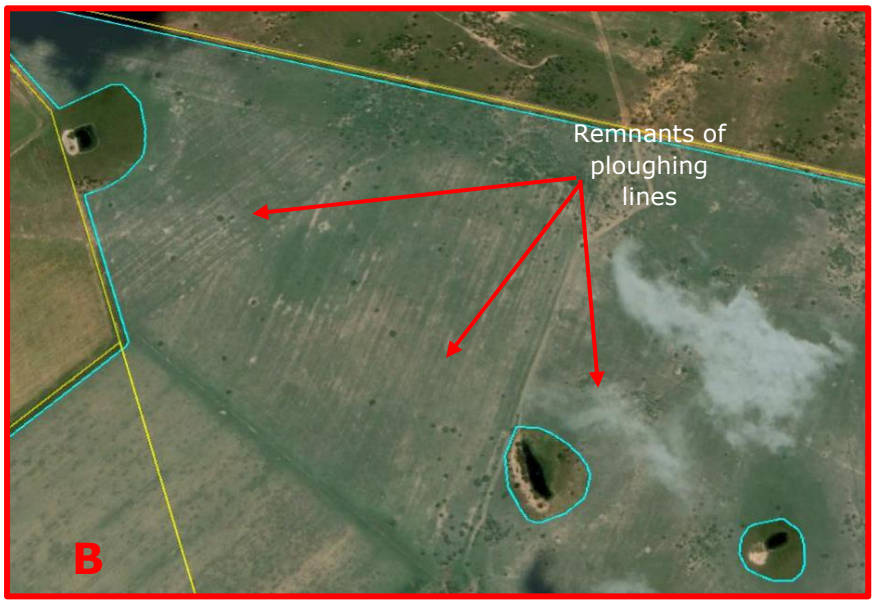
Even though in the past, cultivation within larger portions of the project site have occurred, these areas have been abandoned for a while. Relative recent abandoned areas (areas that have not been ploughed for at least the last fifteen years covers approximately 59% of the project site and are now covered by pioneer and sub-climax grasses and weeds or permanent pastures and are now likely utilised as grazing for livestock. Historically cultivated land (> 15 years), covers an area of approximately 13% and appears to have been re-established by grasses and low shrubs (plagioclimax grassland), with the only evidence, from available spatial data, being feint ploughing contour lines (Figure 2). These areas are also now likely being utilised as grazing. Subsequently, approximately 72% have been, at some time, subjected to ploughing and cultivation. When adding all the other areas that have been subjected to some other form of transformation or disturbance (e.g. roads, fire breaks, woodlots), almost 74% of the project site have been transformed at some time. Only approximately 149 ha (22%) natural veld remain comprising of grasslands with varying coverage/density of shrubs.

Furthermore, natural wetland features cover approximately 3% of the project area, comprising mostly of valley-bottom and depression wetlands. Numerous small earth dam

structures have been created within some of the wetlands, in an attempt to concentrate and store surface water for longer periods of time within these wetland features.

The majority of the SEF Development Area is located on old abandoned land (approximately 61.43%), with approximately 21.2% of the development area traversing historical cultivated areas and only approximately 17% of natural veld.





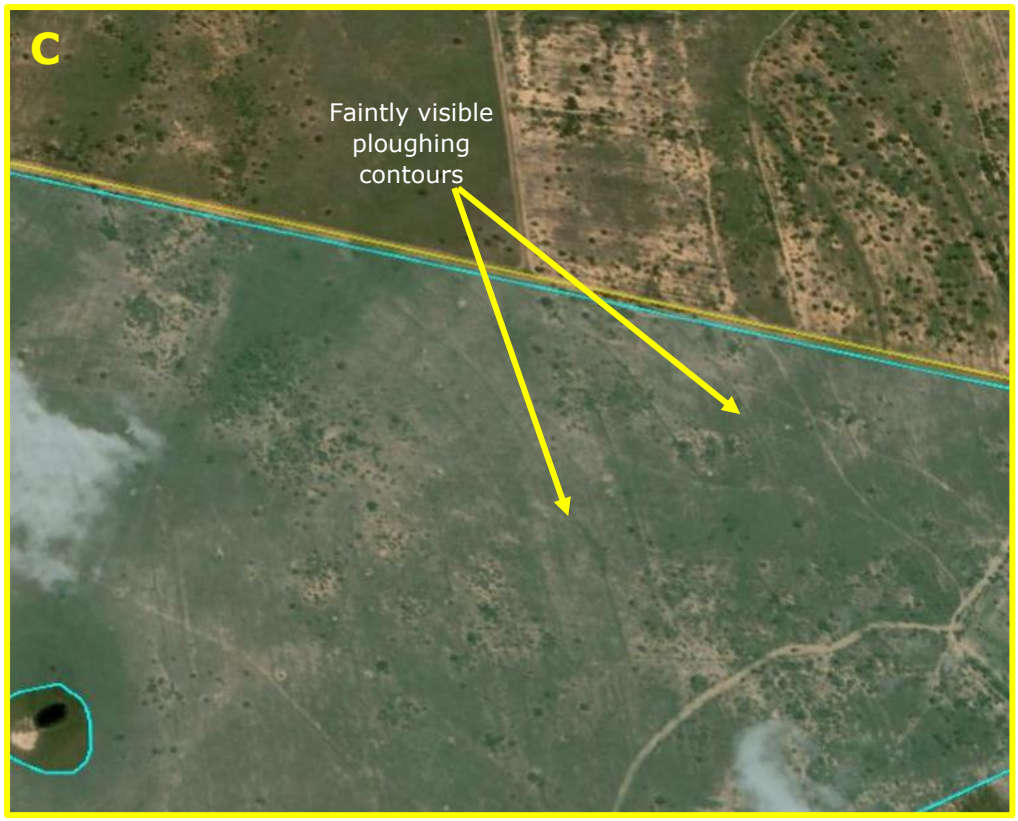


Figure 2 (A-C) Evidence of historical cultivation (>10years) within areas that have been mapped as natural grassland within the Free State Province Land Cover dataset as well as within the Critical Biodiversity Area data sets.

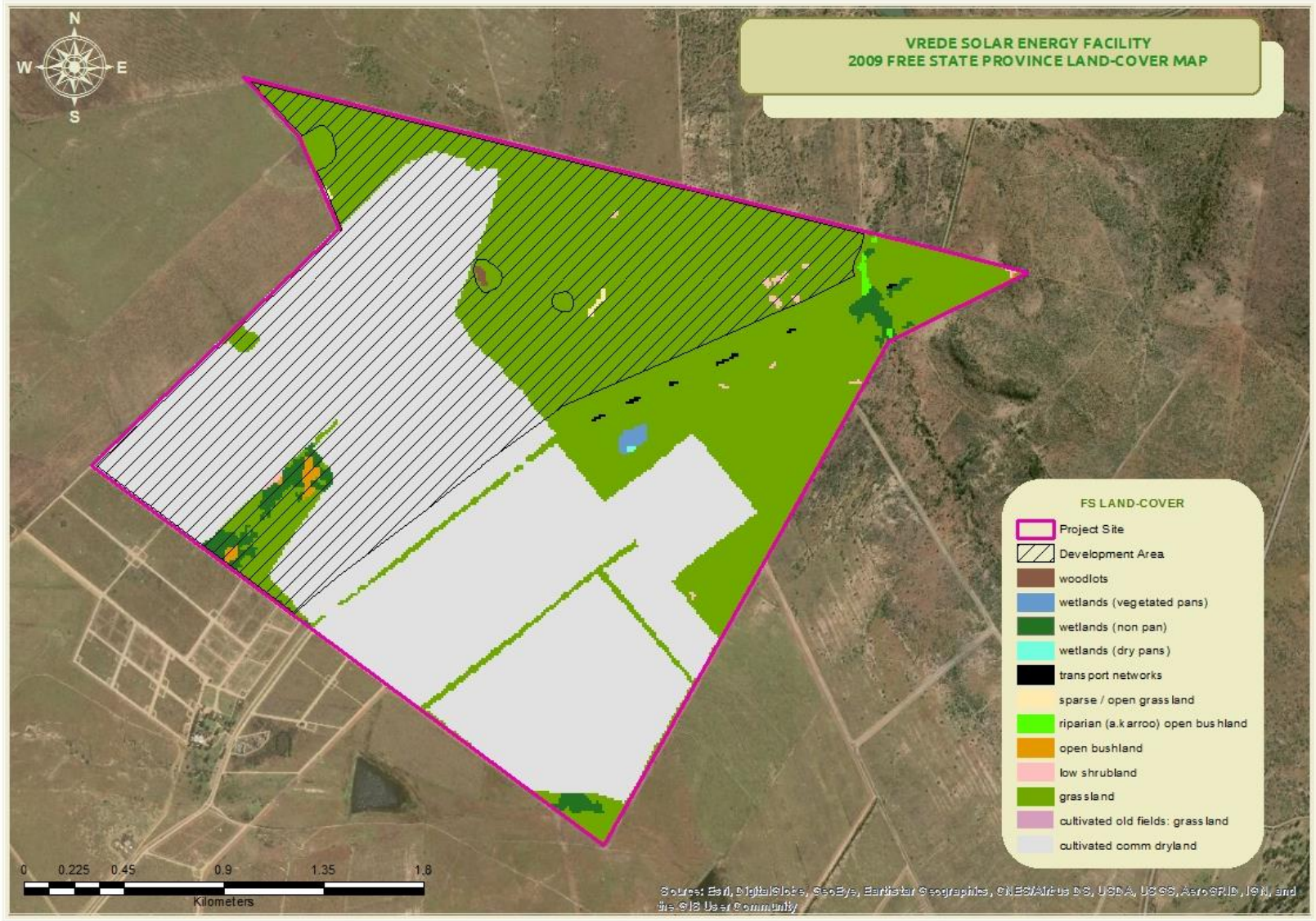


Figure 3: 2009 Free State Province Land-Cover Map

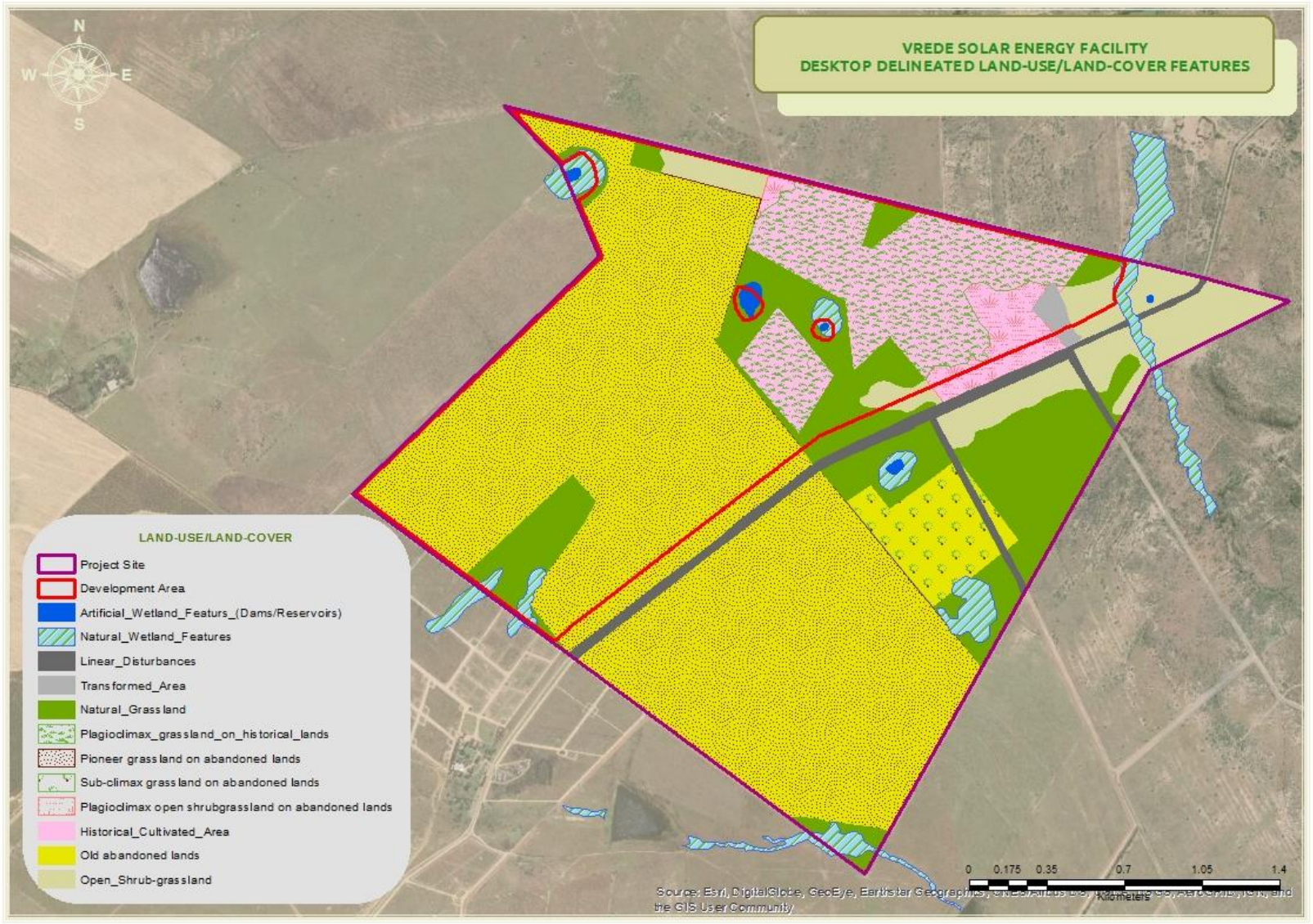


Figure 4: Desktop delineated land-cover features

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 Development Area.

Biophysical Aspect	Desktop Biophysical Details		Source
Physiography			
Landscape Description	A relative flat plains-dominated landscape with a small isolated koppies/outcrop located north-east of the development area. As already described, large tracts of land have been transformed for cultivation purposes. These plains are typically dominated by low-tussock grasslands with a prominent karroid element. Shrubby trees, such as Acacia karroo (also known as Vachellia karroo) may also be a common feature, especially near watercourses and wetland areas. Depression wetlands are a common feature within this landscape, as well as valley-bottom wetlands (usually channelled), which tend to drain in a north-eastern/eastern direction towards the Blomspruit River.		Google Earth
Dominant Land Type	Bd21		ARC
Dominant Terrain Type	Symbol	Description	ARC
	A2	Level plains or plateaus with a local relief between 30-90m	
Geomorphic Province	Southern Highveld		Partridge et al., 2010
Geology	Mudrock and subordinate sandstone of the Adelaide Subgroup (Beaufort Group). Occasional dolerite sills may also be present.		ARC & SA Geological Dataset
Soils (General)	Soils with a plinthic catena characterised by loamy red yellow and greyish sand with a high base status		ARC
Prominent Soil Forms	Avalon, Westleigh, Valsrivier. The lower lying areas such as depressions, valley bottom wetlands and watercourses are typically characterised by Dundee, Bonheim and Valsrivier soil types		ARC
Susceptibility to Wind Erosion	Class	Description	ARC
	3a (Wind), & 1 (Water)	Land with moderate wind erosion susceptibility and a low susceptibility to water erosion. Generally, level to gently sloping. Soils have a favourable erodibility index.	
Climate			
Köppen-Geiger Climate Classification	BSk (Cold semi-arid climate)		Climate-data.org
Mean annual temperature	16.6°C		Climate-data.org
Warmest Month & Av. Temp.	January: 22.4°C		Climate-data.org
Coldest Month & Av. Temp.	June: 8.8°C		Climate-data.org
Rainfall Seasonality	Mid-summer (January – February)		DWAF, 2007
Mean annual precipitation	545 mm		Schulze, 1997
Mean annual runoff	10.3 mm up to 25.8mm		Schulze, 1997

Mean annual evaporation	1 600 – 1 700 mm			Schulze, 1997
Surface Hydrology				
DWA Ecoregions	Level 1	Level 2		DWA, 2005
	Highveld	11.08		
Wetland vegetation group	Dry Highveld Grassland (Group 3 & 4)			CSIR, 2011
Water management area	Middle Vaal WMA (09)			DWA
Quaternary catchment	Name (Symbol)			DWA
	C60H (Primary), C60G & C60F			
Main collecting river(s) in the catchment	Tributaries of the Vals River including Blomespruit to the east and Otterspruit to the west.			CSIR, 2011
Closest river to the project site	Tributary of the Otterspruit (~3.8km to the west).			Google Earth
Geomorphic Class	Symbol	Description	Slope (%)	CSIR, 2011
	V4	Upper foothills	0.005 – 0.019	
	V4, V2	Lower foothills	0.001 - 0.005	
	Description			
	Watercourses to the west correspond more with Lower Foothill systems, whist the watercourses to the east are more typical of Upper Foothill systems. » Upper Foothill systems tend to be moderately steep streams dominated by bedrock or boulders. Reach types may include plain-bed, pool-riffle or pool-rapid reach types. Length of pools and riffles/rapids are usually similar. Narrow flood plain of sand, gravel or cobble often present. » Lower Foothill systems typically have lower gradient mixed bed alluvial channels with sand and gravel dominating the bed, locally may be bedrock controlled. Reach types typically include pool-riffle or pool-rapid, sand bars common in pools. Pools of significantly greater extent than rapids or riffles. Flood plan often present.			
Vegetation Overview				
Biome	Grassland Biome (Dry Highveld Grassland Bioregion)			Mucina & Rutherford, 2018
Vegetation Types	» Western portion of the project site including the SEF Development Area: Vaal-Vet Sandy Grassland. » Eastern portion of the project site including north-eastern most corner of the SEF Development Area: Central Free State Grassland			Mucina & Rutherford, 2018
Vegetation & Landscape Feature	<u>Vaal-Vet Sandy Grassland:</u> Plainns-dominated landscape with some scattered, slightly irregular undulating plains and hills. Mainly low-tussock grasslands with and abundant karroid element. Dominance of *Themeda triandra* is an important feature of this vegetation unit. Locally low cover of *T. triandra* and the associated increase in *Elionurus muticus, Cymbopogon pospischilii* and *Aristida congesta* is attributed to heavy grazing. <u>Central Free State Grassland</u>: Undulating plains supporting short grassland, in natural condition dominated by *Themeda triandra* while *Eragrostis curvula* and *E. chloromelas* become dominant in degraded			Mucina & Rutherford, 2006

	habitats. Dwarf karoo bushes establish in severely degraded clayey bottomlands. Overgrazed and trampled low-lying areas with heavy clayey soils are prone to *Acacia karroo* (also known as *Vachellia karroo*) encroachment.	
BODATSA Data	Regional: Total Species Observed	2020-08-02_231620030-BRAHMSOnlineData
	491	
	Indigenous Flora	
	419	
	Non-indigenous Flora	
	52	
	South African Endemic Flora	
	29	
	Threatened Flora	
	Data Deficient: 1 Species; Endangered: 1 Species Not Evaluated: 19 Species	

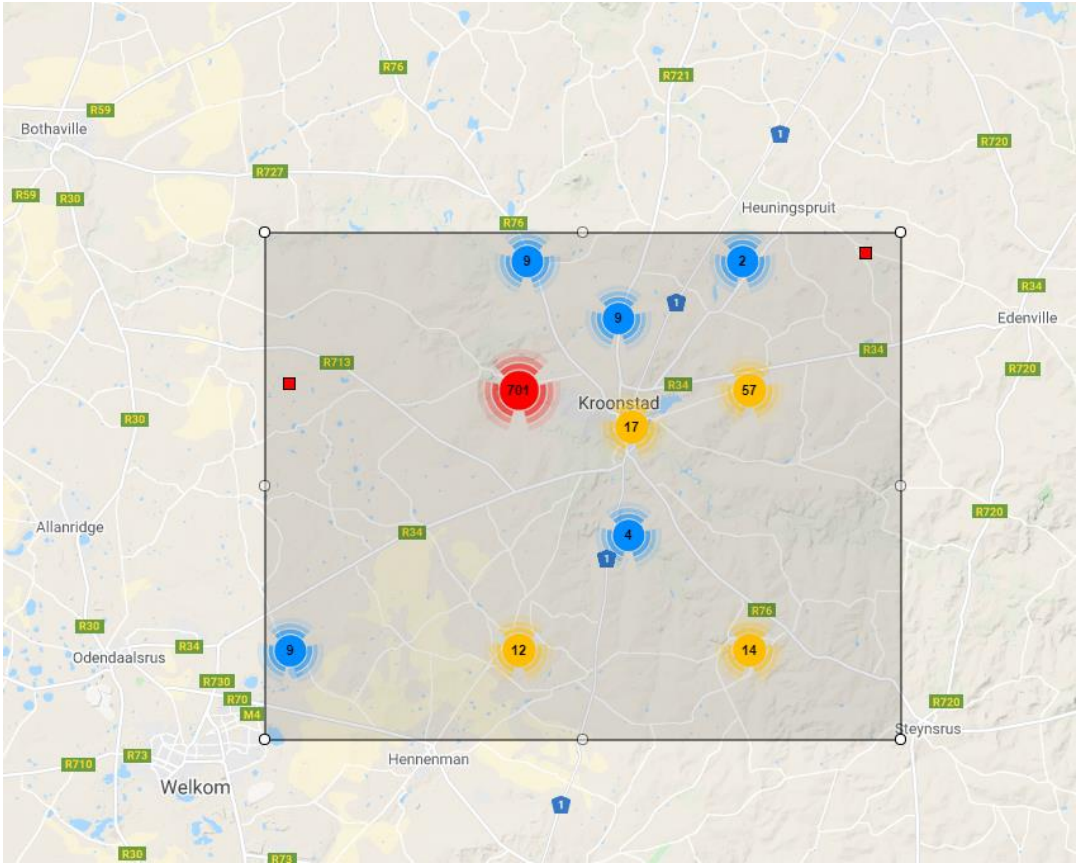


Figure 5: Extracted area and sample locations from POSA. Extracted data was used to compile a plant species list of species that may potentially occur within the project site and provide an indication of potential conservation important species that may be found within the area.

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	Outside of Focus Area: ± 2km south of a Free State Highveld Focus Area	Not Classified
	Protected Areas and Conservation Areas (PACA) Database	South African Conservation Area (SACA)	Well outside of any SACA:	Not Classified
		South African Protected Area (SAPA)	Located adjacent, south of Boslaagte Private Nature Reserve	Boslaagte Private Nature Reserve
	Strategic Water Source Areas for groundwater (SWSA-gw)	Areas with high groundwater availability and of national importance	Located within the Kroonstad SWSA-gw	Located within important groundwater recharge area.
	Vegetation Types	Vaal-Vet Sandy Grassland	Vegetation of Study Area	Endangered
		Central Free State Grassland	Vegetation of Study Area	Least Threatened
	Threatened Ecosystems	Vaal-Vet Sandy Grassland Ecosystem	Ecosystems of Study Area	Endangered
	National Freshwater Ecosystem Priority Area	River FEPA	Located outside of any River FEPAs	Not Classified
		Wetland FEPA	No Wetland FEPAs located within project site.	Not Classified
PROVINCIAL AND REGIONAL LEVEL CONSERVATION PLANNING CONTEXT	NCBSP: Critical Biodiversity Areas	Ecological Support Areas ESA1	Corridors/linkages between the upland (terrestrial) areas and important water resource features such as the Vals and Blomspruit Rivers. No ESA1 located within the SEF Development Area.	ESA
		Critical Biodiversity Areas CBA1	Natural areas of Vaal-Vet Sandy Grassland which are regarded as irreplaceable and essential in meeting the biodiversity conservation	CBA1

			targets as set out for the Free State Province North-eastern and north-western portions of SEF Development Area falls within CBAs	

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 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 outside of any Focus Area (Figure 6) with the closest focus area located approximately 2km to the north (Free State Highveld Focus Area). Subsequently, no NPAES Focus Areas will be impacted by the development.

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 Areas are located in close proximity to the project site, however the Boslaagte Private Nature Reserve is listed as a National Protected Area. This nature reserve is located adjacent to the north-east of the proposed SEF Development Area (Figure 6). Such nature reserves are typically well cordoned off with game fences, often with some electrified wires, as such it is unlikely that this development will have a significant impact on the nature reserve as well as its associated fauna and flora. Some disturbance of the nature reserves' fauna may however occur along the boundary fence during the construction phase and periods of maintenance during the operational phase. Most animals will likely merely move away from the area near the disturbance and will likely move back as the movement and noise declines. This potential impact will however be assessed during the EIA phase and recommendations and mitigation measures will be provided in order to reduce the impact of noise and human movement on the fauna of the nature reserve.

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 Kroonstad SWSA-gw (Figure 7).

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)

Vaal-Vet Sandy Grassland	24%	0.3%	65.2%	Endangered	Endangered
Central Free State Grassland	24%	0.8%	23.5%	Least Concerned	Not Listed

According to current layout the bulk of the SEF Development Area is located within the endangered Vaal-Vet Sandy Grassland (Figure 6), with only a small portion of the north-eastern corner falling within the Central Free State Grassland. However, as described earlier (Land cover and Land Use Section), more than 80% of the development area is located within transformed areas whist approximately 17% of the development area is located in what appears to be grassland largely consistent to that of Vaal-Vet Sandy Grassland.

The presence, extent and condition of these remaining grassland 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. At this stage, due to the small extent of natural grassland within the SEF Development Area as well as the fractured nature of these patches of grassland, it appears unlikely that the development will have a significant impact on this vegetation/ecosystem type.

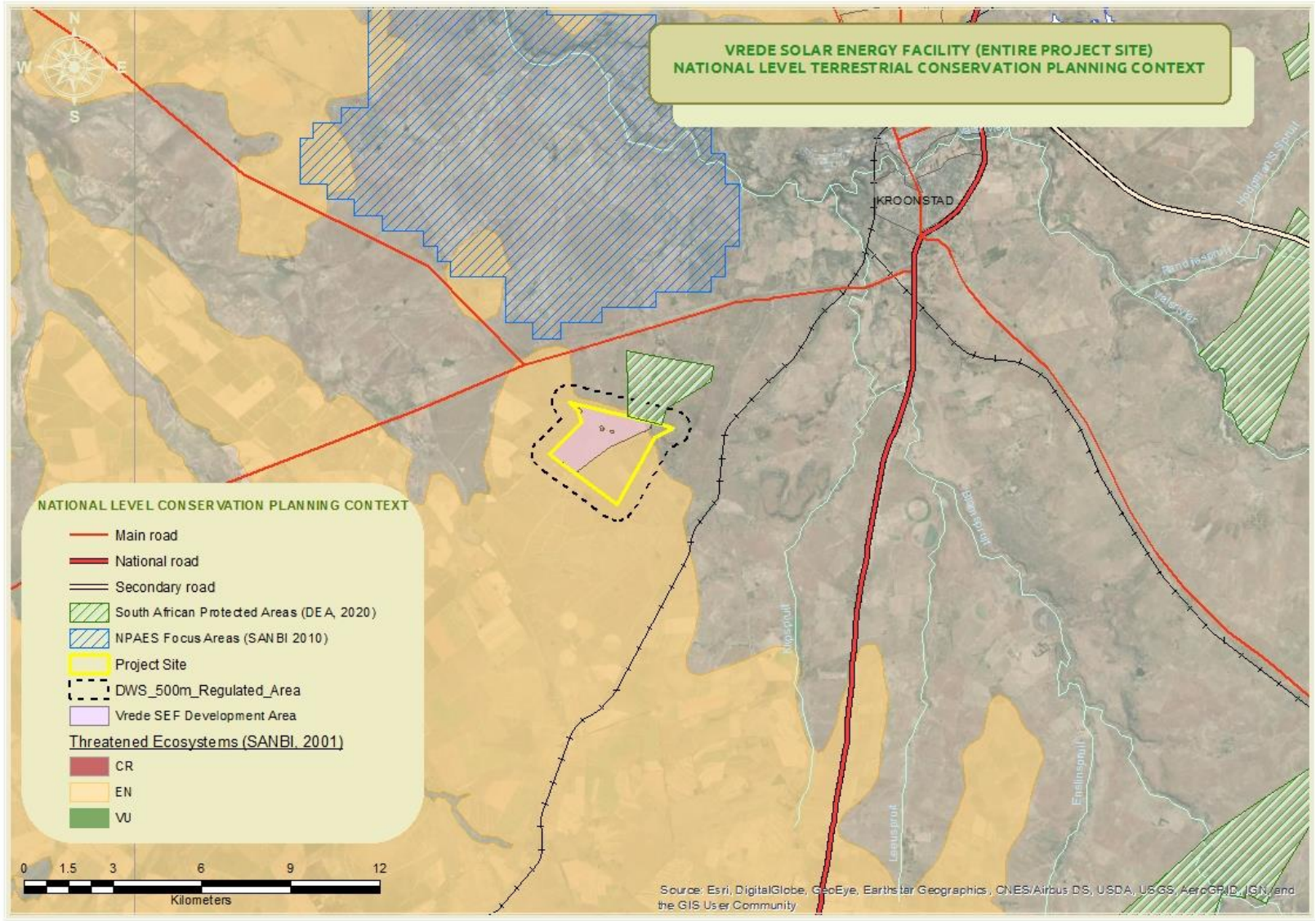


Figure 6: National Level Terrestrial Conservation Planning Context

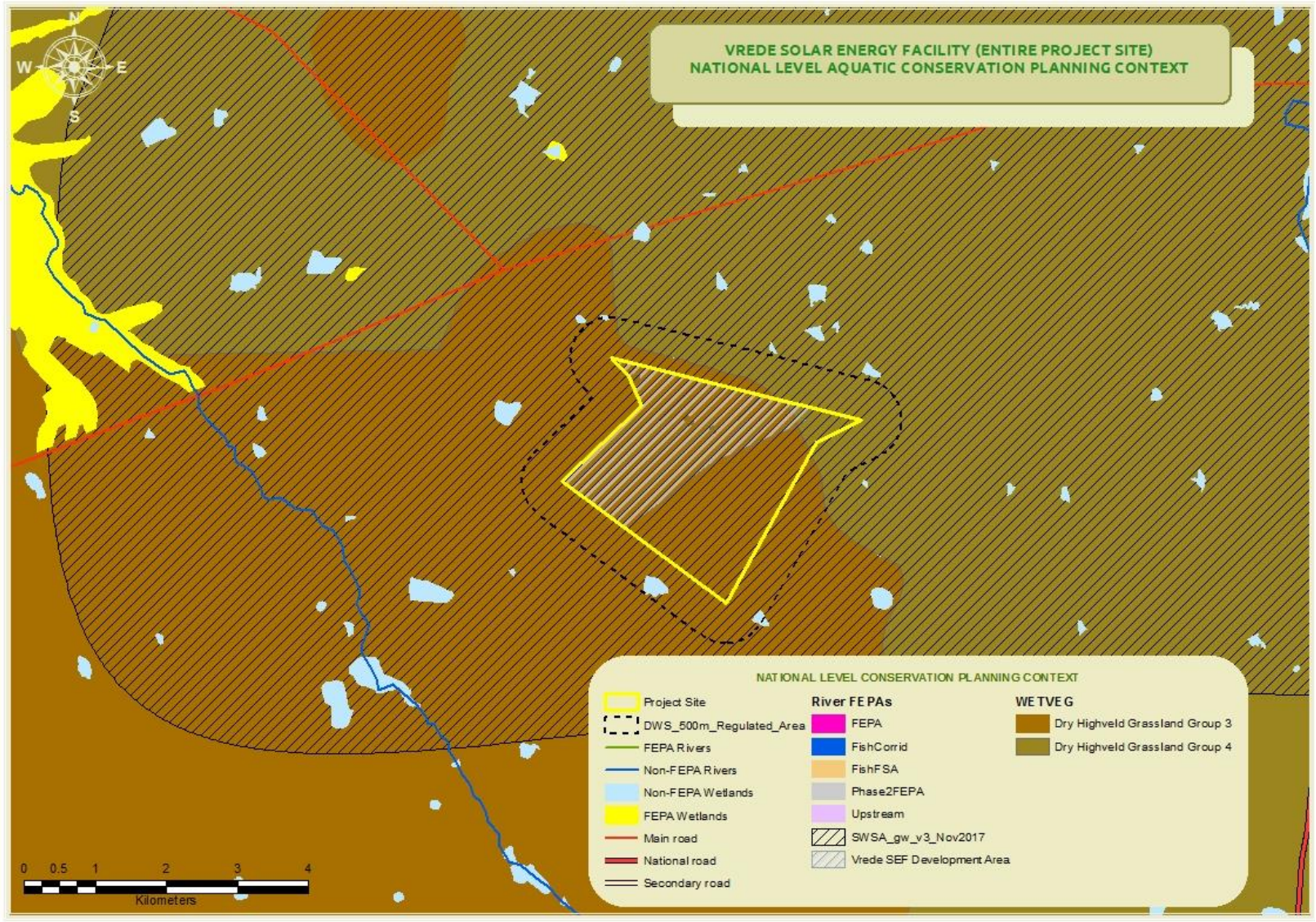


Figure 7: National Level Aquatic Conservation Planning Context.

Critical Biodiversity Areas and Broad Scale Ecological Processes

The SEF Development Area falls within the planning domain of the Free State Province Biodiversity Conservation Assessment which maps Critical Biodiversity Areas and Ecological Support Areas within the Free State Province. The majority of the development area falls within degraded areas whilst the north-eastern and north-western portions of the development area is located within CBA1 (Figure 8).

Typically, natural features are classified according to the different categories on the basis of the following criteria's:

» **Critical Biodiversity Areas (CBAs)** that contain three types of areas:
  - Irreplaceable areas, which are essential in meeting targets set for the conservation of biodiversity in Free State.
  - Areas that are important for the conservation of biodiversity in Free State.
  - Conserved areas, which include all existing level 1 and 2 protected areas.

Level 1 and Level 2 protected areas are proclaimed in terms of relevant legislation (National Environmental Management Protected Areas Act, 2003 (Act No 57 of 2003) specifically for the protection of biodiversity (or for the purposes of nature conservation).

» **Ecological Support Areas (ESAs).** ESAs are an imperative part of the Free State Biodiversity Plan to ensure sustainability in the long term. ESAs are part of the entire hierarchy of biodiversity, but it is not possible to include all biodiversity features in them. Landscape features associated with ESAs (termed spatial surrogates for ESAs) that are essential for the maintenance and generation of biodiversity in sensitive areas, and therefore that require sensitive management were incorporated into Biodiversity Plan.

Critical Biodiversity Areas 1

The CBAs located within the SEF Development Area, have been classified as such due to fact that these areas are regarded as irreplaceable as they are essential in meeting the targets set for the conservation of the endangered Vaal-Vet Sandy Grassland. However, during a thorough examination of available satellite imagery (including historical imagery) it was found that large portions of that have been classified as CBAs were in fact historical cultivated areas that have been left fallow for an extensive period of time allowing for succession to take place to a stage where these areas are now covered with a relative stable grass and dwarf shrub cover. Subsequently, natural/original Vaal-Vet Sandy Grassland are only confined to a few isolated patches. Due to the small extent and patchy distribution of this endangered vegetation type within the SEF Development Area, it is unlikely that this development will have an impact on the status of the remaining natural Vaal-Vet Sandy Grassland. However, this statement can only be confirmed during the EIA phase when these areas will be assessed during a site visit.

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.

A review of the NFEPA coverage for the project site (Figure 7) revealed that no River FEPAs are located within the entire project site. Furthermore, the NFEPA coverage for the project site shows that now Wetland FEPAs are located within the entire project site.

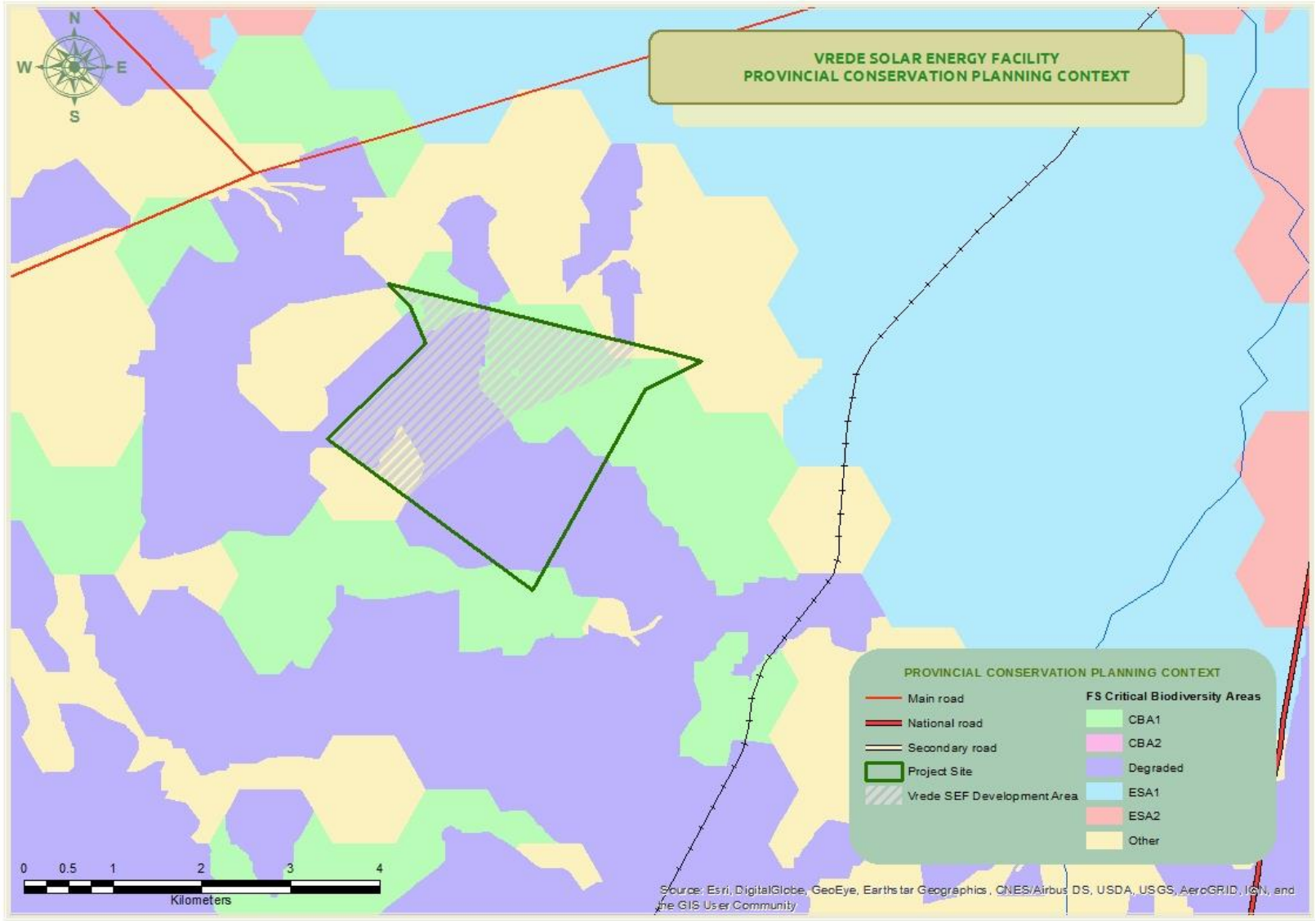


Figure 8: Provincial Level Conservation Planning Context – CBA Map (Free State Province Biodiversity Conservation Assessment).

Terrestrial Ecological Scoping Assessment

Vegetation Overview

Broad Vegetation Types

The overall project site 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 overall project site is situated within two vegetation types, namely the Vaal-Vet Sandy Grassland (Gh10) and Central Free State Grassland (Gh6) according to Mucina & Rutherford (2006) (Figure 9). The proposed SEF development area is however almost solely situated within one vegetation type, the Vaal-Vet Sandy Grassland with only a small portion extending into the Central Free State Grassland.

A. Vaal Vet Sandy Grassland

The Vaal Vet Sandy Grassland vegetation type is found in North-West and Free State Provinces. This vegetation type typically comprises of plains-dominated landscape with some scattered, slightly irregular undulating plains and hills. Mainly low-tussock grasslands with an abundant karroid element. Dominance of *Themeda triandra* is an important feature of this vegetation unit. Locally low cover of *T. triandra* and the associated increase in *Elionurus muticus, Cymbopogon pospischilii* and *Aristida congesta* is attributed to heavy grazing and/or erratic rainfall (Mucina & Rutherford, 2006).

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 Vaal Vet Sandy Grassland.

Graminoids: *Anthephora pubescens* (d), *Aristida congesta* (d), *Chloris virgata* (d), *Cymbopogon caesius* (d), *Cynodon dactylon* (d), *Digitaria argyrograpta* (d), *Elionurus muticus* (d), *Eragrostis chloromelas* (d), *E. lehmanniana* (d), *E. plana* (d*), E. trichophora* (d), *Heteropogon contortus* (d), *Panicum gilvum* (d), *Setaria sphacelata* (d), *Themeda triandra* (d), *Tragus berteronianus* (d), *Brachiaria serrata*, *Cymbopogon pospischilii, Digitaria eriantha, Eragrostis curvula, E. obtusa, E. superba, Panicum coloratum, Pogonarthria squarrosa, Trichoneura grandiglumis, Triraphis andropogonoides* (Mucina & Rutherford, 2006).

Herbs**:** *Stachys spathulata* (d), *Barleria macrostegia*, *Berkheya onopordifolia* var. *onopordifolia*, *Chamaesyce inaequilatera*, *Geigeria aspera* var. *aspera*, *Helichrysum caespititium*, *Hermannia depressa, Hibiscus pusillus, Monsonia burkeana, Rhynchosia adenodes, Selago densiflora, Vernonia oligocephala* (Mucina & Rutherford, 2006).

Geophytic Herbs: *Bulbine narcissifolia, Ledebouria marginata*.

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

Low Shrubs: *Felicia muricata* (d), *Pentzia globosa* (d), *Anthospermum rigidum* subsp. *pumilum, Helichrysum dregeanum*, *H. paronychioides, Ziziphus zeyheriana* (Mucina & Rutherford, 2006).

Endemic Taxon Herb: *Lessertia phillipsiana*.

B. Central Free State Grassland

The Central Free State Grassland vegetation type is found in the Free State and marginally into Gauteng Province. This vegetation type typically comprises of undulating plains supporting short grassland, in natural condition dominated by *Themeda triandra* while *Eragrostis curvula and E. chloromelas* become dominant in degraded habitats. Dwarf karoo bushes establish in severely degraded clayey bottomlands. Overgrazed and trampled low-lying areas with heavy clayey soils are prone to *Acacia karroo* encroachment (Mucina & Rutherford, 2006).

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 Central Free State Grassland.

Graminoids: *Aristida adscensionis* (d), *A. congesta* (d), *Cynodon dactylon* (d), *Eragrostis chloromelas* (d), *E. curvula* (d), *E. plana* (d), *Panicum coloratum* (d), *Setaria sphacelata* (d), *Themeda triandra* (d), *Tragus koelerioides* (d), *Agrostis lachnantha*, *Andropogon appendiculatus, Aristida bipartita, A. canescens, Cymbopogon pospischilii, Cynodon transvaalensis, Digitaria argyrograpta, Elionurus muticus, Eragrostis lehmanniana, E. micrantha, E. obtusa, E. racemosa, E. trichophora, Heteropogon contortus, Microchloa caffra, Setaria incrassata, Sporobolus discosporus* (Mucina & Rutherford, 2006).

Herbs: *Berkheya onopordifolia* var. *onopordifolia, Chamaesyce inaequilatera, Conyza pinnata, Crabbea acaulis, Geigeria aspera* var. *aspera, Hermannia depressa, Hibiscus pusillus, Pseudognaphalium luteo-album, Salvia stenophylla, Selago densiflora, Sonchus dregeanus* (Mucina & Rutherford, 2006).

Geophytic Herbs: *Oxalis depressa, Raphionacme dyeri* (Mucina & Rutherford, 2006).

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

Low Shrubs: *Felicia muricata* (d), *Anthospermum rigidum* subsp. *pumilum, Helichrysum dregeanum, Melolobium candicans, Pentzia globosa* (Mucina & Rutherford, 2006).

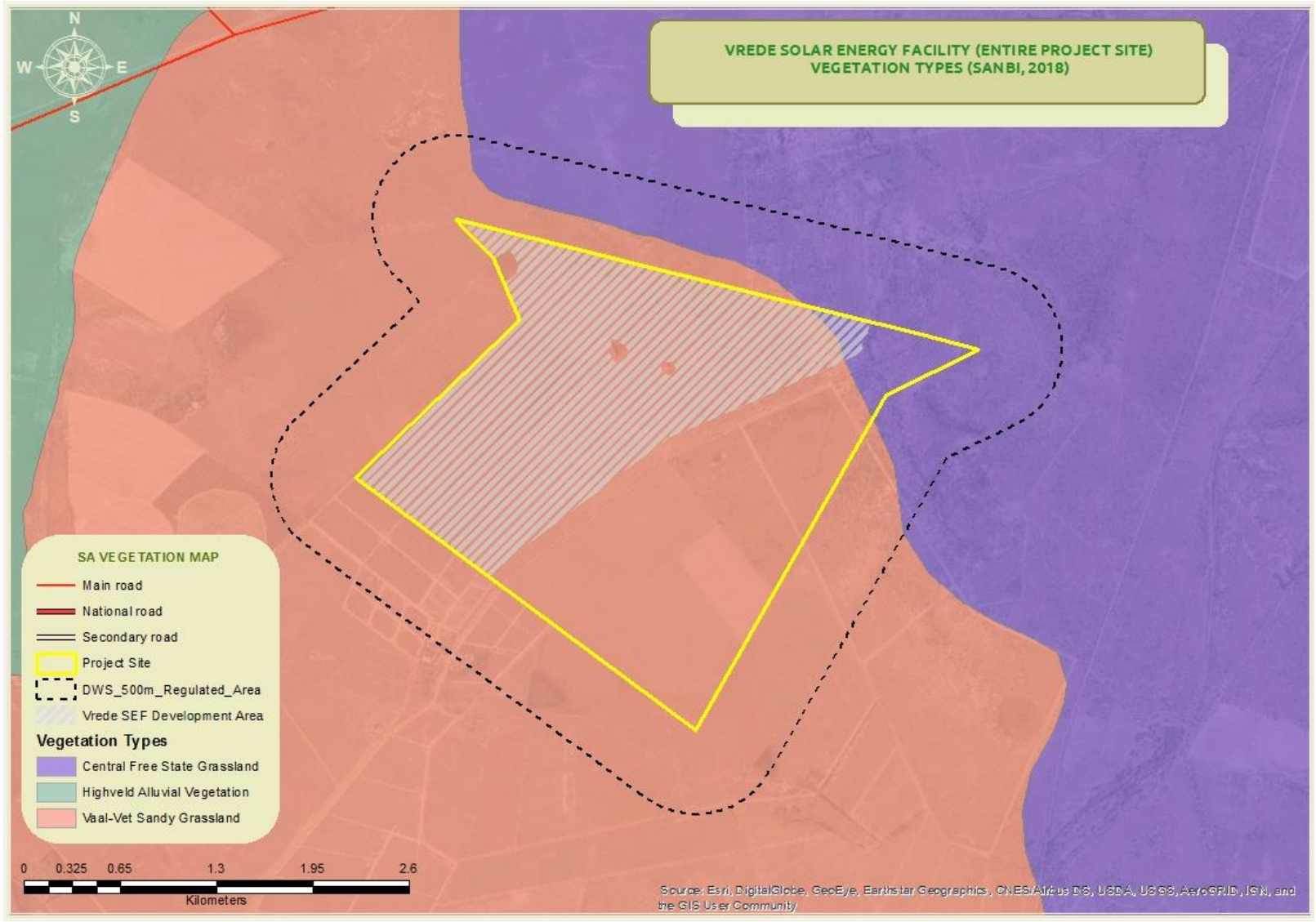


Figure 9: Vegetation Types (SANBI, 2018)

Plant Species of Conservation Concern

Based on the Plants of Southern Africa (BODATSA-POSA, 2020) database, 491 plant species are expected to occur in the project site. Figure 5 shows the extent of the grid that was used to compile the expected species list based on the Plants of Southern Africa (BODATSA-POSA, 2020) database. The list of expected plant species is provided in Appendix 1. Of the 491-plant species, only one species is listed as being a Species of Conservation Concern (SCC) namely *Anacampseros recurvata* subsp. *buderiana*. It is likely that this individual has been wrongfully identified as this species is Endemic to the quartz plains and outcrops of the Richtersveld. As such the Likelihood of Occurrence for this species within the project area is highly unlikely.

Faunal Overview

Mammals

The IUCN Red List Spatial Data lists 73 mammal species that could be expected to occur within the vicinity of the project site (Appendix 2). Of these species, 8 are medium to large conservation dependant species, such as *Ceratotherium simum* (Southern White 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 65 small to medium sized mammal species, ten (10) are listed as being of conservation concern on a regional or global basis (Table 8).

The list of potential species includes:

- One (1) that is listed as Endangered (EN) on a regional basis;
- Four (4) that are listed as Vulnerable (VU) on a regional basis; and
- Five (5) that are listed as Near Threatened (NT) on a regional scale.

Table 8: 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	High
Lycaon pectus	African Wild Dog	EN	EN	Low
Mystromys albicaudatus	White-tailed Rat	VU	EN	High
Panthera pardus	Leopard	VU	VU	Low
Parahyaena brunnea	Brown Hyena	NT	NT	Moderate

Species	Common Name	Conservation Status		Likelihood of Occurrence
		Red Data	IUCN	
Poecilogale albinucha	African Striped Weasel	NT	LC	Moderate

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 site 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 site 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 site 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 site 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.

Lycaon pictus (African Wild Dog) is categorised as Endangered on both a regional and an international scale. Population size is continuing to decline as a result of ongoing habitat fragmentation, conflict with human activities, and infectious disease. African Wild Dogs are generalist predators, occupying a range of habitats including short-grass plains, semi-desert, bushy savannas and upland forest. This species mainly occurs in recognised

protected areas but a few free ranging groups can still be found in South Africa. The likelihood of occurrence in the project site is rated as low.

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 site 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 site and the likelihood of occurrence of this species is therefore considered to be moderate.

Reptiles

Based on the IUCN Red List Spatial Data (IUCN, 2017) and the ReptileMap database provided by the Animal Demography Unit (ADU, 2017) twenty-eight (28) reptile species are expected to occur in the project area (Appendix 3). Two reptile species of conservation concern is expected to be present in the project site, namely *Smaug giganteus* (Sungazer or Ouvolk) and *Chamaesaura aenea* (Coppery Grass Lizard) (Table 9).

Smaug giganteus (Sungazer or 'Ouvolk') is categorised as Vulnerable on both a regional and an international scale. It is endemic to South Africa, where it is found only in the grasslands of the northern Free State and the southwestern parts of Mpumalanga (IUCN, 2017). Habitat loss due to agriculture is a continuing threat. Large portions of the grassland habitat are underlain by coal beds of varying quality and extent, and exploitation of coal for fuel has and will result in further habitat loss. The likelihood of finding the species in the project site is high.

Chamaesaura aenea (Coppery Grass Lizard) is categorised as near threatened on both an international and a regional scale. A population reduction of over 20% in the last 18 years (three generations) is inferred from the transformation of large parts of the Grassland Biome. They are threatened by transformation of land for crop farming and plantations, overgrazing by livestock, infrastructural development, frequent anthropogenic fires and use of pesticides. The likelihood of occurrence in the project site is rated as moderate.

Amphibians

Based on the IUCN Red List Spatial Data (IUCN, 2017) and the AmphibianMap database provided by the Animal Demography Unit (ADU, 2017) twenty (20) amphibian species are expected to occur in the project site (Appendix 4).

One amphibian species of conservation concern could be present in the project area according to the above-mentioned sources, namely *Pyxicephalus adspersus* (Giant Bullfrog) (Table 9).

The Giant Bull Frog (*Pyxicephalus adspersus*) is a species of conservation concern that may possibly occur in the project area. 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). There appears to be moderate suitable habitat for this species in the project site and therefore the likelihood of occurrence is regarded as moderate.

Table 9: List of herpetofaunal 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	
Amphibians				
Pyxicephalus adspersus	Giant Bullfrog	VU	VU	Moderate
Reptiles				
Smaug giganteus	Sungazer	NT	NT	High
Chamaesaura aenea	Coppery Grass Lizard	NT	LC	Moderate

Freshwater Resource Scoping Assessment

Desktop Wetland Delineation

According to Partridge *et al*. (2010) 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).

The sub-Province Southern Highveld is drained by south-bank Vaal River tributaries. The rivers rise in the Eastern Escarpment Hinterland in the south before flowing northwest into the Vaal River valley. The valley cross-sectional profiles are broader than in the North-eastern Highveld, but narrower than those of the North-western Highveld. There is also a broad trend from north to south, with narrower valley cross-sectional profiles and flatter slopes in the north and broader valley forms and steeper slopes in the south. Significantly, however, the average valley slopes are flatter than in the other two sub-provinces. The sub-province is therefore characterised predominantly by BF[1] and WF sediment storage surrogate descriptors. With the exception of the Wilge River (which has a logarithmic BFC[2]), the concave longitudinal profiles are predominantly exponential.

Wetlands within the region are 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 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

[1] BF & WF: Sediment storage surrogate descriptor indicative of high sediment storage capability.
[2] BFCs: Macro-reach Best Fit Curves

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 Vals and Vet Rivers.

As mentioned, in terms of the NFEPA (2011) and the NBAs 2018 National Wetlands Map 5 the project area contains a few small natural endorheic depression (pans) features and some numerous small earth dam/reservoir structures (artificial wetlands). Most of these small dams have been constructed within the natural depression features in an attempt to deepen portions of the wetlands in order to collect store surface water for longer periods of time. According to the NFEPA Wetland coverage no wetland features are located within the SEF Development Area, whilst the NBAs National Wetland coverage also indicates no wetlands within the development area, but shows two small depression wetlands located just outside of the development area.

However, following a desktop mapping exercise wherein all available Geo-spatial resources were closely analysed numerous wetland features were identified within the project site as well as the DWS 500m regulated area (Figure 10 and 11).

A total of sixteen (10) natural wetland features have been identified, most of which were depression or valley-bottom wetlands. A few seepage wetlands were also identified, mostly along the southern boundary of the development area. Most of the valley-bottom (VB) wetlands were naturally unchanneled, however the fairly large VB wetland identified within the north-eastern corner of the project site was predominantly channelled. All of these VB wetlands drain either in a northern or a north-western direction towards the Blomspruit River located approximately five (6) kilometres to the west of the project site. The delineated channelled VB wetland can be regarded as the primary drainage feature within the project site.

The presence and extent of all wetland features, at risk of being potentially impacted by the development (refer to risk screening section below) will be confirmed, and their boundaries adjusted where needed, following an infield delineation (using all wetland indicators) of these features during the EIA phase. Furthermore, these wetland features' Present Ecological State (PES), their Ecological Sensitivity and Importance (EIS) as well their recommended buffer areas will be determined during the EIA phase.

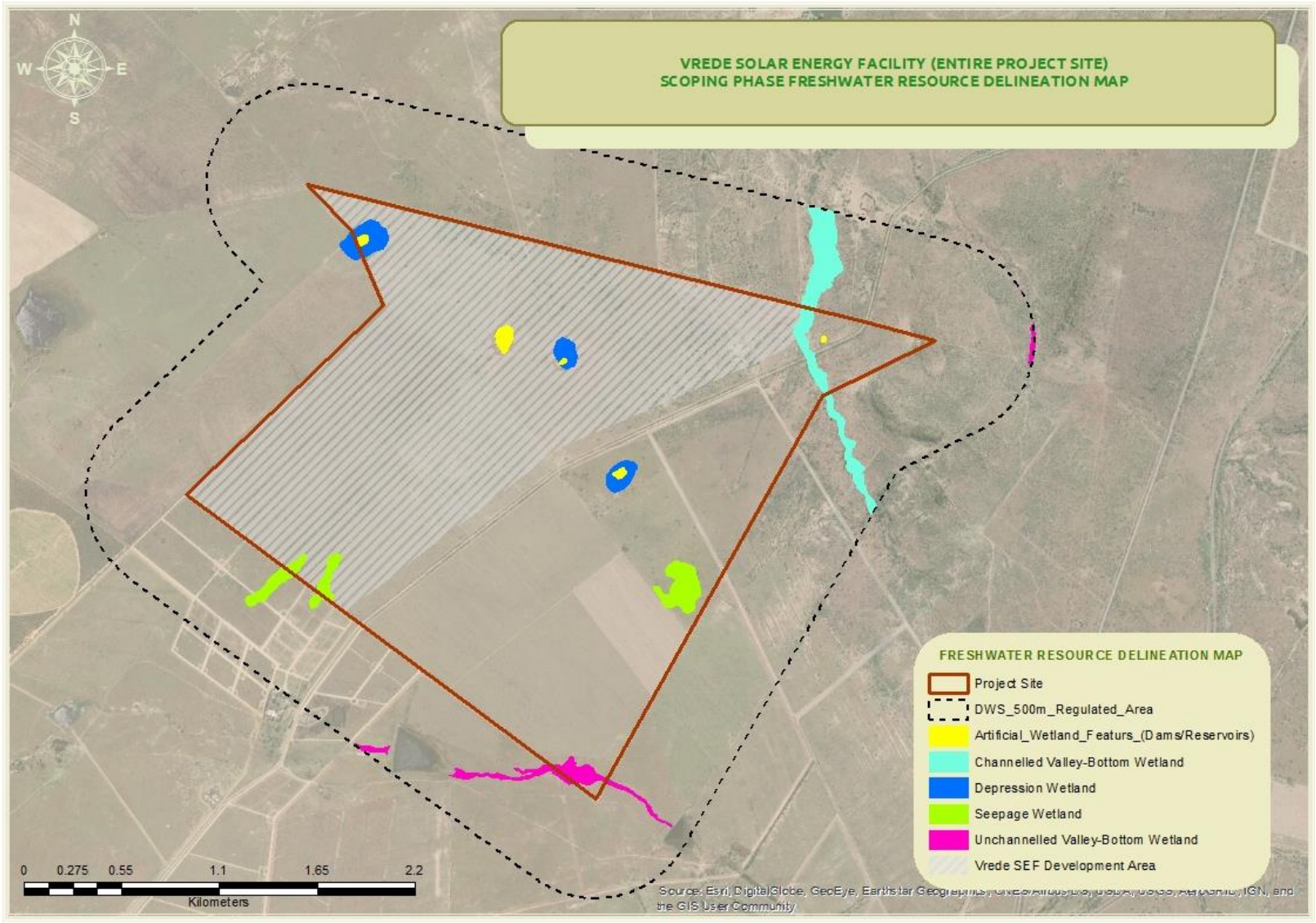


Figure 10: Desktop delineated freshwater resources (Map of entire project site).

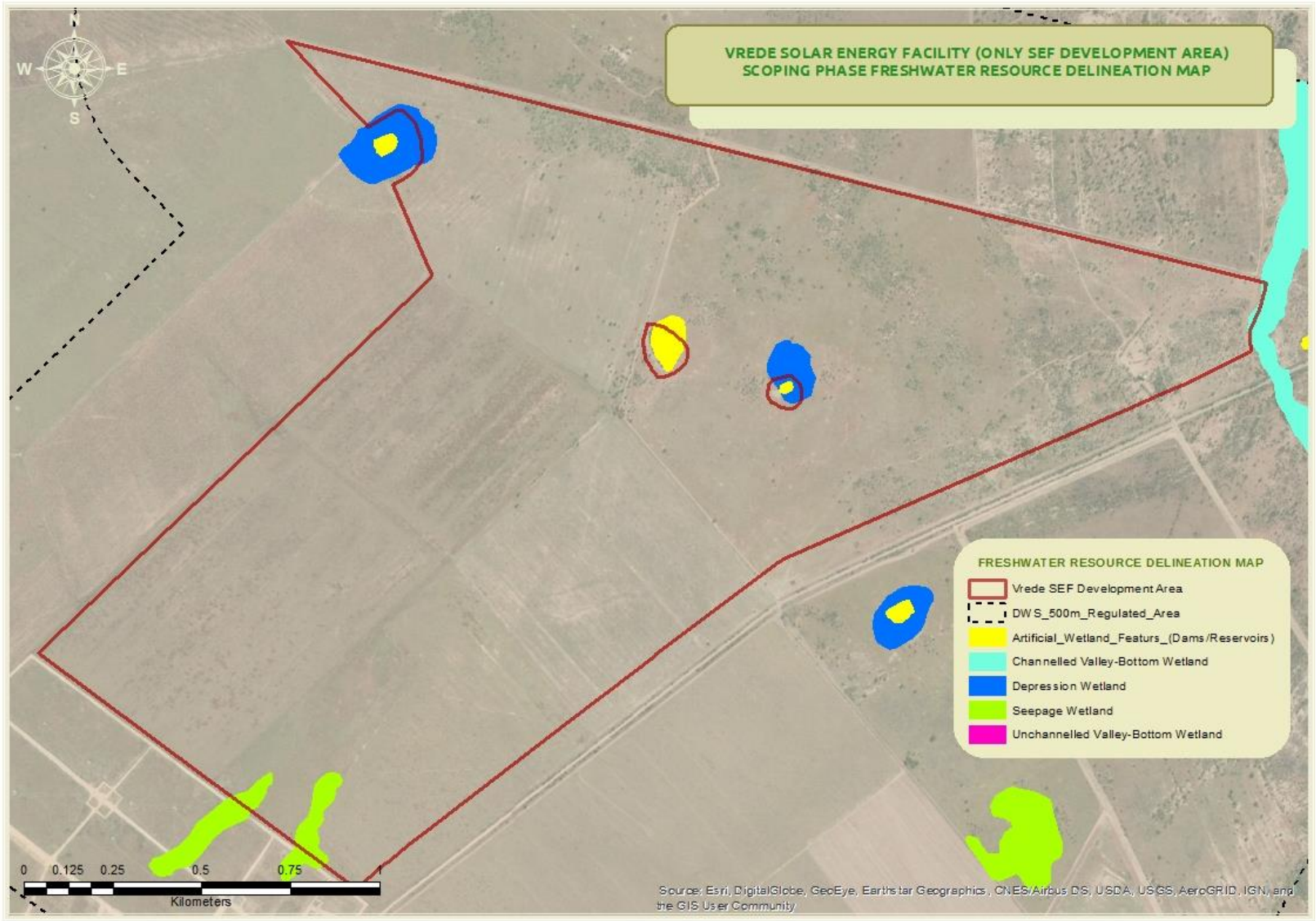


Figure 11: Desktop delineated freshwater resources (Map of Vrede SEF Development Area).

Desktop Wetland Risk Screening

As described within the previous section, water resources (wetland) within a radius of 500m around the proposed project site was mapped and classified at a desktop level. Following the delineation exercise a desktop rating of risk associated with the proposed activities has been done. This has been undertaken to guide field assessments and inform water use identification for the proposed project. Several water resources were identified and rated and include wetland features in the form of endorheic depression wetlands, seepages and valley bottom wetlands that fall within the 500m regulated area.

Typically, the main risks associated with the construction and operations of the proposed activities are:

» Direct physical modification / destruction of surface water resources within/in the vicinity of the development area.
» Direct physical loss and/or modification of surface water resources within the development area, both planned and accidental;
» Direct physical alteration of flow characteristics of wetlands within the development site and associated erosion and sedimentation impacts;
» Alteration of catchment / surface water processes / hydrological inputs and associated erosion and sedimentation impacts; and
» Surface runoff contamination and local watercourse water quality deterioration.

The risk ratings for each of the mapped water resources are presented in Table 10 and Figure 12 below. The proposed activities pose a potential high risk to five (5) wetland features (two seepage wetlands, two depression wetlands and the channelled VB wetland), and a medium risk to one depression wetland which is located outside of the development area but with its catchment extending slightly into the proposed development area. The remainder of the delineated wetlands are located outside of the development area and with their catchments either located outside of the development area (Low Risk) or which are located far enough outside of the development area, for the development to pose a low risk to these wetlands.

Note: The risk ratings provided relates to the likelihood that a water resources unit may be measurably negatively affected to inform the legal processes. Thus, this is essentially risk screening, **not a risk assessment and risk ratings are not a representation of impact intensity/magnitude of the change.**

Table 10: Preliminary risk ratings for the mapped wetland units including rationale.

Risk Class	Water Resource Number	Water Resource	Rationale
High	4	Depression Wetland	These are all surface water resource features located within the development area, or located in very close proximity to the area.
	5	Depression Wetland	
	7	Channelled Valley-Bottom Wetland	
	9	Seepage Wetland	
	10	Seepage Wetland	
Moderate	6	Depression Wetland	These are surface water resource features that are all located outside of the development area but still in relatively close proximation to the development area. Furthermore, these features are located downslope of the development area, with catchments that include portions of the development area. Due to the low impact nature of this type of development, these surface water features are at moderate risk of being impacted.
Low	1	Seepage Wetland	These are all surface water features located quite some distance from the development area (>200m), with the development area located either some distance outside of these features' catchment areas or some distance downstream. Subsequently the likelihood of risk of impact, posed by the development, on these features are low.
	2	Seepage Wetland	
	3	Unchanneled Valley-Bottom Wetland	

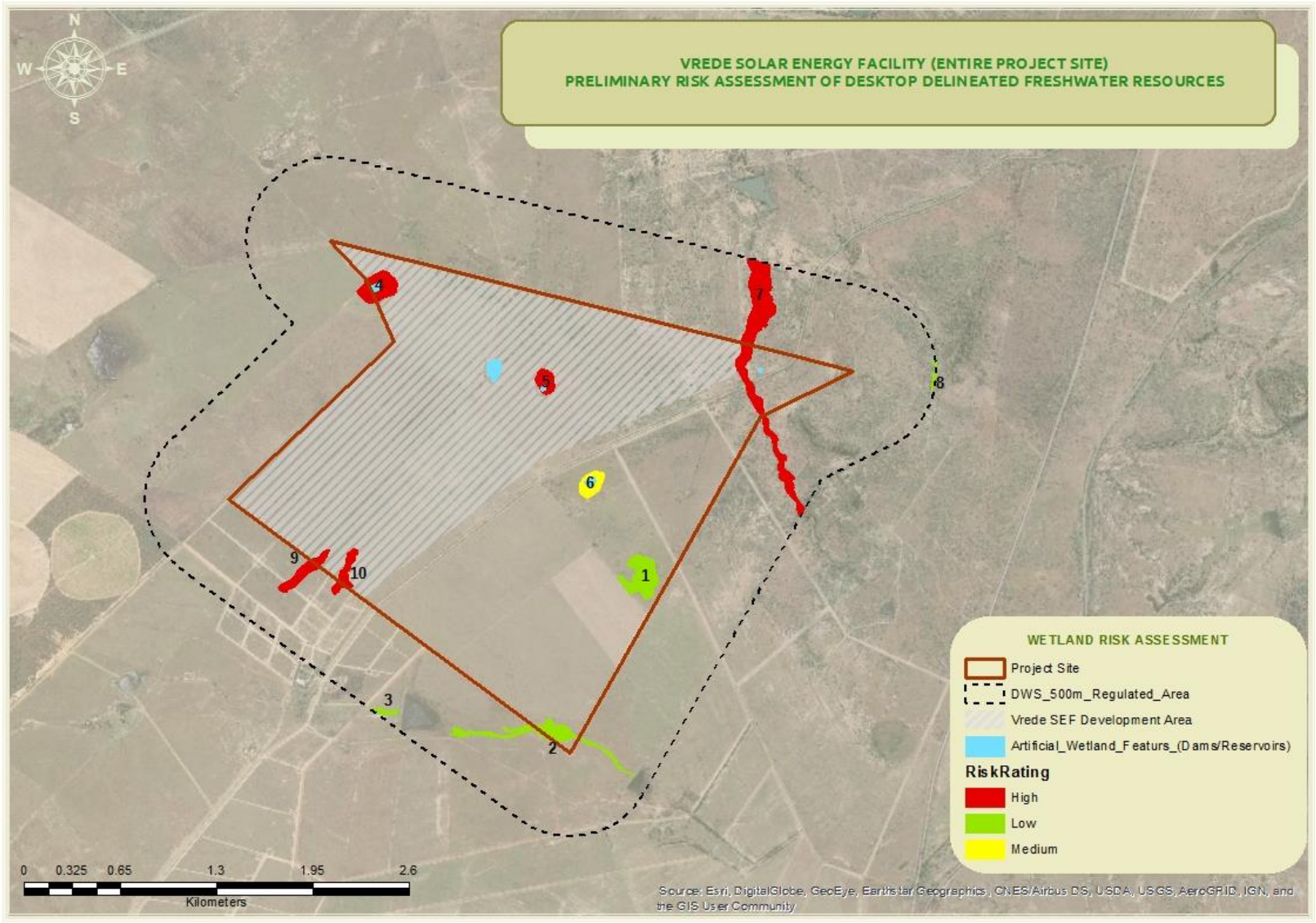


Figure 12: Risk Assessment of delineated freshwater resources.

Scoping Phase Sensitivity Analysis

The following sensitivity map (Figure 13) has been compiled using available Geo-spatial information as well as existing information such as Critical Biodiversity Areas in combination with NFEPA Wetlands. This is only a preliminary map and information obtained during the site visit in the EIA Phase will be used to fine-tune and ground-truth the map.

Very High Sensitivity

» Wetland Features: Wetland features that feed into important downstream watercourses, are associated with natural Vaal-Vet Sandy Grassland and CBA1, provide various unique habitats and niches (contribute to habitat and species diversity), are a potential suitable habitat for *Pyxicephalus adspersus* – Giant Bullfrog (Near Threatened), and fulfil vital ecological functions and services such as flood attenuation, stream flow augmentation, erosion control and the enhancement of water quality (sediment trapping, removal and storage of phosphates, nitrates and toxicants).

» Natural Grassland and Open Shrub Grassland: Natural grassland features that are representative of Vaal-Vet Sandy Grassland (Endangered), are located within CBA1, and provide potential habitat for species of conservation concern, especially *Smaug gigantius* – Sungazer (Vulnerable).

High Sensitivity

» Natural Wetland Features: All natural wetland features that are located outside of natural Vaal-Vet Sandy Grassland and CBA1 but are still regarded as relative natural capable of providing important functions and services such as flood attenuation, erosion control, the removal and storage of Nitrates and toxicants (enhancement of water quality) and the contribution to habitat and niche diversity. Wetland located within ESA1 have also been classified as high.

» Artificial Wetland Features: All dam/reservoir features associated with natural wetlands regarded as very high sensitive.

Medium Sensitivity

» Artificial Wetland Features: Dams and reservoirs located outside of any sensitive natural wetland features. Even though regarded as a form of disturbance, these dams/reservoirs provide and store surface water for the natural fauna of the area as well as livestock.

» Grassland and Open Shrub Grassland: Small isolated and fractured natural to near natural grassland patches that are representative of Vaal-Vet Sandy Grassland but due to their size as well as fractured and isolated nature (surrounded by highly transformed areas), are not regarded as important for the conservation of this endangered vegetation type. Furthermore, all grassland features located outside of CBAs or which represent Central Free State Grassland have also been classified as medium sensitive. These grassland features also provides potential habitat for *Smaug gigantius* – Sungazer (Vulnerable).

» Re-established grassland on historical cultivated areas: These areas have been left fallow for an extended period of time and the re-establishment of mostly indigenous vegetation have been allowed to such an extent that the vegetation can be regarded as stable (plagioclimax), providing most of the functions and services associated with natural grassland. These areas are also potential habitat for *Smaug gigantius* – Sungazer (Vulnerable).

Low Sensitivity

» All transformed and disturbed area: This includes access roads and disturbed road shoulders, farm roads, fire breaks, trampled and overgrazed grassland, as well as old abandoned cultivated areas.

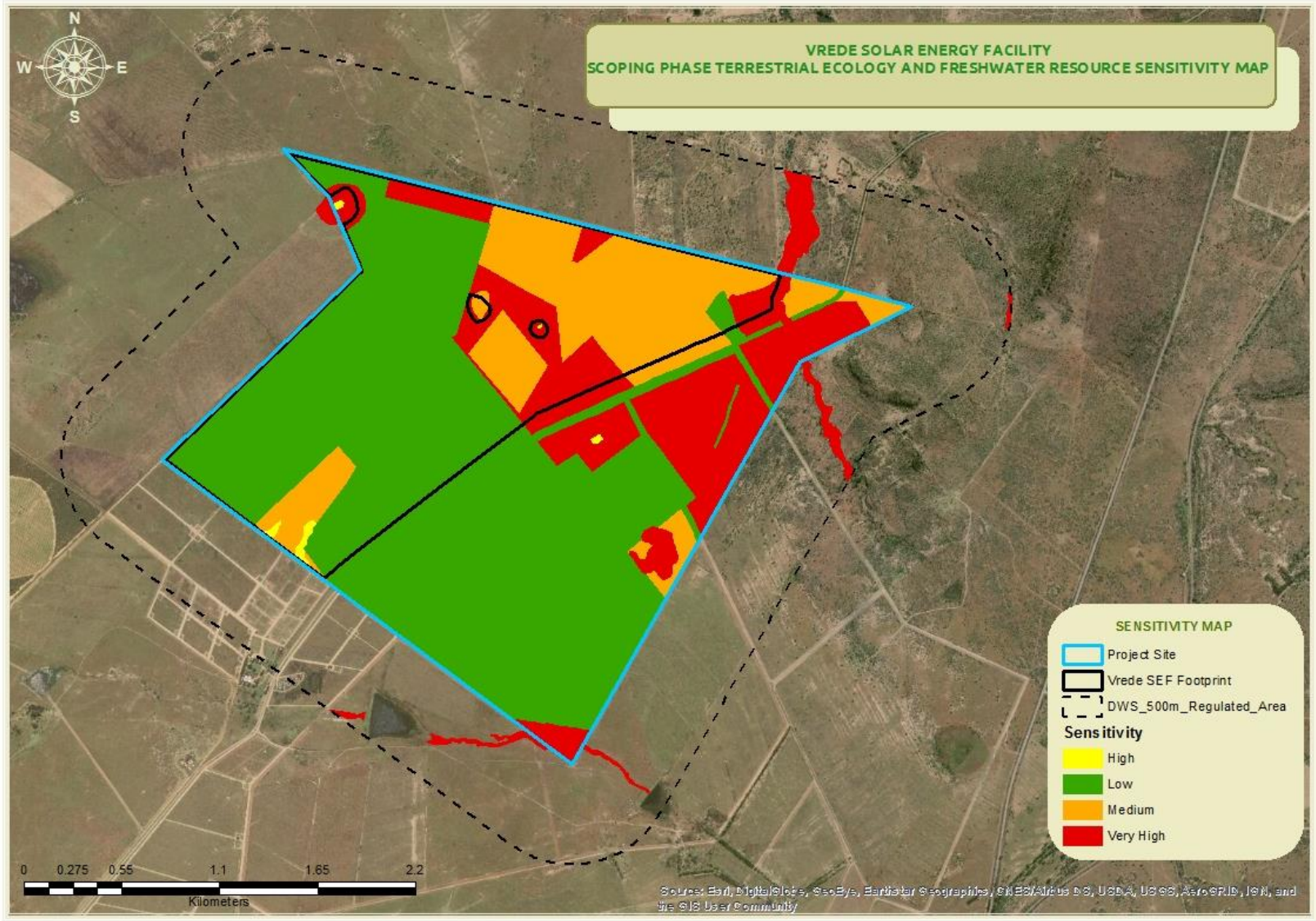


Figure 13: Scoping Phase Terrestrial Ecology and Freshwater Resource Sensitivity Map.

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.

The largest portion of the development area is located within Vaal-Vet Sandy Grassland which is classified as Endangered 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). Although the development will impact at a local scale it is highly unlikely that this development will impact the status of this vegetation type. Furthermore, the development will be, although long term, not permanent and by selecting fixed panel technology accompanied by only mowing of lower plant layers instead of total clearance of the vegetation within the development area, the original lower strata vegetation will be allowed to somewhat persist within most of the development area. With the absence of grazing activities taking place within the development area some areas may even progress into a more natural state.

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 area 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 Critical Biodiversity Areas and Broad-Scale Ecological Processes*

The north-eastern and north-western portion of the SEF Development Area is located within a CBA1, due to its location within the endangered Vaal-Vet Sandy Grassland Ecosystem. The loss of and transformation of intact, habitats could compromise the status and ecological functioning of these habitats and may fracture and disrupt the connectivity of these CBAs, impacting the Province's ability to meet its conservation targets

Impact on these Critical Biodiversity Areas can be maintained to an absolute minimum or even avoided by restricting the development to disturbed and transformed areas within the CBA's. By furthermore implementing effective mitigation measures the functionality of these areas and connectivity between these areas may be maintained.

During a thorough examination of available satellite imagery (including historical imagery) it was found that large portions of that have been classified as CBAs were in fact historical cultivated areas that have been left fallow for an extensive period of time allowing for succession to take place to a stage where these areas are now covered with a relative stable grass and dwarf shrub cover. Subsequently, natural/original Vaal-Vet Sandy Grassland are only confined to a few isolated patches. Due to the small extent and patchy distribution of this endangered vegetation type within the SEF Development Area, it is unlikely that this development will have an impact on the status of the remaining natural Vaal-Vet Sandy Grassland. However, this statement can only be confirmed during the EIA phase when these areas will be assessed during a site visit.

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;	Local	No "no-go' areas so far identified. During the EIA Phase natural and undisturbed forms of Vaal-Vet Sandy Grassland and areas containing SCC 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.

	» 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; » 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;	Local	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. However, due to present and past transformation of a large part of the area and surroundings, the presence of critical/ restricted habitats for SCC are regarded as unlikely.

	» 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.		
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	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.

	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 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 CBAs may negatively impact biodiversity and the ecological functioning of the CBA.	Local and Regional	The CBA located in the study area may be a potential no-go area, following a survey of the area during the EIA phase, wherein the natural state and contribution to the CBA unit as a whole will be determined.

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; » 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.	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.
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 Kroonstad 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 area, the species composition 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;	Local	No "no-go' areas so far identified. During the EIA Phase natural and undisturbed forms of Vaal-Vet Sandy Grassland and areas containing SCC 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.

	» 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.		
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, especially to lower-lying wetland areas, and » Impairment of wetland function.		

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 (e.g. wetlands, drainage lines and other sensitive habitats) from the development 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 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 Critical Biodiversity Areas.

Freshwater Resource Impacts Assessment

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

Overview of the most significant impacts of the proposed development

Construction and operation may lead to potential indirect loss of / or damage to potential wetland habitats. This may potentially lead to localised loss of wetland habitat and may lead to downstream impacts that affect a greater extent of wetlands or impact on wetland function and biodiversity. Where these habitats are already stressed due to degradation and transformation, the loss may lead to increased vulnerability (susceptibility to future damage) of the habitat. Physical alteration to wetlands can have an impact on the functioning of those wetlands. Consequences may include:

» *increased loss of soil;*
» *loss of/or disturbance to indigenous wetland vegetation;*
» *loss of sensitive wetland habitats;*
» *loss or disturbance to individuals of rare, endangered, endemic and/or protected species that occur in wetlands;*
» *fragmentation of sensitive habitats;*

- » *impairment of wetland function;*
- » *change in channel morphology in downstream wetlands, potentially leading to further loss of wetland vegetation; and*
- » *reduction in water quality in wetlands downstream*

Sixteen (10) wetland features have preliminary been identified. The extent, condition as well as functions and services of these wetlands will be determined during the EIA phase Assessment and final appropriate buffers will be recommended. Preliminary buffer size, based on the desktop survey of these wetland features have been determined to be 35m. Following the field survey (EIA Phase) and buffer size recommendations as provided within the DWS's Buffer Tool, this size may be amended within the EIA Phase.

Issue	**Nature of Impact during the <u>Construction Phase</u>**	**Extent of Impact**	**No-Go Areas**
Disturbance to and loss of wetland vegetation	Construction of infrastructure may lead to direct loss of vegetation, causing a localised or more extensive reduction in the overall extent of vegetation. Potential consequences include: » General loss of habitat for sensitive fauna and flora species; » General reduction in biodiversity; » Reduction in the ability of the wetlands to fulfil their ecological services and functions such as flood attenuation and the enhancement of water quality through the precipitation and storage of nitrates and toxicants; » Disturbance to processes maintaining biodiversity and ecosystem goods and services; and » Exposure of soil to erosion.	Local	All Very High and High Sensitive wetland features should be regarded as 'No-Go' Areas A preliminary buffer area of 35m is recommended, however the final buffer size will be determined within the EIA Phase. These buffer areas should also be considered as a 'No-Go' area
Impact on wetland systems through the	An increase in the surface water budget of the wetlands, due to an increase in volume and velocity of surface water flow from the cleared construction areas	Local and immediate surroundings	All Very High and High Sensitive wetland features should be regarded as 'No-Go' Areas

possible increase in surface water runoff	into the wetlands, may result in the loss of natural wetland vegetation and potentially expose the wetland soils to erosion.		A preliminary buffer area of 35m is recommended, however the final buffer size will be determined within the EIA Phase. These buffer areas should also be considered as a 'No-Go' area
Increase sedimentation and erosion	Activities associated with the construction phase may potentially lead to some direct or indirect loss of or damage to the identified wetlands and watercourses. Impacts on these systems will most likely be: » Vegetation clearing within the development area may result in an increase in surface water flow and expose areas prone to erosion and these areas may expand / spread into the wetlands. » The eroded material may enter the wetlands and may potentially impact these systems through siltation.	Local and immediate surroundings	All Very High and High Sensitive wetland features should be regarded as 'No-Go' Areas A preliminary buffer area of 35m is recommended, however the final buffer size will be determined within the EIA Phase. These buffer areas should also be considered as a 'No-Go' area
Impact on localized surface water quality	Chemical pollutants (hydrocarbons from equipment and vehicles, cleaning fluids, cement etc.) could potentially be washed downslope into the wetlands and potentially affect water quality.	Local and immediate surroundings	All Very High and High Sensitive wetland features should be regarded as 'No-Go' Areas A preliminary buffer area of 35m is recommended, however the final buffer size will be determined within the EIA Phase. These buffer areas should also be considered as a 'No-Go' area
Loss of habitat for fauna dependent on such habitats.	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	Local	All Very High and High Sensitive wetland features should be regarded as 'No-Go' Areas A preliminary buffer area of 35m is recommended, however the final buffer size will be determined within

	spatially limited, such as isolated, endorheic pans, and will be negatively impacted by a development. 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 is SCC that may potentially utilized these habitat types, namely the Giant Bull Frog. Some of the wetlands identified within the study area may potentially be suitable habitat. However, this will be confirmed during the EIA Phase		the EIA Phase. These buffer areas should also be considered as a 'No-Go' area

Gaps in knowledge & recommendations for further study

» A detailed Surface Hydrological survey and assessment will be undertaken during the EIA phase according to methods outlined in this report.
» Following, the determination of habitat integrity and sensitivity (during EIA phase), especially towards the impacts associated with such a PV development; appropriate buffers will be recommended as well as activities which may be acceptable within the buffer areas without threatening the integrity of the wetland areas.

Issue	Nature of Impact during the Operational Phase	Extent of Impact	No-Go Areas
Impact on wetland systems through the possible increase in surface water runoff	An increase in the surface water budget of the wetlands, due to an increase in volume and velocity of surface water flow from the cleared areas and from any compacted and hard surface (including PV panels). This may result in: » a change in vegetation composition and structure, » the exposure of wetland soils leaving these areas prone to soil erosion; » increase in sedimentation and subsequently a reduction in water quality; and » reduction in the ability of the wetlands to fulfil vital ecological functions and services such as flood attenuation and precipitation of minerals such as nitrates and toxicants.	Local to immediate surroundings	All Very High and High Sensitive wetland features should be regarded as 'No-Go' Areas A preliminary buffer area of 35m is recommended, however the final buffer size will be determined within the EIA Phase. These buffer areas should also be considered as a 'No-Go' area
Impact on localized surface water quality	Chemical pollutants (hydrocarbons from service equipment and vehicles etc.) could potentially be washed downslope into these wetlands and potentially affect water quality.	Local to immediate surroundings	All Very High and High Sensitive wetland features should be regarded as 'No-Go' Areas A preliminary buffer area of 35m is recommended, however the final buffer size will be determined within the EIA Phase. These buffer areas should also be considered as a 'No-Go' area
Gaps in knowledge & recommendations for further study » A detailed Surface Hydrological survey and assessment will be undertaken during the EIA phase according to methods outlined in this report.			

» Following the determination of habitat integrity and sensitivity (during EIA phase), especially towards the impacts associated with such a PV development; appropriate buffers will be recommended as well as activities which may be acceptable within the buffer areas without threatening the integrity of the wetland areas.

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

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.

Due to the fact that these identified wetlands have been subjected to very long term (>12 years) cultivation practices, as well as other forms of disturbances these wetlands have lost some of their functions and services with the remainder occurring in a limited and highly altered manner. Subsequently, their value (ecological importance and sensitivity) has been significantly reduced. It is also probable that this value will only slightly increase if rehabilitated to a satisfactory level (will never be able to rehabilitate to original form). Taking the current state, value and rehabilitation potential into account, the potential significance, magnitude, extent of the above described impacts is regarded as very low. Furthermore, with the necessary mitigation measures, the significance of these impacts can be even further reduced.

Furthermore, potential cumulative impacts are:

» The compromise of ecological processes as well as ecological functioning of these important freshwater resource habitats
  - Transformation of intact habitat could potentially compromise ecological processes as well as ecological functioning of important habitats and would contribute to habitat fragmentation and potentially disruption of habitat connectivity and furthermore impair their ability to respond to environmental fluctuations. This is especially of relevance for larger watercourses and wetlands serving as important groundwater recharge and floodwater attenuation zones, important microhabitats for various organisms and important corridor zones for faunal movement

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.

The Terrestrial Biodiversity (Fauna and Flora and Terrestrial Habitat) Assessment as well as Aquatic Biodiversity 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).

Plan of Study for Detailed Freshwater Resource Assessment

- » Detailed baseline field survey to confirm / ground-truth wetland boundaries, assess wetland condition, functioning and importance/sensitivity.
- » Identification and assessment of the estimated significance of key ecological impacts to wetlands.
- » Confirm any fatal flaws from an aquatic ecological perspective to inform planning and layout of development proposed.
- » Assess the need and desirability for wetland 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 relevant wetland buffer zones, development realignments, onsite controls (Best Management Practices: BMPs) and initial post-development rehabilitation requirements (i.e. conceptual wetland rehabilitation strategy).

8. CONCLUSION AND RECOMMENDATIONS

The study area falls within two vegetation types namely; Vaal-Vet Sandy Grassland and Central Free State Grassland. However, the proposed Development Area is located mostly within the Vaal-Vet Sandy Grassland with a small portion extending into the Central Free State Grassland. Vaal-Vet Sandy Grassland is listed as an endangered ecosystem whilst the Central Free State Grassland is not listed as a threatened ecosystem.

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 compilation of a scoping report (i.e. this document) with the intention of the scoping process being 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 13). 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:

Very High Sensitivity

- » <u>Wetland Features:</u> Wetland features that feed into important downstream watercourses, are associated with natural Vaal-Vet Sandy Grassland and CBA1, provide various unique habitats and niches (contribute to habitat and species diversity), are a potential suitable habitat for *Pyxicephalus adspersus* – Giant Bullfrog (Near

Threatened), and fulfil vital ecological functions and services such as flood attenuation, stream flow augmentation, erosion control and the enhancement of water quality (sediment trapping, removal and storage of phosphates, nitrates and toxicants).

» Natural Grassland and Open Shrub Grassland: Natural grassland features that are representative of Vaal-Vet Sandy Grassland (Endangered), are located within CBA1, and provide potential habitat for species of concervation concern, especially *Smaug gigantius* – Sungazer (Vulnerable).

High Sensitivity

» Natural Wetland Features: All natural wetland features that are located outside of natural Vaal-Vet Sandy Grassland and CBA1 but are still regarded as relative natural capable of providing important functions and services such as flood attenuation, erosion control, the removal and storage of Nitrates and toxicants (enhancement of water quality) and the contribution to habitat and niche diversity. Wetland located within ESA1 have also been classified as high.

» Artificial Wetland Features: All dam/reservoir features associated with natural wetlands regarded as very high sensitive.

Medium Sensitivity

» Artificial Wetland Features: Dams and reservoirs located outside of any sensitive natural wetland features. Even though regarded as a form of disturbance, these dams/reservoirs provide and store surface water for the natural fauna of the area as well as livestock.

» Grassland and Open Shrub Grassland: Small isolated and fractured natural to near natural grassland patches that are representative of Vaal-Vet Sandy Grassland but due to their size as well as fractured and isolated nature (surrounded by highly transformed areas), are not regarded as important for the conservation of this endangered vegetation type. Furthermore, all grassland features located outside of CBAs or which represent Central Free State Grassland have also been classified as medium sensitive. These grassland features also provides potential habitat for *Smaug gigantius* – Sungazer (Vulnerable).

» Re-established grassland on historical cultivated areas: These areas have been left fallow for an extended period of time and the re-establishment of mostly indigenous vegetation have been allowed to such an extent that the vegetation can be regarded as stable (plagioclimax), providing most of the functions and services associated with natural grassland. These areas are also potential habitat for *Smaug gigantius* – Sungazer (Vulnerable).

Low Sensitivity

» All transformed and disturbed area: This includes access roads and disturbed road shoulders, farm roads, fire breaks, trampled and overgrazed grassland, woodlots and small plantations as well as fallow and old cultivated areas.

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.

The most significant potential impacts expected to occur with the development of the proposed Vrede 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.
» Possible impacts on the wetland areas due to altered surface hydrology of the surrounding plains. This may result in the exposure of wetland soil leaving these areas prone to soil erosion and invasion with alien plants.

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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).

Family	Taxon	IUCN	Ecology
Acanthaceae	*Blepharis integrifolia (L.f.) E.Mey. ex Schinz var. integrifolia*	LC	Indigenous
Acanthaceae	*Justicia orchioides L.f. subsp. glabrata Immelman*	LC	Indigenous; Endemic
Acanthaceae	*Blepharis subvolubilis C.B.Clarke*	LC	Indigenous
Acanthaceae	*Barleria macrostegia Nees*	LC	Indigenous
Acanthaceae	*Dicliptera leistneri K.Balkwill*	LC	Indigenous; Endemic
Acanthaceae	*Crabbea acaulis N.E.Br.*	LC	Indigenous
Acanthaceae	*Dicliptera clinopodia Nees*	LC	Indigenous
Acanthaceae	*Dyschoriste burchellii (Nees) Kuntze*	LC	Indigenous
Agavaceae	*Chlorophytum fasciculatum (Baker) Kativu*	LC	Indigenous
Aizoaceae	*Chasmatophyllum musculinum (Haw.) Dinter & Schwantes*	LC	Indigenous
Aizoaceae	*Ruschia sp.*		
Aizoaceae	*Hereroa glenensis (N.E.Br.) L.Bolus*	LC	Indigenous; Endemic
Aizoaceae	*Delosperma mahonii (N.E.Br.) N.E.Br.*	LC	Indigenous
Aizoaceae	*Braunsia apiculata (Kensit) L.Bolus*	LC	Indigenous; Endemic
Aizoaceae	*Delosperma sp. L.Bolus*		
Alliaceae	*Tulbaghia acutiloba Harv.*	LC	Indigenous
Alliaceae	*Tulbaghia sp.*		
Amaranthaceae	*Salsola glabrescens Burtt Davy*	LC	Indigenous
Amaranthaceae	*Amaranthus hybridus L. subsp. hybridus var. hybridus*		Not indigenous; Naturalised
Amaranthaceae	*Chenopodium album L.*		Not indigenous; Naturalised; Invasive
Amaranthaceae	*Sericorema sericea (Schinz) Lopr.*	LC	Indigenous
Amaranthaceae	*Aerva leucura Moq.*	LC	Indigenous
Amaranthaceae	*Guilleminea densa (Humb. & Bonpl. ex Schult.) Moq.*		Not indigenous; Naturalised; Invasive
Amaranthaceae	*Alternanthera pungens Kunth*		Not indigenous; Naturalised
Amaranthaceae	*Salsola kali L.*		Not indigenous; Naturalised; Invasive
Amaranthaceae	*Sericorema remotiflora (Hook.f.) Lopr.*	LC	Indigenous
Amaranthaceae	*Dysphania carinata (R.Br.) Mosyakin & Clemants*		Not indigenous; Naturalised; Invasive
Amaranthaceae	*Amaranthus thunbergii Moq.*	LC	Indigenous
Amaranthaceae	*Atriplex semibaccata R.Br.*		Not indigenous; Naturalised; Invasive
Amaryllidaceae	*Gethyllis transkarooica D.Mull.-Doblies*	LC	Indigenous
Amaryllidaceae	*Boophone disticha (L.f.) Herb.*	LC	Indigenous

Amaryllidaceae	*Nerine hesseoides L.Bolus*	LC	Indigenous; Endemic
Amaryllidaceae	*Ammocharis coranica (Ker Gawl.) Herb.*	LC	Indigenous
Amaryllidaceae	*Nerine laticoma (Ker Gawl.) T.Durand & Schinz*	LC	Indigenous
Amaryllidaceae	*Crinum bulbispermum (Burm.f.) Milne-Redh. & Schweick.*	LC	Indigenous
Amaryllidaceae	*Brunsvigia radulosa Herb.*	LC	Indigenous
Amaryllidaceae	*Haemanthus montanus Baker*	LC	Indigenous
Anacampserotaceae	*Anacampseros recurvata Schonland subsp. buderiana (Poelln.) Gerbaulet*	EN	Indigenous; Endemic
Anacampserotaceae	*Anacampseros ustulata E.Mey. ex Fenzl*	LC	Indigenous; Endemic
Anacampserotaceae	*Anacampseros sp.*		
Anacardiaceae	*Smodingium argutum E.Mey. ex Sond.*	LC	Indigenous; Endemic
Anacardiaceae	*Searsia rigida (Mill.) F.A.Barkley var. rigida*	LC	Indigenous; Endemic
Anacardiaceae	*Searsia pyroides (Burch.) Moffett var. pyroides*	LC	Indigenous
Anacardiaceae	*Searsia lancea (L.f.) F.A.Barkley*	LC	Indigenous
Apiaceae	*Deverra burchellii (DC.) Eckl. & Zeyh.*	LC	Indigenous
Apiaceae	*Conium chaerophylloides (Thunb.) Sond.*	LC	Indigenous
Apocynaceae	*Raphionacme hirsuta (E.Mey.) R.A.Dyer*	LC	Indigenous
Apocynaceae	*Stenostelma capense Schltr.*	LC	Indigenous
Apocynaceae	*Xysmalobium brownianum S.Moore*	LC	Indigenous
Apocynaceae	*Araujia sericifera Brot.*		Not indigenous; Naturalised; Invasive
Apocynaceae	*Orbea lutea (N.E.Br.) Bruyns subsp. lutea*	LC	Indigenous
Apocynaceae	*Cordylogyne globosa E.Mey.*	LC	Indigenous
Apocynaceae	*Brachystelma foetidum Schltr.*	LC	Indigenous
Apocynaceae	*Brachystelma ramosissimum (Schltr.) N.E.Br.*	LC	Indigenous
Apocynaceae	*Asclepias aurea (Schltr.) Schltr.*	LC	Indigenous
Apocynaceae	*Asclepias gibba (E.Mey.) Schltr. var. media N.E.Br.*	LC	Indigenous
Apocynaceae	*Asclepias gibba (E.Mey.) Schltr. var. gibba*	LC	Indigenous
Apocynaceae	*Asclepias stellifera Schltr.*	LC	Indigenous
Aponogetonaceae	*Aponogeton junceus Lehm.*	LC	Indigenous
Asparagaceae	*Asparagus laricinus Burch.*	LC	Indigenous
Asparagaceae	*Asparagus suaveolens Burch.*	LC	Indigenous
Asparagaceae	*Asparagus bechuanicus Baker*	LC	Indigenous
Asparagaceae	*Asparagus cooperi Baker*	LC	Indigenous
Asparagaceae	*Asparagus setaceus (Kunth) Jessop*	LC	Indigenous
Asphodelaceae	*Trachyandra asperata Kunth var. asperata*	LC	Indigenous
Asphodelaceae	*Bulbine abyssinica A.Rich.*	LC	Indigenous
Asphodelaceae	*Aloe subspicata (Baker) Boatwr. & J.C.Manning*		Indigenous
Asphodelaceae	*Bulbine asphodeloides (L.) Spreng.*	LC	Indigenous
Asphodelaceae	*Trachyandra asperata Kunth var. basutoensis (Poelln.) Oberm.*	LC	Indigenous
Asphodelaceae	*Trachyandra saltii (Baker) Oberm. var. saltii*	LC	Indigenous
Asphodelaceae	*Trachyandra asperata Kunth var. nataglencoensis (Kuntze) Oberm.*	LC	Indigenous
Asphodelaceae	*Trachyandra saltii (Baker) Oberm.*		Indigenous
Asphodelaceae	*Bulbine capitata Poelln.*	LC	Indigenous

Asphodelaceae	*Aloe grandidentata Salm-Dyck*	LC	Indigenous
Asphodelaceae	*Bulbine narcissifolia Salm-Dyck*	LC	Indigenous
Asphodelaceae	*Trachyandra laxa (N.E.Br.) Oberm. var. rigida (Suess.) Roessler*	LC	Indigenous
Asphodelaceae	*Bulbine frutescens (L.) Willd.*	LC	Indigenous
Asphodelaceae	*Trachyandra asperata Kunth var. macowanii (Baker) Oberm.*	LC	Indigenous
Asteraceae	*Tagetes minuta L.*		Not indigenous; Naturalised; Invasive
Asteraceae	*Litogyne gariepina (DC.) Anderb.*	LC	Indigenous
Asteraceae	*Osteospermum spinescens Thunb.*	LC	Indigenous
Asteraceae	*Pseudognaphalium luteoalbum (L.) Hilliard & B.L.Burtt*	LC	Not indigenous; cryptogenic
Asteraceae	*Nolletia ciliaris (DC.) Steetz*	LC	Indigenous
Asteraceae	*Erigeron bonariensis L.*		Not indigenous; Naturalised; Invasive
Asteraceae	*Helichrysum rugulosum Less.*	LC	Indigenous
Asteraceae	*Senecio consanguineus DC.*	LC	Indigenous
Asteraceae	*Tolpis capensis (L.) Sch.Bip.*	LC	Indigenous
Asteraceae	*Dicoma macrocephala DC.*	LC	Indigenous
Asteraceae	*Felicia muricata (Thunb.) Nees subsp. muricata*	LC	Indigenous
Asteraceae	*Platycarphella parvifolia (S.Moore) V.A.Funk & H.Rob.*	LC	Indigenous; Endemic
Asteraceae	*Dicoma anomala Sond. subsp. anomala*	LC	Indigenous
Asteraceae	*Dimorphotheca zeyheri Sond.*	LC	Indigenous
Asteraceae	*Acanthospermum glabratum (DC.) Wild*		Not indigenous; Naturalised
Asteraceae	*Arctotis venusta Norl.*	LC	Indigenous
Asteraceae	*Denekia capensis Thunb.*	LC	Indigenous
Asteraceae	*Zinnia peruviana (L.) L.*		Not indigenous; Naturalised; Invasive
Asteraceae	*Hilliardiella capensis (Houtt.) H.Rob., Skvarla & V.A.Funk*		Indigenous
Asteraceae	*Helichrysum pumilio (O.Hoffm.) Hilliard & B.L.Burtt subsp. pumilio*	LC	Indigenous; Endemic
Asteraceae	*Seriphium plumosum L.*		Indigenous
Asteraceae	*Haplocarpha scaposa Harv.*	LC	Indigenous
Asteraceae	*Helichrysum dregeanum Sond. & Harv.*	LC	Indigenous
Asteraceae	*Tarchonanthus camphoratus L.*	LC	Indigenous
Asteraceae	*Pentzia globosa Less.*	LC	Indigenous
Asteraceae	*Conyza podocephala DC.*		Indigenous
Asteraceae	*Helichrysum nudifolium (L.) Less. var. nudifolium*	LC	Indigenous
Asteraceae	*Nidorella resedifolia DC. subsp. resedifolia*	LC	Indigenous
Asteraceae	*Pentzia viridis Kies*	LC	Indigenous; Endemic
Asteraceae	*Hilliardiella elaeagnoides (DC.) Swelank. & J.C.Manning*		Indigenous
Asteraceae	*Lasiospermum pedunculare Lag.*	LC	Indigenous; Endemic
Asteraceae	*Senecio laevigatus Thunb. var. laevigatus*	LC	Indigenous; Endemic
Asteraceae	*Bidens pilosa L.*		Not indigenous; Naturalised
Asteraceae	*Senecio asperulus DC.*	LC	Indigenous
Asteraceae	*Sonchus oleraceus L.*		Not indigenous; Naturalised; Invasive

Asteraceae	*Gazania krebsiana Less. subsp. arctotoides (Less.) Roessler*	LC	Indigenous
Asteraceae	*Osteospermum leptolobum (Harv.) Norl.*	LC	Indigenous; Endemic
Asteraceae	*Arctotis arctotoides (L.f.) O.Hoffm.*	LC	Indigenous
Asteraceae	*Schkuhria pinnata (Lam.) Kuntze ex Thell.*		Not indigenous; Naturalised
Asteraceae	*Pentzia calcarea Kies*	LC	Indigenous
Asteraceae	*Oncosiphon piluliferus (L.f.) Kallersjo*	LC	Indigenous
Asteraceae	*Hertia ciliata (Harv.) Kuntze*	LC	Indigenous
Asteraceae	*Eriocephalus karooicus M.A.N.Mull.*	LC	Indigenous; Endemic
Asteraceae	*Cotula australis (Spreng.) Hook.f.*	LC	Indigenous
Asteraceae	*Geigeria burkei Harv. subsp. burkei var. burkei*	NE	Indigenous
Asteraceae	*Xanthium spinosum L.*		Not indigenous; Naturalised; Invasive
Asteraceae	*Helichrysum zeyheri Less.*	LC	Indigenous
Asteraceae	*Galinsoga parviflora Cav.*		Not indigenous; Naturalised
Asteraceae	*Cotula anthemoides L.*	LC	Indigenous
Asteraceae	*Geigeria aspera Harv. var. aspera*	LC	Indigenous
Asteraceae	*Helichrysum argyrosphaerum DC.*	LC	Indigenous
Asteraceae	*Berkheya radula (Harv.) De Wild.*	LC	Indigenous
Asteraceae	*Geigeria brevifolia (DC.) Harv.*	LC	Indigenous
Asteraceae	*Xanthium strumarium L.*		Not indigenous; Naturalised; Invasive
Asteraceae	*Berkheya onopordifolia (DC.) O.Hoffm. ex Burtt Davy var. onopordifolia*	LC	Indigenous
Asteraceae	*Cineraria erodioides DC. var. erodioides*	LC	Indigenous
Asteraceae	*Cotula sp.*		
Asteraceae	*Ifloga glomerata (Harv.) Schltr.*	LC	Indigenous
Asteraceae	*Helichrysum caespititium (DC.) Harv.*	LC	Indigenous
Asteraceae	*Senecio reptans Turcz.*	LC	Indigenous; Endemic
Asteraceae	*Osteospermum scariosum DC. var. scariosum*	NE	Indigenous
Asteraceae	*Lactuca inermis Forssk.*	LC	Indigenous
Asteraceae	*Gnaphalium confine Harv.*	LC	Indigenous
Asteraceae	*Gnaphalium filagopsis Hilliard & B.L.Burtt*	LC	Indigenous
Asteraceae	*Osteospermum muricatum E.Mey. ex DC. subsp. muricatum*	LC	Indigenous
Asteraceae	*Artemisia afra Jacq. ex Willd. var. afra*	LC	Indigenous
Asteraceae	*Felicia fascicularis DC.*	LC	Indigenous
Asteraceae	*Arctotis microcephala (DC.) Beauverd*	LC	Indigenous
Boraginaceae	*Heliotropium lineare (A.DC.) Gurke*	LC	Indigenous
Boraginaceae	*Trichodesma angustifolium Harv. subsp. angustifolium*	LC	Indigenous
Boraginaceae	*Ehretia alba Retief & A.E.van Wyk*	LC	Indigenous
Boraginaceae	*Anchusa riparia A.DC.*	LC	Indigenous
Boraginaceae	*Lappula heteracantha Ledeb.*		Not indigenous; Naturalised
Boraginaceae	*Anchusa capensis Thunb.*	LC	Indigenous
Boraginaceae	*Anchusa azurea Mill.*		Not indigenous; Naturalised
Boraginaceae	*Lithospermum cinereum A.DC.*	LC	Indigenous

Brassicaceae	*Rorippa nudiuscula Thell.*	LC	Indigenous
Brassicaceae	*Capsella bursa-pastoris (L.) Medik.*		Not indigenous; Naturalised
Brassicaceae	*Lepidium africanum (Burm.f.) DC. subsp. africanum*	LC	Indigenous
Brassicaceae	*Sisymbrium orientale L.*		Not indigenous; Naturalised
Campanulaceae	*Wahlenbergia denticulata (Burch.) A.DC. var. denticulata*	LC	Indigenous
Campanulaceae	*Wahlenbergia undulata (L.f.) A.DC.*	LC	Indigenous
Campanulaceae	*Wahlenbergia androsacea A.DC.*	LC	Indigenous
Caryophyllaceae	*Pollichia campestris Aiton*	LC	Indigenous
Caryophyllaceae	*Corrigiola litoralis L. subsp. litoralis var. litoralis*	NE	Indigenous
Caryophyllaceae	*Dianthus micropetalus Ser.*	LC	Indigenous
Caryophyllaceae	*Silene burchellii Otth ex DC. subsp. modesta J.C.Manning & Goldblatt*	LC	Indigenous
Celastraceae	*Gymnosporia buxifolia (L.) Szyszyl.*	LC	Indigenous
Colchicaceae	*Colchicum melanthioides (Willd.) J.C.Manning & Vinn. subsp. melanthioides*	LC	Indigenous
Colchicaceae	*Colchicum burkei (Baker) J.C.Manning & Vinn.*	LC	Indigenous
Commelinaceae	*Commelina africana L. var. lancispatha C.B.Clarke*	LC	Indigenous
Commelinaceae	*Commelina livingstonii C.B.Clarke*	LC	Indigenous
Commelinaceae	*Commelina benghalensis L.*	LC	Indigenous
Commelinaceae	*Commelina africana L. var. africana*	LC	Indigenous
Convolvulaceae	*Ipomoea oblongata E.Mey. ex Choisy*	LC	Indigenous
Convolvulaceae	*Convolvulus boedeckerianus Peter*	LC	Indigenous; Endemic
Convolvulaceae	*Convolvulus dregeanus Choisy*	LC	Indigenous; Endemic
Convolvulaceae	*Seddera capensis (E.Mey. ex Choisy) Hallier f.*	LC	Indigenous
Convolvulaceae	*Convolvulus sagittatus Thunb.*	LC	Indigenous
Convolvulaceae	*Ipomoea bolusiana Schinz*	LC	Indigenous
Convolvulaceae	*Falkia oblonga Bernh. ex C.Krauss*	LC	Indigenous
Convolvulaceae	*Ipomoea oenotheroides (L.f.) Raf. ex Hallier f.*	LC	Indigenous
Crassulaceae	*Crassula capitella Thunb. subsp. nodulosa (Schonland) Toelken*	LC	Indigenous
Crassulaceae	*Crassula deltoidea Thunb.*	LC	Indigenous
Crassulaceae	*Crassula natalensis Schonland*	LC	Indigenous
Crassulaceae	*Crassula vaillantii (Willd.) Roth*		Not indigenous; Naturalised
Crassulaceae	*Crassula lanceolata (Eckl. & Zeyh.) Endl. ex Walp. subsp. lanceolata*	LC	Indigenous
Crassulaceae	*Crassula lanceolata (Eckl. & Zeyh.) Endl. ex Walp. subsp. transvaalensis (Kuntze) Toelken*	LC	Indigenous
Crassulaceae	*Kalanchoe rotundifolia (Haw.) Haw.*	LC	Indigenous
Cucurbitaceae	*Cucumis myriocarpus Naudin subsp. myriocarpus*	LC	Indigenous
Cucurbitaceae	*Coccinia sessilifolia (Sond.) Cogn.*	LC	Indigenous
Cyperaceae	*Cyperus esculentus L. var. esculentus*	LC	Indigenous
Cyperaceae	*Kyllinga alba Nees*	LC	Indigenous
Cyperaceae	*Cyperus usitatus Burch.*	LC	Indigenous
Cyperaceae	*Cyperus congestus Vahl*	LC	Indigenous
Cyperaceae	*Cyperus semitrifidus Schrad.*	LC	Indigenous
Cyperaceae	*Cyperus marginatus Thunb.*	LC	Indigenous

Cyperaceae	*Cyperus eragrostis Lam.*		Not indigenous; Naturalised
Cyperaceae	*Afroscirpoides dioeca (Kunth) Garcia-Madr.*		Indigenous
Cyperaceae	*Kyllinga erecta Schumach. var. erecta*	LC	Indigenous
Cyperaceae	*Cyperus uitenhagensis (Steud.) C.Archer & Goetgh.*	LC	Indigenous
Cyperaceae	*Cyperus obtusiflorus Vahl var. flavissimus (Schrad.) Boeckeler*	LC	Indigenous
Cyperaceae	*Cyperus longus L. var. tenuiflorus (Rottb.) Boeckeler*	NE	Indigenous
Cyperaceae	*Isolepis setacea (L.) R.Br.*	LC	Indigenous
Cyperaceae	*Eleocharis dregeana Steud.*	LC	Indigenous
Cyperaceae	*Cyperus rupestris Kunth var. rupestris*	LC	Indigenous
Cyperaceae	*Bulbostylis humilis (Kunth) C.B.Clarke*	LC	Indigenous
Cyperaceae	*Scleria sp.*		
Cyperaceae	*Schoenoplectus muricinux (C.B.Clarke) J.Raynal*	LC	Indigenous
Cyperaceae	*Cyperus difformis L.*	LC	Indigenous
Cyperaceae	*Schoenoplectus decipiens (Nees) J.Raynal*	LC	Indigenous
Cyperaceae	*Cyperus denudatus L.f.*	LC	Indigenous
Cyperaceae	*Cyperus fastigiatus Rottb.*	LC	Indigenous
Cyperaceae	*Bulbostylis hispidula (Vahl) R.W.Haines subsp. pyriformis (Lye) R.W.Haines*	LC	Indigenous
Ebenaceae	*Diospyros lycioides Desf. subsp. lycioides*	LC	Indigenous
Elatinaceae	*Bergia pentheriana Keissl.*	LC	Indigenous
Equisetaceae	*Equisetum ramosissimum Desf. subsp. ramosissimum*	LC	Indigenous
Erpodiaceae	*Erpodium beccarii Mull.Hal.*		Indigenous
Euphorbiaceae	*Euphorbia pseudotuberosa Pax*	LC	Indigenous
Euphorbiaceae	*Euphorbia striata Thunb.*	LC	Indigenous
Euphorbiaceae	*Euphorbia inaequilatera Sond. var. inaequilatera*	NE	Indigenous
Euphorbiaceae	*Euphorbia clavarioides Boiss.*	LC	Indigenous
Euphorbiaceae	*Euphorbia prostrata Aiton*	NE	Not indigenous; Naturalised
Euphorbiaceae	*Euphorbia natalensis Bernh. ex Krauss*	LC	Indigenous
Fabaceae	*Senna italica Mill. subsp. arachoides (Burch.) Lock*	LC	Indigenous
Fabaceae	*Listia heterophylla E.Mey.*	LC	Indigenous
Fabaceae	*Indigofera zeyheri Spreng. ex Eckl. & Zeyh.*	LC	Indigenous
Fabaceae	*Chamaecrista biensis (Steyaert) Lock*	LC	Indigenous
Fabaceae	*Rhynchosia holosericea Schinz*	LC	Indigenous
Fabaceae	*Indigofera torulosa E.Mey. var. angustiloba (Baker f.) J.B.Gillett*	LC	Indigenous; Endemic
Fabaceae	*Indigofera cryptantha Benth. ex Harv. var. cryptantha*	LC	Indigenous
Fabaceae	*Dolichos angustifolius Eckl. & Zeyh.*	LC	Indigenous
Fabaceae	*Sesbania transvaalensis J.B.Gillett*	LC	Indigenous
Fabaceae	*Vachellia karroo (Hayne) Banfi & Galasso*	LC	Indigenous
Fabaceae	*Lessertia frutescens (L.) Goldblatt & J.C.Manning subsp. frutescens*	LC	Indigenous
Fabaceae	*Crotalaria distans Benth. subsp. distans*	LC	Indigenous
Fabaceae	*Trifolium africanum Ser. var. africanum*	NE	Indigenous
Fabaceae	*Melolobium calycinum Benth.*	LC	Indigenous

Fabaceae	*Rhynchosia confusa Burtt Davy*	NE	Indigenous
Fabaceae	*Eriosema salignum E.Mey.*	LC	Indigenous
Fabaceae	*Indigofera filipes Benth. ex Harv.*	LC	Indigenous
Fabaceae	*Erythrina zeyheri Harv.*	LC	Indigenous
Fabaceae	*Lotononis sparsiflora (E.Mey.) B.-E.van Wyk*	LC	Indigenous
Fabaceae	*Crotalaria burkeana Benth.*	LC	Indigenous
Fabaceae	*Indigofera alternans DC. var. alternans*	LC	Indigenous
Fabaceae	*Argyrolobium molle Eckl. & Zeyh.*	LC	Indigenous; Endemic
Fabaceae	*Crotalaria virgulata Klotzsch subsp. grantiana (Harv.) Polhill*	LC	Indigenous
Fabaceae	*Rhynchosia totta (Thunb.) DC. var. totta*	LC	Indigenous
Fabaceae	*Argyrolobium collinum Eckl. & Zeyh.*	LC	Indigenous
Fabaceae	*Rhynchosia minima (L.) DC. var. prostrata (Harv.) Meikle*	NE	Indigenous
Fabaceae	*Elephantorrhiza elephantina (Burch.) Skeels*	LC	Indigenous
Fabaceae	*Zornia milneana Mohlenbr.*	LC	Indigenous
Fabaceae	*Melolobium obcordatum Harv.*	LC	Indigenous
Fabaceae	*Leobordea divaricata Eckl. & Zeyh.*	LC	Indigenous
Fabaceae	*Crotalaria sphaerocarpa Perr. ex DC. subsp. sphaerocarpa*	LC	Indigenous
Fabaceae	*Medicago laciniata (L.) Mill. var. laciniata*	NE	Not indigenous; Naturalised
Fabaceae	*Lessertia frutescens (L.) Goldblatt & J.C.Manning subsp. microphylla (Burch. ex DC.) J.C.Manning & Boatwr.*	LC	Indigenous
Fabaceae	*Vicia sp.*		
Fabaceae	*Rhynchosia nervosa Benth. ex Harv. var. nervosa*	LC	Indigenous
Fabroniaceae	*Fabronia pilifera Hornsch.*		Indigenous
Fagaceae	*Quercus robur L.*		Not indigenous; Cultivated; Naturalised; Invasive
Fagaceae	*Quercus acutissima Carruth.*		Not indigenous; Cultivated; Naturalised
Gentianaceae	*Sebaea exigua (Oliv.) Schinz*	LC	Indigenous
Geraniaceae	*Pelargonium sidoides DC.*	LC	Indigenous
Geraniaceae	*Monsonia angustifolia E.Mey. ex A.Rich.*	LC	Indigenous
Gisekiaceae	*Gisekia pharnaceoides L. var. pharnaceoides*	LC	Indigenous
Hyacinthaceae	*Drimia capensis (Burm.f.) Wijnands*	LC	Indigenous; Endemic
Hyacinthaceae	*Albuca sp.*		
Hyacinthaceae	*Albuca prasina (Ker Gawl.) J.C.Manning & Goldblatt*		Indigenous
Hyacinthaceae	*Ledebouria cooperi (Hook.f.) Jessop*	LC	Indigenous
Hyacinthaceae	*Massonia jasminiflora Burch. ex Baker*	LC	Indigenous
Hyacinthaceae	*Albuca shawii Baker*	LC	Indigenous
Hyacinthaceae	*Ledebouria marginata (Baker) Jessop*	LC	Indigenous
Hyacinthaceae	*Albuca virens (Ker Gawl.) J.C.Manning & Goldblatt subsp. virens*	LC	Indigenous
Hyacinthaceae	*Drimia intricata (Baker) J.C.Manning & Goldblatt*	LC	Indigenous
Hyacinthaceae	*Eucomis autumnalis (Mill.) Chitt. subsp. clavata (Baker) Reyneke*	NE	Indigenous
Hyacinthaceae	*Ledebouria ovatifolia (Baker) Jessop*		Indigenous

Hyacinthaceae	*Dipcadi ciliare (Eckl. & Zeyh. ex Harv.) Baker*	LC	Indigenous; Endemic
Hyacinthaceae	*Schizocarphus nervosus (Burch.) Van der Merwe*	LC	Indigenous
Hyacinthaceae	*Dipcadi marlothii Engl.*	LC	Indigenous
Hyacinthaceae	*Dipcadi viride (L.) Moench*	LC	Indigenous
Hyacinthaceae	*Ornithogalum juncifolium Jacq. var. juncifolium*	NE	Indigenous
Hyacinthaceae	*Drimia multisetosa (Baker) Jessop*	LC	Indigenous
Hyacinthaceae	*Albuca setosa Jacq.*	LC	Indigenous
Hyacinthaceae	*Lachenalia ensifolia (Thunb.) J.C.Manning & Goldblatt*	LC	Indigenous; Endemic
Hyacinthaceae	*Ledebouria sp.*		
Hyacinthaceae	*Drimia sp.*		
Hyacinthaceae	*Drimia elata Jacq. ex Willd.*	DD	Indigenous
Hydrocharitaceae	*Lagarosiphon muscoides Harv.*	LC	Indigenous
Hypoxidaceae	*Hypoxis iridifolia Baker*	LC	Indigenous
Hypoxidaceae	*Hypoxis hemerocallidea Fisch., C.A.Mey. & Ave-Lall.*	LC	Indigenous
Hypoxidaceae	*Hypoxis rigidula Baker var. rigidula*	LC	Indigenous
Hypoxidaceae	*Hypoxis argentea Harv. ex Baker var. argentea*	LC	Indigenous
Iridaceae	*Lapeirousia plicata (Jacq.) Diels subsp. foliosa Goldblatt & J.C.Manning*		Indigenous
Iridaceae	*Gladiolus permeabilis D.Delaroche subsp. edulis (Burch. ex Ker Gawl.) Oberm.*	LC	Indigenous
Iridaceae	*Duthieastrum linifolium (E.Phillips) M.P.de Vos*	LC	Indigenous; Endemic
Iridaceae	*Tritonia laxifolia (Klatt) Benth. ex Baker*	LC	Indigenous
Iridaceae	*Gladiolus dalenii Van Geel subsp. dalenii*	LC	Indigenous
Iridaceae	*Moraea pallida (Baker) Goldblatt*	LC	Indigenous
Iridaceae	*Moraea simulans Baker*	LC	Indigenous
Kewaceae	*Kewa bowkeriana (Sond.) Christenh.*	LC	Indigenous
Lamiaceae	*Salvia runcinata L.f.*	LC	Indigenous
Lamiaceae	*Mentha longifolia (L.) Huds. subsp. polyadena (Briq.) Briq.*	LC	Indigenous
Lamiaceae	*Teucrium trifidum Retz.*	LC	Indigenous
Lamiaceae	*Salvia stenophylla Burch. ex Benth.*		Indigenous
Lamiaceae	*Salvia verbenaca L.*	LC	Not indigenous; Naturalised; Invasive
Lamiaceae	*Stachys hyssopoides Burch. ex Benth.*	LC	Indigenous
Lamiaceae	*Stachys spathulata Burch. ex Benth.*	LC	Indigenous
Leskeaceae	*Pseudoleskeopsis claviramea (Mull.Hal.) Ther.*		Indigenous
Linderniaceae	*Linderniella nana (Engl.) Eb.Fisch., Schaferh. & Kai Mull.*		Indigenous
Lobeliaceae	*Lobelia sonderiana (Kuntze) Lammers*	LC	Indigenous
Malvaceae	*Grewia flava DC.*	LC	Indigenous
Malvaceae	*Corchorus asplenifolius Burch.*	LC	Indigenous
Malvaceae	*Hermannia depressa N.E.Br.*	LC	Indigenous
Malvaceae	*Sphaeralcea bonariensis (Cav.) Griseb.*		Not indigenous; Naturalised
Malvaceae	*Hibiscus calyphyllus Cav.*	LC	Indigenous
Malvaceae	*Hibiscus trionum L.*		Not indigenous; Naturalised
Malvaceae	*Sida chrysantha Ulbr.*	LC	Indigenous

Malvaceae	*Hermannia sp.*		
Malvaceae	*Pavonia burchellii (DC.) R.A.Dyer*	LC	Indigenous
Malvaceae	*Hermannia quartiniana A.Rich.*	LC	Indigenous
Malvaceae	*Hibiscus pusillus Thunb.*	LC	Indigenous
Malvaceae	*Hermannia oblongifolia (Harv.) Hochr.*	LC	Indigenous; Endemic
Malvaceae	*Malva parviflora L. var. parviflora*		Not indigenous; Naturalised
Malvaceae	*Hibiscus microcarpus Garcke*	LC	Indigenous
Marsileaceae	*Marsilea sp.*		
Marsileaceae	*Marsilea macrocarpa C.Presl*	LC	Indigenous
Nyctaginaceae	*Commicarpus plumbagineus (Cav.) Standl. var. plumbagineus*	LC	Indigenous
Nyctaginaceae	*Commicarpus pentandrus (Burch.) Heimerl*	LC	Indigenous
Oleaceae	*Menodora africana Hook.*	LC	Indigenous
Oleaceae	*Ligustrum lucidum W.T.Aiton*		Not indigenous; Cultivated; Naturalised; Invasive
Ophioglossaceae	*Ophioglossum sp.*		
Orchidaceae	*Eulophia ovalis Lindl. var. ovalis*	LC	Indigenous
Orchidaceae	*Habenaria epipactidea Rchb.f.*	LC	Indigenous
Oxalidaceae	*Oxalis latifolia Kunth*		Not indigenous; Naturalised; Invasive
Oxalidaceae	*Oxalis depressa Eckl. & Zeyh.*	LC	Indigenous
Pedaliaceae	*Pterodiscus speciosus Hook.*	LC	Indigenous
Phrymaceae	*Mimulus gracilis R.Br.*	LC	Indigenous
Phyllanthaceae	*Phyllanthus maderaspatensis L.*	LC	Indigenous
Phyllanthaceae	*Phyllanthus parvulus Sond. var. parvulus*	LC	Indigenous
Plantaginaceae	*Veronica anagallis-aquatica L.*	LC	Indigenous
Plantaginaceae	*Plantago major L.*		Not indigenous; Naturalised
Plantaginaceae	*Plantago lanceolata L.*	LC	Indigenous
Poaceae	*Eragrostis trichophora Coss. & Durieu*	LC	Indigenous
Poaceae	*Eragrostis pseudobtusa De Winter*	NE	Indigenous; Endemic
Poaceae	*Pogonarthria squarrosa (Roem. & Schult.) Pilg.*	LC	Indigenous
Poaceae	*Dactyloctenium aegyptium (L.) Willd.*	LC	Indigenous
Poaceae	*Anthephora pubescens Nees*	LC	Indigenous
Poaceae	*Eragrostis curvula (Schrad.) Nees*	LC	Indigenous
Poaceae	*Sporobolus fimbriatus (Trin.) Nees*	LC	Indigenous
Poaceae	*Urochloa mosambicensis (Hack.) Dandy*	LC	Indigenous
Poaceae	*Digitaria sanguinalis (L.) Scop.*	NE	Not indigenous; Naturalised
Poaceae	*Agrostis lachnantha Nees var. lachnantha*	LC	Indigenous
Poaceae	*Eragrostis gummiflua Nees*	LC	Indigenous
Poaceae	*Hyparrhenia dregeana (Nees) Stapf ex Stent*	LC	Indigenous
Poaceae	*Eragrostis lehmanniana Nees var. lehmanniana*	LC	Indigenous
Poaceae	*Ehrharta erecta Lam. var. erecta*	LC	Indigenous
Poaceae	*Eustachys paspaloides (Vahl) Lanza & Mattei*	LC	Indigenous
Poaceae	*Eragrostis micrantha Hack.*	LC	Indigenous

Poaceae	*Digitaria tricholaenoides Stapf*	LC	Indigenous
Poaceae	*Aristida congesta Roem. & Schult. subsp. barbicollis (Trin. & Rupr.) De Winter*	LC	Indigenous
Poaceae	*Echinochloa colona (L.) Link*	LC	Indigenous
Poaceae	*Cynodon hirsutus Stent*	LC	Indigenous
Poaceae	*Cymbopogon caesius (Hook. & Arn.) Stapf*	LC	Indigenous
Poaceae	*Eragrostis obtusa Munro ex Ficalho & Hiern*	LC	Indigenous
Poaceae	*Aristida adscensionis L.*	LC	Indigenous
Poaceae	*Cymbopogon pospischilii (K.Schum.) C.E.Hubb.*	NE	Indigenous
Poaceae	*Setaria sphacelata (Schumach.) Stapf & C.E.Hubb. ex M.B.Moss var. sphacelata*	LC	Indigenous
Poaceae	*Echinochloa holubii (Stapf) Stapf*	LC	Indigenous
Poaceae	*Helictotrichon turgidulum (Stapf) Schweick.*	LC	Indigenous
Poaceae	*Eragrostis sp.*		
Poaceae	*Andropogon appendiculatus Nees*	LC	Indigenous
Poaceae	*Eragrostis chloromelas Steud.*	LC	Indigenous
Poaceae	*Panicum sp.*		
Poaceae	*Melinis repens (Willd.) Zizka subsp. repens*	LC	Indigenous
Poaceae	*Brachiaria eruciformis (Sm.) Griseb.*	LC	Indigenous
Poaceae	*Eleusine coracana (L.) Gaertn. subsp. africana (Kenn.-O'Byrne) Hilu & de Wet*	LC	Indigenous
Poaceae	*Chloris virgata Sw.*	LC	Indigenous
Poaceae	*Panicum stapfianum Fourc.*	LC	Indigenous
Poaceae	*Panicum schinzii Hack.*	LC	Indigenous
Poaceae	*Eragrostis racemosa (Thunb.) Steud.*	LC	Indigenous
Poaceae	*Aristida junciformis Trin. & Rupr. subsp. junciformis*	LC	Indigenous
Poaceae	*Bromus sp.*		
Poaceae	*Phalaris canariensis L.*	NE	Not indigenous; Naturalised
Poaceae	*Panicum coloratum L.*	LC	Indigenous
Poaceae	*Tragus berteronianus Schult.*	LC	Indigenous
Poaceae	*Sporobolus tenellus (Spreng.) Kunth*	LC	Indigenous
Poaceae	*Paspalum distichum L.*	LC	Not indigenous; Naturalised; Invasive
Poaceae	*Tragus koelerioides Asch.*	LC	Indigenous
Poaceae	*Setaria nigrirostris (Nees) T.Durand & Schinz*	LC	Indigenous
Poaceae	*Eragrostis superba Peyr.*	LC	Indigenous
Poaceae	*Tragus racemosus (L.) All.*	LC	Indigenous
Poaceae	*Aristida stipitata Hack. subsp. graciliflora (Pilg.) Melderis*	LC	Indigenous
Poaceae	*Enneapogon scoparius Stapf*	LC	Indigenous
Poaceae	*Digitaria argyrograpta (Nees) Stapf*	LC	Indigenous
Poaceae	*Trachypogon spicatus (L.f.) Kuntze*	LC	Indigenous
Poaceae	*Elionurus muticus (Spreng.) Kunth*	LC	Indigenous
Poaceae	*Hemarthria altissima (Poir.) Stapf & C.E.Hubb.*	LC	Indigenous
Poaceae	*Themeda triandra Forssk.*	LC	Indigenous
Poaceae	*Aristida congesta Roem. & Schult. subsp. congesta*	LC	Indigenous

Poaceae	*Aristida diffusa Trin. subsp. burkei (Stapf) Melderis*	LC	Indigenous
Poaceae	*Eragrostis biflora Hack. ex Schinz*	LC	Indigenous
Poaceae	*Eragrostis capensis (Thunb.) Trin.*	LC	Indigenous
Poaceae	*Aristida bipartita (Nees) Trin. & Rupr.*	LC	Indigenous
Poaceae	*Phragmites australis (Cav.) Steud.*	LC	Indigenous
Poaceae	*Hyparrhenia hirta (L.) Stapf*	LC	Indigenous
Poaceae	*Digitaria eriantha Steud.*	LC	Indigenous
Poaceae	*Setaria incrassata (Hochst.) Hack.*	LC	Indigenous
Poaceae	*Enneapogon cenchroides (Licht. ex Roem. & Schult.) C.E.Hubb.*	LC	Indigenous
Poaceae	*Sporobolus oxyphyllus Fish*	LC	Indigenous; Endemic
Poaceae	*Echinochloa crus-galli (L.) P.Beauv.*	LC	Indigenous
Poaceae	*Avena sativa L.*	NE	Not indigenous; Naturalised; Invasive
Poaceae	*Sporobolus sp.*		
Poaceae	*Urochloa panicoides P.Beauv.*	LC	Indigenous
Poaceae	*Brachiaria serrata (Thunb.) Stapf*	LC	Indigenous
Poaceae	*Leersia hexandra Sw.*	LC	Indigenous
Poaceae	*Setaria sphacelata (Schumach.) Stapf & C.E.Hubb. ex M.B.Moss var. torta (Stapf) Clayton*	LC	Indigenous
Poaceae	*Melica decumbens Thunb.*	LC	Indigenous
Poaceae	*Eragrostis lappula Nees*	LC	Indigenous
Poaceae	*Cynodon transvaalensis Burtt Davy*	LC	Indigenous
Poaceae	*Cynodon dactylon (L.) Pers.*	LC	Indigenous
Poaceae	*Setaria sp.*		
Poaceae	*Cymbopogon dieterlenii Stapf ex E.Phillips*	LC	Indigenous
Poaceae	*Triraphis andropogonoides (Steud.) E.Phillips*	LC	Indigenous
Poaceae	*Pennisetum villosum R.Br. ex Fresen.*	NE	Not indigenous; Naturalised; Invasive
Poaceae	*Eragrostis plana Nees*	LC	Indigenous
Polygalaceae	*Polygala hottentotta C.Presl*	LC	Indigenous
Polygonaceae	*Persicaria hystricula (J.Schust.) Sojak*	LC	Indigenous
Polygonaceae	*Persicaria lapathifolia (L.) Delarbre*		Not indigenous; Naturalised; Invasive
Polygonaceae	*Rumex lanceolatus Thunb.*	LC	Indigenous
Polygonaceae	*Rumex sagittatus Thunb.*	LC	Indigenous
Potamogetonaceae	*Potamogeton pectinatus L.*	LC	Indigenous
Potamogetonaceae	*Potamogeton crispus L.*	LC	Indigenous
Ranunculaceae	*Ranunculus multifidus Forssk.*	LC	Indigenous
Ranunculaceae	*Clematis brachiata Thunb.*	LC	Indigenous
Ranunculaceae	*Ranunculus trichophyllus Chaix*	LC	Indigenous
Rhamnaceae	*Ziziphus zeyheriana Sond.*	LC	Indigenous
Rhamnaceae	*Ziziphus mucronata Willd. subsp. mucronata*	LC	Indigenous
Ricciaceae	*Riccia angolensis Steph.*		Indigenous
Rubiaceae	*Anthospermum rigidum Eckl. & Zeyh. subsp. rigidum*	LC	Indigenous
Rubiaceae	*Cordylostigma virgatum (Willd.) Groeninckx & Dessein*		Indigenous

Rubiaceae	*Kohautia amatymbica Eckl. & Zeyh.*	LC	Indigenous
Rubiaceae	*Vangueria pygmaea Schltr.*	LC	Indigenous
Rubiaceae	*Galium capense Thunb. subsp. capense*	LC	Indigenous
Rubiaceae	*Nenax microphylla (Sond.) T.M.Salter*	LC	Indigenous
Rubiaceae	*Rubia petiolaris DC.*	LC	Indigenous
Ruscaceae	*Eriospermum porphyrium Archibald*	LC	Indigenous
Ruscaceae	*Eriospermum schinzii Baker*	LC	Indigenous
Salicaceae	*Salix mucronata Thunb. subsp. mucronata*	LC	Indigenous
Santalaceae	*Thesium costatum A.W.Hill var. costatum*	LC	Indigenous
Santalaceae	*Thesium hirsutum A.W.Hill*	LC	Indigenous; Endemic
Scrophulariaceae	*Aptosimum elongatum (Hiern) Engl.*	LC	Indigenous
Scrophulariaceae	*Gomphostigma virgatum (L.f.) Baill.*	LC	Indigenous
Scrophulariaceae	*Jamesbrittenia sp.*		
Scrophulariaceae	*Jamesbrittenia atropurpurea (Benth.) Hilliard subsp. atropurpurea*	LC	Indigenous
Scrophulariaceae	*Selago sp.*		
Scrophulariaceae	*Aptosimum procumbens (Lehm.) Steud.*	LC	Indigenous
Scrophulariaceae	*Buddleja saligna Willd.*	LC	Indigenous
Scrophulariaceae	*Nemesia fruticans (Thunb.) Benth.*	LC	Indigenous
Scrophulariaceae	*Chaenostoma patrioticum (Hiern) Kornhall*	LC	Indigenous
Solanaceae	*Lycium ferocissimum Miers*	LC	Indigenous
Solanaceae	*Solanum elaeagnifolium Cav.*		Not indigenous; Naturalised; Invasive
Solanaceae	*Datura ferox L.*		Not indigenous; Naturalised; Invasive
Solanaceae	*Solanum rostratum Dunal*		Not indigenous; Naturalised
Solanaceae	*Solanum lichtensteinii Willd.*	LC	Indigenous
Solanaceae	*Solanum supinum Dunal*		Indigenous
Solanaceae	*Lycium arenicola Miers*	LC	Indigenous
Solanaceae	*Nicotiana glauca Graham*		Not indigenous; Naturalised; Invasive
Solanaceae	*Solanum retroflexum Dunal*	LC	Indigenous
Solanaceae	*Cestrum parqui L'Her.*		Not indigenous; Naturalised; Invasive
Solanaceae	*Lycium horridum Thunb.*	LC	Indigenous
Solanaceae	*Solanum campylacanthum Hochst. ex A.Rich.*		Indigenous
Solanaceae	*Lycium schizocalyx C.H.Wright*	LC	Indigenous
Solanaceae	*Withania somnifera (L.) Dunal*	LC	Indigenous
Solanaceae	*Lycium pilifolium C.H.Wright*	LC	Indigenous
Solanaceae	*Lycium hirsutum Dunal*	LC	Indigenous
Solanaceae	*Datura stramonium L.*		Not indigenous; Naturalised; Invasive
Talinaceae	*Talinum caffrum (Thunb.) Eckl. & Zeyh.*	LC	Indigenous
Thymelaeaceae	*Lasiosiphon capitatus (L.f.) Burtt Davy*	LC	Indigenous
Thymelaeaceae	*Lasiosiphon burchellii Meisn.*	LC	Indigenous
Thymelaeaceae	*Lasiosiphon kraussianus (Meisn.) Meisn.*		Indigenous
Typhaceae	*Typha capensis (Rohrb.) N.E.Br.*	LC	Indigenous

Ulmaceae	*Ulmus parvifolia Jacq.*		Not indigenous; Cultivated; Naturalised; Invasive
Vahliaceae	*Vahlia capensis (L.f.) Thunb. subsp. capensis*	LC	Indigenous
Vahliaceae	*Vahlia capensis (L.f.) Thunb. subsp. vulgaris Bridson var. linearis E.Mey. ex Bridson*	NE	Indigenous
Verbenaceae	*Lippia scaberrima Sond.*	LC	Indigenous
Verbenaceae	*Lantana rugosa Thunb.*	LC	Indigenous
Verbenaceae	*Verbena officinalis L.*		Not indigenous; Naturalised
Verbenaceae	*Glandularia aristigera (S.Moore) Tronc.*		Not indigenous; Naturalised; Invasive
Verbenaceae	*Chascanum pinnatifidum (L.f.) E.Mey. var. pinnatifidum*	LC	Indigenous
Verbenaceae	*Verbena brasiliensis Vell.*		Not indigenous; Naturalised; Invasive
Xyridaceae	*Xyris gerrardii N.E.Br.*	LC	Indigenous
Zygophyllaceae	*Tribulus terrestris L.*	LC	Indigenous

Appendix 2: Listed of Mammals

List of Mammals which potentially occur at the project site.

Species	Common name	Conservation Status	
		Regional (SANBI, 2016)	IUCN (2017)
Aethomys ineptus	Tete Veld Rat	LC	LC
Aethomys namaquensis	Namaqua rock rat	LC	LC
Alcelaphus buselaphus	Hartebeest	LC	LC
Antidorcas marsupialis	Sclater's Shrew	LC	LC
Aonyx capensis	Cape Clawless Otter	NT	NT
Atelerix frontalis	South Africa Hedgehog	NT	LC
Atilax paludinosus	Water Mongoose	LC	LC
Canis mesomelas	Black-backed Jackal	LC	LC
Caracal caracal	Caracal	LC	LC
Ceratotherium simum	White Rhinoceros	NT	NT
Connochaetes gnou	Black Wildebeest	LC	LC
Connochaetes taurinus	Blue Wildebeest	LC	LC
Crocidura cyanea	Reddish-grey Musk Shrew	LC	LC
Cryptomys hottentotus	Common Mole-rat	LC	LC
Cynictis penicillata	Yellow Mongoose	LC	LC
Damaliscus pygargus	Blesbok	LC	LC
Desmodillus auricularis	Short-tailed Gerbil	LC	LC

Diceros bicornis	Black Rhinoceros	EN	CR
Eidolon helvum	African Straw-colored Fruit Bat	LC	NT
Elephantulus myurus	Eastern Rock Sengi	LC	LC
Eptesicus hottentotus	Long-tailed Serotine Bat	LC	LC
Felis nigripes	Black-footed Cat	VU	VU
Felis silvestris	African Wildcat	LC	LC
Genetta genetta	Small-spotted Genet	LC	LC
Gerbilliscus brantsii	Highveld Gerbil	LC	LC
Gerbilliscus leucogaster	Bushveld Gerbil	LC	LC
Herpestes sanguineus	Slender Mongoose	LC	LC
Hydrictis maculicollis	Spotted-necked Otter	VU	NT
Hystrix africaeaustralis	Cape Porcupine	LC	LC
Ichneumia albicauda	White-tailed Mongoose	LC	LC
Ictonyx striatus	Striped Polecat	LC	LC
Leptailurus serval	Serval	NT	LC
Lepus capensis	Cape Hare	LC	LC
Lepus saxatilis	Scrub Hare	LC	LC
Lepus victoriae	African Savanna Hare	LC	LC
Lycaon pictus	African Wild Dog	EN	EN
Mastomys coucha	Multimammate Mouse	LC	LC
Mellivora capensis	Honey Badger	LC	LC

Appendix 3: Listed of Reptiles

Reptile species expected to occur in the project area

Species	Common name	Conservation Status	
		Regional (SANBI, 2016)	IUCN (2017)
Acontias gracilicauda	Thin-tailed Legless Skink	LC	LC
Afroedura nivaria	Drankensberg Flat Gecko	LC	LC
Agama aculeata distanti	Eastern Ground Agama	LC	LC
Agama atra	Southern Rock Agama	LC	LC
Aparallactus capensis	Black-headed Centipede-eater	LC	LC
Boaedon capensis	Brown House Snake	LC	LC
Chamaeleo dilepis	Common Flap-neck Chameleon	LC	LC
Chamaesaura aenea	Coppery Grass Lizard	NT	NT
Dasypeltis scabra	Common egg eater	LC	LC
Duberria lutrix	Common Slug-eater	LC	LC
Elapsoidea sundevallii sundevallii	Sundevall's Garter Snake	LC	Unlisted
Hemachatus haemachatus	Rinkhals	LC	LC
Lamprophis aurora	Aurora House Snake	LC	LC
Lygodactylus capensis capensis	Common Dwarf Gecko	LC	Unlisted
Pachydactylus capensis	Cape Gecko	LC	Unlisted
Panaspis wahlbergii	Wahlberg's Snake-eyed Skink	LC	Unlisted
Prosymna ambigua	Angolan Shovel-snout	Unlisted	LC
Prosymna sundevallii	Sundevall's Shovel-snout	LC	LC
Psammophis crucifer	Cross-marked Grass Snake	LC	LC
Psammophylax rhombeatus rhombeatus	Spotted Grass Snake	LC	Unlisted
Psammophylax tritaeniatus	Striped Grass Snake	LC	LC
Pseudaspis cana	Mole Snake	LC	Unlisted
Smaug giganteus	Giant Dragon Lizard	VU	VU
Stigmochelys pardalis	Leopard Tortoise	LC	LC
Thelotornis capensis	Southern Twig Snake	LC	LC
Trachylepis capensis	Cape Skink	LC	Unlisted
Trachylepis punctatissima	Speckled Rock Skink	LC	LC
Trachylepis varia	Variable Skink	LC	LC
Varanus niloticus	Water Monitor	LC	Unlisted

Appendix 4: Listed of Amphibians

Amphibian species expected to occur in the project area

Species	Common name	Conservation Status	
		Regional (SANBI, 2016)	IUCN (2017)
Amietia angolensis	Angola River Frog	LC	LC
Amietia delalandii	Delalande's River Frog	LC	Unlisted
Amietia fuscigula	Cape River Frog	LC	LC
Breviceps adspersus	Bushveld Rain Frog	LC	LC
Cacosternum boettgeri	Common Caco	LC	LC
Kassina senegalensis	Bubbling Kassina	LC	LC
Phrynobatrachus natalensis	Snoring Puddle Frog	LC	LC
Poyntonophrynus vertebralis	Southern Pygmy Toad	LC	LC
Pyxicephalus adspersus	Giant Bullfrog	NT	LC
Schismaderma carens	African Red Toad	LC	LC
Schismaderma carens	Red Toad	LC	LC
Sclerophrys capensis	Raucous Toad	LC	LC
Sclerophrys gutturalis	Guttural Toad	LC	LC
Sclerophrys poweri	Power's Toad	LC	LC
Semnodactylus wealii	Rattling Frog	LC	LC
Strongylopus fasciatus	Striped Stream Frog	LC	LC
Tomopterna cryptotis	Tremelo Sand Frog	LC	LC
Tomopterna natalensis	Natal Sand Frog	LC	LC
Tomopterna tandyi	Tandy's Sand Frog	LC	LC
Xenopus laevis	Common Platanna	LC	LC

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).