ECOLOGICAL SCOPING REPORT FOR THE PROPOSED LUCKHOFF SOLAR 2 PHOTOVOLTAIC SOLAR ENERGY FACILITY, LUCKHOFF, FREE STATE PROVINCE

Prepared for:

Luckhoff Solar 2 (Pty) Ltd

Prepared by:

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Author

Tarryn Martin (Botanical Specialist) (*Pri. Sci. Nat* 008745)

Tarryn has over ten years of experience working as a botanist, nine of which are in the environmental sector. She has worked as a specialist and project manager on projects within South Africa, Mozambique, Lesotho, Zambia, Tanzania, Cameroon, Swaziland and Malawi. The majority of these projects required lender finance and consequently met both in-country and lender requirements.

Tarryn has extensive experience writing botanical impact assessments, critical habitat assessments, biodiversity management plans, biodiversity monitoring plans and Environmental Impact Assessments to International Standards, especially to those of the International Finance Corporation (IFC). Her experience includes working on large mining projects such as the Kenmare Heavy Minerals Mine, where she monitored forest health, undertook botanical impact assessments for their expansion projects and designed biodiversity management and monitoring plans. She has also project managed Environmental Impact Assessments for graphite mines in northern Mozambique and has a good understanding of the Mozambique Environmental legislation and processes.

Tarryn holds a BSc (Botany and Zoology), a BSc (Hons) in African Vertebrate Biodiversity and an MSc with distinction in Botany from Rhodes University. Tarryn's Master's thesis examined the impact of fire on the recovery of C3 and C4 Panicoid and non-Panicoid grasses within the context of climate change for which she won the Junior Captain Scott-Medal (Plant Science) for producing the top MSc of 2010 from the South African Academy of Science and Art as well as an Award for Outstanding Academic Achievement in Range and Forage Science from the Grassland Society of Southern Africa.
Tarryn is a professional member of the South African Council for Natural Scientific Professionals (since 2014).

Amber Jackson (Faunal Specialist) (*Cand. Nat. Sci)*

Amber has over ten years' experience in environmental consulting and has managed projects across various sectors including mining, agriculture, forestry, renewable energy, housing, coastal and wetland recreational infrastructure. Most of these projects required lender finance and therefore met both in-country, lender and sector specific requirements.

Amber completed the IFC lead and Swiss funded programme in Environmental and Social Risk Management course in 2018. The purpose of the course was to upskill Sub-Saharan African environmental consultants to increase the uptake of E&S standards by Financial Institutions.

Amber specialises in terrestrial vertebrate faunal assessments. She has conducted large scale faunal impact assessments that are to international lender's standards in Mozambique, Tanzania, Lesotho and Malawi. In South Africa her faunal impact assessments comply with the protocols for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial biodiversity and follows the SANBI Species Environmental Assessment Guideline. Her specialist input goes beyond impact assessments and includes faunal opportunities and constraints assessments, Critical Habitat Assessments, Biodiversity related Management Plans and Biodiversity Monitoring Programmes.

Amber holds a BSc (Zoology and Ecology, Environment & Conservation) and BSc (Hons) in Ecology, Environment & Conservation from WITS University and an MPhil in Environmental Management from University of Cape Town. She was awarded the Denzil and Dorethy Carr Prize for her plant collection in 2006. Amber's honours focused on the landscape effects on Herpetofauna in Kruger National Park and her Master's thesis focused on the management of social and natural aspects of environmental systems with a dissertation in food security that investigated the complex food system of informal and formal distribution markets.

Declaration of Independence

Tarryn Martin (Botanical Specialist)

- I, Tarryn Martin, declare that, in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Amended Environmental Impact Assessment Regulations, 2017;
- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this report are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

…….. 15/01/2023……

SIGNED DATE

Amber Jackson (Faunal Specialist)

- I, Amber Jackson, declare that, in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Amended Environmental Impact Assessment Regulations, 2017;
- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this report are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

…… 17.01.2023

SIGNED DATE

Introduction

The applicant is proposing the development of a photovoltaic solar facility and associated infrastructure on a site located 3km north of the town of Luckhoff in the Letsemeng Local Municipality, which falls in the Xhariep District Municipality in the Free State Province.

Two additional photovoltaic facilities are concurrently being considered on the surrounding properties and are assessed by way of separate impact assessment processes contained in the 2014 Environmental Impact Assessment Regulations (GN No. R982, as amended) for listed activities contained in Listing Notices 1, 2 and 3 (GN R983, R984 and R985, as amended.

A preferred project site with an extent of approximately 480 ha has been identified as a technically suitable area for the development of the project. It is proposed that facility will either be fixed to a single-axis horizontal tracking structure where the orientation of the panel varies according to the time of the day, as the sun moves from east to west or tilted at a fixed angle equivalent to the latitude at which the site is in order to capture the most sun. The generation capacity will be up to 240MW.

In order to evacuate the energy generated by the facilities to the national grid, Luckhoff Solar 1 (Pty) Ltd is proposing to develop grid connection infrastructure which consists of Electrical Grid Infrastructure (EGI) 132kV single/double-circuit overhead power line (with the associated infrastructure) to enable the connection and evacuation of the generated electricity of the proposed Luckhoff Solar 1, 2 and 3 Photovoltaic Solar Energy Facilities, to the national grid network.

The EA applications for the solar farm project and grid connection infrastructure are being undertaken in parallel as they are co-dependent, i.e. one will not be developed without the other.

Methodology

A desktop assessment was undertaken prior to the site visit to determine the vegetation types present, identify species of conservation concern that might occur on site and identify the conservation status of the project site.

Additionally, the known diversity of the terrestrial vertebrate fauna (excluding birds and bats) in the project area was determined by a literature review. Species known from the region, or from adjacent regions whose preferred habitat(s) were known to occur within the study area, were also included.

A field survey was undertaken during the early flowering season from 22-25 November 2022. The purpose of the survey was to assess the site-specific botanical state of the project area by recording the species present (both indigenous and alien invasive species), identifying sensitive ecosystems such as rocky outcrops, riparian areas or areas with species of conservation concern, and identifying the current land use.

The project site was walked, and sample plots were analysed by determining the dominant species in each plot, as well as any alien invasive species and potential SCC occurring within the plots. Each

sample plot was sampled until no new species were recorded. Vegetation communities were then described according to the dominant species recorded from each type, and these were mapped and assigned a sensitivity score. The entire Solar Photovoltaic cluster was sampled and adequate data gathered for the vegetation types present to provide an assessment of the impacts of the project on the vegetation and species present.

Based on the sensitivity feature in the DFFE Screening Report, a site visit by the faunal specialist was not required and the faunal component was therefore done at a desktop level.

Results

The development is situated within Northern Upper Karoo which is widespread and listed as Least Concern with few SCC likely to be present. The Site Ecological Importance (SEI) for this vegetation type was found to be of low sensitivity meaning that construction within these areas is permissible from an ecological perspective.

Four impacts associated with the vegetation and flora present on site were identified. Given that the site sensitivity is low and there are no recorded or potential species of conservation concern present within the site, three of the impacts are of low significance and one is negligible.

Four impacts associated with the fauna potentially present on site were identified. Three impacts are of low significance and one is medium before mitigation and all are of low significance after mitigation.

Recommendations

It is recommended that the following conditions are included in the Final EMPr as well as the conditions of the Environmental Authorisation (EA), if granted:

- The remaining vegetation within the property should remain intact so that it can continue to function as an ecological corridor for species movement.
- All necessary plant permits must be obtained prior to the commencement of any construction activities.
- Where feasible, laydown areas must be placed in previously disturbed sites.
- A walkthrough of the final layout must be undertaken by a botanist and if populations of SCC will be impacted, infrastructure should be moved to avoid these areas. Where this is not feasible, a search and rescue plan will be required.
- If any SCC are to be impacted, these must be relocated to nearest appropriate habitat.
- Construction vehicles and machinery must not encroach into identified 'no-go' areas or areas outside the project footprint.
- Topsoil (20 cm, where possible) must be collected and stored in an area of low sensitivity and used to rehabilitate impacted areas that are no longer required during the operational phase (e.g. laydown areas).
- Employees must be prohibited from collecting any plants.
- Alien invasive plant clearing should be undertaken in line with an Alien Vegetation Management plan, which should be compiled as part of the EMPr and implemented with immediate effect.

- Only indigenous plant species typical of the local vegetation and approved by a botanist should be used for the rehabilitation of natural habitat.
- Any terrestrial vertebrate fauna found on site during construction must be relocated to habitat immediately adjacent to the development and should these be SCC recorded the ECO must record the release site on iNaturalist.
- Development must be designed to allow unencumbered movement of this species. e.g., trenches with sloped side to allow faunal species to exit.
- The development must consolidate road networks to minimise the loss of faunal habitat.
- Laydown areas must be rehabilitated with specific measures to create fauna habitat.
- Speed restrictions within the development for all vehicles (30km/h is recommended) should be in place to reduce the impact of killed fauna on the project roads.
- In addition to all mitigations listed above a clause must be included in contracts for ALL personnel working on site stating that: "no wild animals will be hunted, killed, poisoned or captured. No wild animals will be imported into, exported from or transported in or through the province. No wild animals will be sold, bought, donated and no person associated with the development will be in possession of any live wild animal, carcass or anything manufactured from the carcass." A clause relating to fines, possible dismissal and legal prosecution must be included should any of the above transgressions occur, especially for SCC.

Ecological Statement and Opinion of the Specialist

Impacts on the terrestrial plant species and faunal habitats can be reduced to acceptable levels through the implementation of mitigation measures. The specialist is therefore of the opinion that the development can proceed, provided the recommendations contained in this report are implemented.

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Glossary of Terms

Alien Invasive Species refers to an exotic species that can spread rapidly and displace native species causing damage to the environment

Biodiversity is the term that is used to describe the variety of life on Earth and is defined as "*the variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems, and the ecological complexes of which they are part; this includes diversity within species, between species, and of ecosystems*" (Secretariat of the Convention on Biological Diversity, 2005).

Habitat Fragmentation occurs when large expanses of habitat are transformed into smaller patches of discontinuous habitat units isolated from each other by transformed habitats such as farmland.

Natural Habitat refers to habitats composed of viable assemblages of plant and/or animal species of largely native origin and/or where human activity has not essentially modified an area's primary ecological function and species composition.

Project Area is defined as the area that will be directly impacted by project infrastructure such as the roads, turbine hardstands and offices.

Project area of influence (PAOI) refers to the broader area around the project area that may be indirectly impacted by project activities.

Protected Area is a clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values**.** *(IUCN Definition 2008)*

Acronyms

CBA	Critical Biodiversity Area
CR	Critically Endangered
CCR	Core Cape Subregion
ECO	Environmental Control Officer
EN	Endangered
EIA	Environmental Impact Assessment
EOO	Extent of Occupancy
GBIF	Global Biodiversity Information Facility
GIS	Geographical Information System
IUCN	International Union for Conservation of Nature
LC	Least Concern
MTS	Municipal Transformer Station
NEMBA	National Environmental Management Biodiversity Act
PAOI	Project Area of Influence
PNCO	Provincial Nature Conservation Ordinance
SCC	Species of Conservation Concern
QDS	Quarter Degree Square
SA	South Africa
SANBI	South African National Biodiversity Institute
SCC	Species of Conservation Concern
TOPS	Threatened and Protected Species
VU	Vulnerable

Specialist Check List

The contents of this specialist report complies with the legislated requirements as described in the Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Biodiversity (GN R. 320 of 2020).

SPECIALIST REPORT REQUIREMENTS ACCORDING TO GN R. 320			SECTION OF REPORT
3.1	The Terrestrial Biodiversity Specialist Assessment Report must contain, as a minimum, the following information:		
	3.1.1	Contact details of the specialist, their SACNASP registration number, their field of expertise and a curriculum vitae;	Page 2 and 3 Appendix 3 and 4
	3.1.2	A signed statement of independence by the specialist;	Page 4 and 5
	3.1.3	A statement of the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;	Section 2.4 and 1.3
	3.1.4	A description of the methodology used to undertake the site verification and impact assessment and site inspection, including equipment and modelling used, where relevant;	Chapter 2
	3.1.5	A description of the assumptions made and any uncertainties or gaps in knowledge or data as well as a statement of the timing and intensity of site inspection observations;	Section 1.3
	3.1.6	A location of the areas not suitable for development, which are to be avoided during construction and operation (where relevant);	Section 6.2
	3.1.7	Additional environmental impacts expected from the proposed development;	Chapter 7
	3.1.8	Any direct, indirect and cumulative impacts of the proposed development;	Chapter 7
	3.1.9	The degree to which the impacts and risks can be mitigated;	Chapter 7
	3.1.10	The degree to which the impacts and risks can be reversed;	
	3.1.11	The degree to which the impacts and risks can cause loss of irreplaceable resources;	
	3.1.12	Proposed impact management actions and impact management outcomes proposed by the specialist for inclusion in the Environmental Management Programme (EMPr);	Chapter 7 and 8.2
	3.1.13	A motivation must be provided if there were development footprints identified as per paragraph 2.3.6 above that were identified as having a “low” terrestrial biodiversity sensitivity and that were not considered appropriate;	N/A
	3.1.14	A substantiated statement, based on the findings of the specialist assessment, regarding the acceptability, or not, of the proposed development, if it should receive approval or not; and	Section 8.3
	3.1.15	Any conditions to which this statement is subjected.	Section 8.2
3.2	The findings of the Terrestrial Biodiversity Specialist Assessment must be incorporated into the Basic Assessment Report or the Environmental Impact Assessment Report, including the mitigation and monitoring measures as identified, which must be incorporated into the EMPr where relevant.		✓
3.3	A signed copy of the assessment must be appended to the Basic Assessment Report or Environmental Impact Assessment Report.		

1. INTRODUCTION

1.1. Project Description

The applicant is proposing the development of a photovoltaic solar facility and associated infrastructure on a site located 3km north of the town of Luckhoff in the Letsemeng Local Municipality, which falls in the Xhariep District Municipality in the Free State Province (Figure 1.1).

Two additional photovoltaic facilities are concurrently being considered on the surrounding properties and are assessed by way of separate impact assessment processes contained in the 2014 Environmental Impact Assessment Regulations (GN No. R982, as amended) for listed activities contained in Listing Notices 1, 2 and 3 (GN R983, R984 and R985, as amended).

A preferred project site with an extent of approximately 480 ha has been identified as a technically suitable area for the development of the project. It is proposed that facility will either be fixed to a single-axis horizontal tracking structure where the orientation of the panel varies according to the time of the day, as the sun moves from east to west or tilted at a fixed angle equivalent to the latitude at which the site is in order to capture the most sun. The generation capacity will be up to 240MW.

The Luckhoff Solar 2 Photovoltaic Solar Energy Facility project site is proposed to accommodate the following infrastructure, which will enable the facility to supply a contracted capacity of up to 240 MW:

- The PV Panel Array and associated wiring to inverters
- Electrical reticulation network that will be lain 2-4m underground
- Supporting infrastructure including a 33kV switch room, gate house, ablutions, workshops, storage and warehousing areas, site offices and a control centre.
- A Battery Storage Facility with a maximum height of 8m and a maximum volume of 1,740 m^3 of batteries and associated operational, safety and control infrastructure.
- Access will be obtained via the S572 off the R48, an existing gravel road located adjacent to the site. An internal site road network will also be required to provide access to the solar field and associated infrastructure.
- For health, safety and security reasons, the facility will be required to be fenced off from the surrounding farm. Fencing with a height of 3.5 meters will be used.
- Temporary laydown areas

In order to evacuate the energy generated by the facilities to the national grid, Luckhoff Solar 1 (Pty) Ltd is proposing to develop grid connection infrastructure which consists of the following Electrical Grid Infrastructure (EGI) 132kV single/double-circuit overhead power line (with the associated infrastructure) to enable the connection and evacuation of the generated electricity of the proposed Luckhoff Solar 1, 2 and 3 Photovoltaic Solar Energy Facilities, to the national grid network:

- A collector switching station (up to 132kV)
- A ~2.5 km 132 kV single/double circuit overhead powerline linking the collector switching station to the proposed Luckhoff Main Transmission Substation (MTS)(see below)
- A new 132 kV / 400 kV MTS
- Three 400kV Loop-in-Loop Out power lines from the existing Eskom powerlines (Hydra/Perseus 2, Hydra/Perseus 3 and Beta/Hydra 1) to the MTS.

The EA applications for the solar farm project and grid connection infrastructure are being undertaken in parallel as they are co-dependent, i.e. one will not be developed without the other.

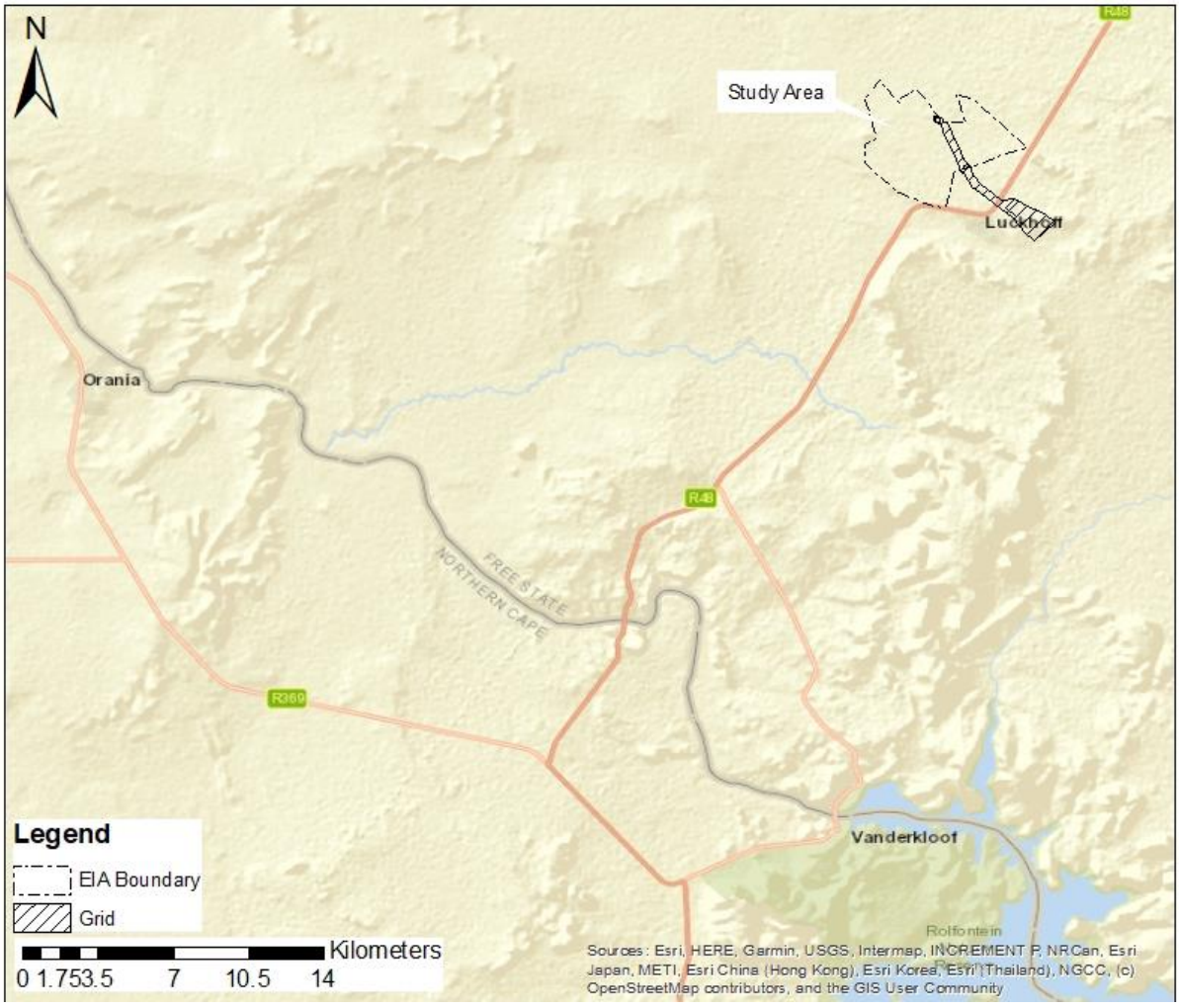

Figure 1.1: Location of the Solar Photovoltaic cluster in relation to Orania and Vanderkloof.

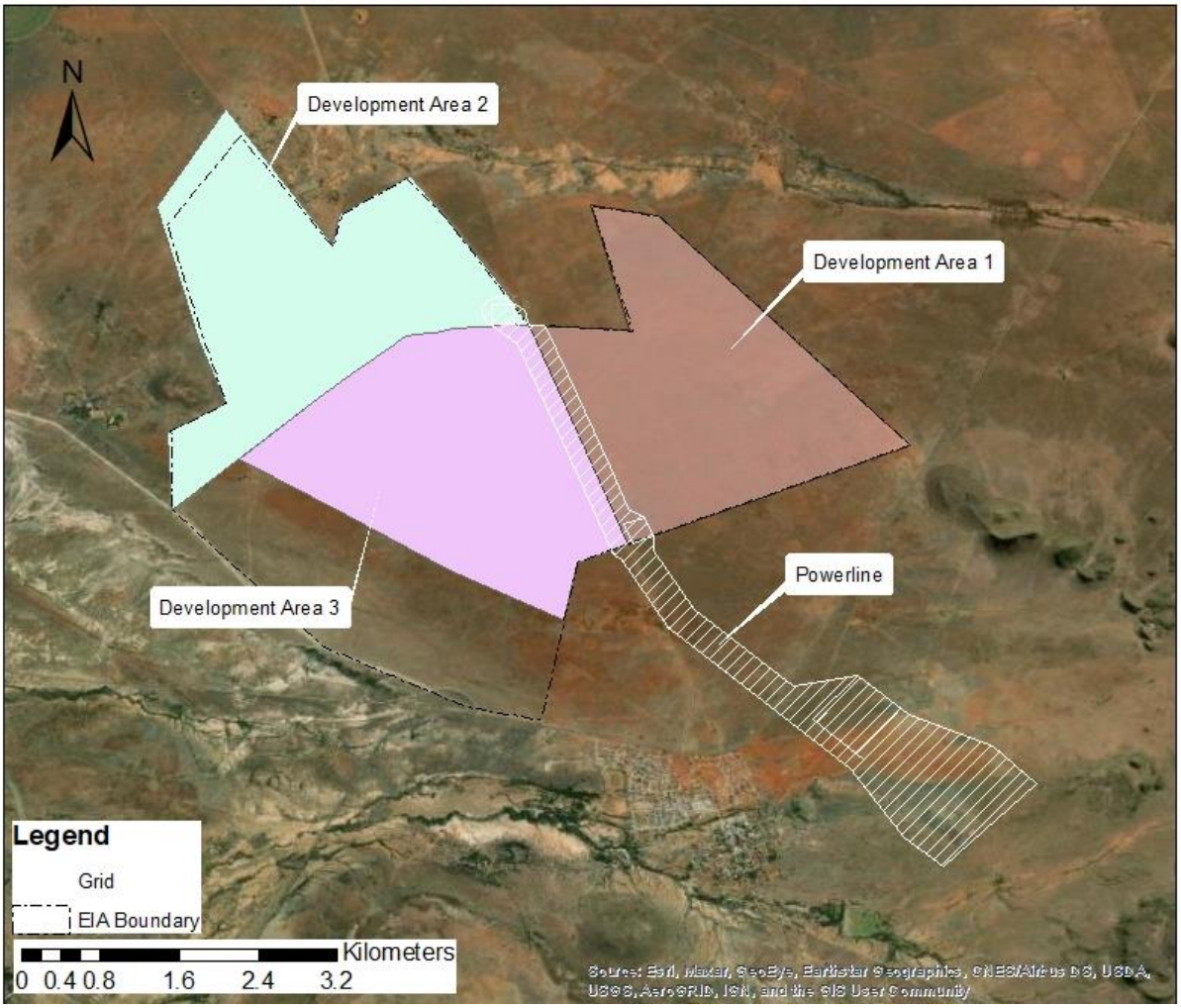

Figure 1.2: Location of the Solar Photovoltaic cluster developments in relation to each other

1.2. Objectives

The objectives of the ecological assessment are as follows:

- Undertake a desktop assessment of the site to determine its sensitivity and species of conservation concern (SCC) (plants, amphibians, reptiles, mammals) that could be present within the site.
- Undertake a field survey, to record the following information:
    - Species present
    - Identification of species that are either protected (TOPS and PNCO) or considered threatened (CR, EN, VU) on the South African Red Data List
    - Assess the level of degradation/ecological status of the site (i.e. intact, near natural, transformed).
- Assess the sensitivity of each site using the sensitivity analysis outlined in the Species Guideline Document (2021).
- For areas of moderate and high sensitivity, assess the impact that the construction of the project infrastructure will have on the vegetation and plant SCC.
- Where necessary, provide mitigation measures to reduce the impact of the infrastructure on the environment.
- Provide a specialist statement/opinion.

1.3. Limitations and Assumptions

This report is based on current available information and, as a result, the following limitations and assumptions are implicit:

- Species of Conservation Concern (SCC) are difficult to find and may be difficult to identify, thus species described in this report do not comprise an exhaustive list. It is almost certain that additional SCCs are present.
- Sampling could only be carried out at one stage in the annual or seasonal cycle. The survey was conducted in late spring (22-25 November 2022) when most plants were flowering. The time available in the field, and information gathered during the survey was sufficient to provide enough information to determine the status of the affected area and provide comment on the likelihood of occurrence of species of conservation concern.
- This assessment includes plants, mammals (excluding bats), amphibians and reptiles. It does not include birds, bats or invertebrates.
- The faunal assessment is based on a desktop assessment.
- The assessment has been undertaken to meet the Protocol for the Specialist Assessment and Minimum Report Requirements for Environmental Impacts on Terrestrial Biodiversity (2020) and the Species Environmental Assessment Guidelines (2021).

2. METHODOLOGY

2.1. Project Area

The "project area" or "project site" is defined as the area that will be directly impacted by project infrastructure during both construction (temporary) and operation (permanent), such as the roads, offices and solar photovoltaic panels.

The project area of influence (PAOI) refers to the broader area around the project site that may be indirectly impacted by project activities.

2.2. DFFE Screening Report

The DFFE Screening report identifies environmental sensitivities for the project site. This is based on available desktop data and requires that a suitably qualified specialist verify the findings. Of relevance to this report is the animal species theme, plant species theme and the terrestrial biodiversity theme (Table 2.1). Comment has been provided in the table below indicating how these themes have been assessed.

Table 2.1: Summary of DFFE screening report themes relevant to this study

Theme	Sensitivity	Assessment
Animal Species Theme	Medium • Likely presence of *Neotis ludwigii* (Ludwig's Bustard)	The animal species theme has been categorised as medium due to the potential presence of Ludwig's Bustard. Since birds have been addressed in a separate specialist report, the faunal assessment in this report focuses on amphibians, reptiles and mammals. Based on the sensitivity feature, a site visit by the faunal specialist was not required and the faunal component was therefore done at a desktop level.
Plant Species Theme	Medium • Likely presence of *Tridentia virescens (*Rare)	The likelihood of occurrence of this species was assessed (section 3.3) based on distribution records and available habitat on site.
Terrestrial Biodiversity Theme	Very High • CBA 1 and 2 present • ESA 1 and 2 present • Thanda Tula Reserve within close proximity	Comment has been provided on the impact of the project on the CBA and ESA present (section 6.1).

2.3. Desktop Assessment

2.3.1. Flora

A desktop assessment was undertaken prior to the site visit to determine the vegetation types present, identify species of conservation concern that might occur on site and identify the conservation status of the project site. Key resources consulted include:

- The DFFE screening report for the site.
- The South African Vegetation Map (Mucina and Rutherford, 2018).
- Free State Terrestrial CBAS (2015)
- The IUCN Red List of Ecosystems for South Africa (SANBI, 2021).
- National Biodiversity Management: Biodiversity Act (NEMBA) List of Threatened or Protected Species.
- The National Biodiversity Assessment (SANBI, 2018).
- The Plants of Southern Africa (POSA) database.
- iNaturalist.

A species list was compiled for the site and the likelihood of occurrence assessed for species listed as Critically Endangered, Endangered, Vulnerable and Near Threatened (Section 4.2).

2.3.2. Fauna

The known diversity of the terrestrial vertebrate fauna (excluding birds and bats) in the project area was determined by a literature review. Species known from the region, or from adjacent regions whose preferred habitat(s) were known to occur within the study area, were also included. Literature sources included:

- Amphibians – Du Preez & Carruthers (2017), FrogMap (ADU, 2021)
- Reptiles – Branch (1998), ReptileMap (ADU, 2021),
- Mammals – Stuart & Stuart (2014), MammalMap (ADU, 2021).
- iNaturalist.

To establish which of those species identified in the literature review are Species of Conservation Concern (SCC), the following sources were consulted:

- Atlas and Red List of Reptiles of South Africa, Lesotho and Swaziland (Bates *et al*., 2014)
- Atlas and Red List of Frogs of South Africa, Lesotho and Swaziland (Minter *et al*., 2004)
- Red List of Mammals of South Africa, Swaziland and Lesotho.
- CITES Appendix I and II

2.4. Field Survey

2.4.1. Botanical

A field survey was undertaken during the early flowering season from 22-25 November 2022. The purpose of the survey was to assess the site-specific botanical state of the project area by recording

the species present (both indigenous and alien invasive species), identifying sensitive ecosystems such as rocky outcrops, riparian areas or areas with species of conservation concern, and identifying the current land use.

The project site was walked, and sample plots were analysed by determining the dominant species in each plot, as well as any alien invasive species and potential SCC occurring within the plots (Figure 2.1). Each sample plot was sampled until no new species were recorded. Vegetation communities were then described according to the dominant species recorded from each type, and these were mapped and assigned a sensitivity score. The entire Solar Photovoltaic cluster was sampled and adequate data gathered for the vegetation types present to provide an assessment of the impacts of the project on the vegetation and species present. Figure 2.1 illustrates the location of the sample plots.

As discussed under section 2.2, based on the sensitivity feature in the DFFE Screening Report, a site visit by the faunal specialist was not required and the faunal component was therefore done at a desktop level.

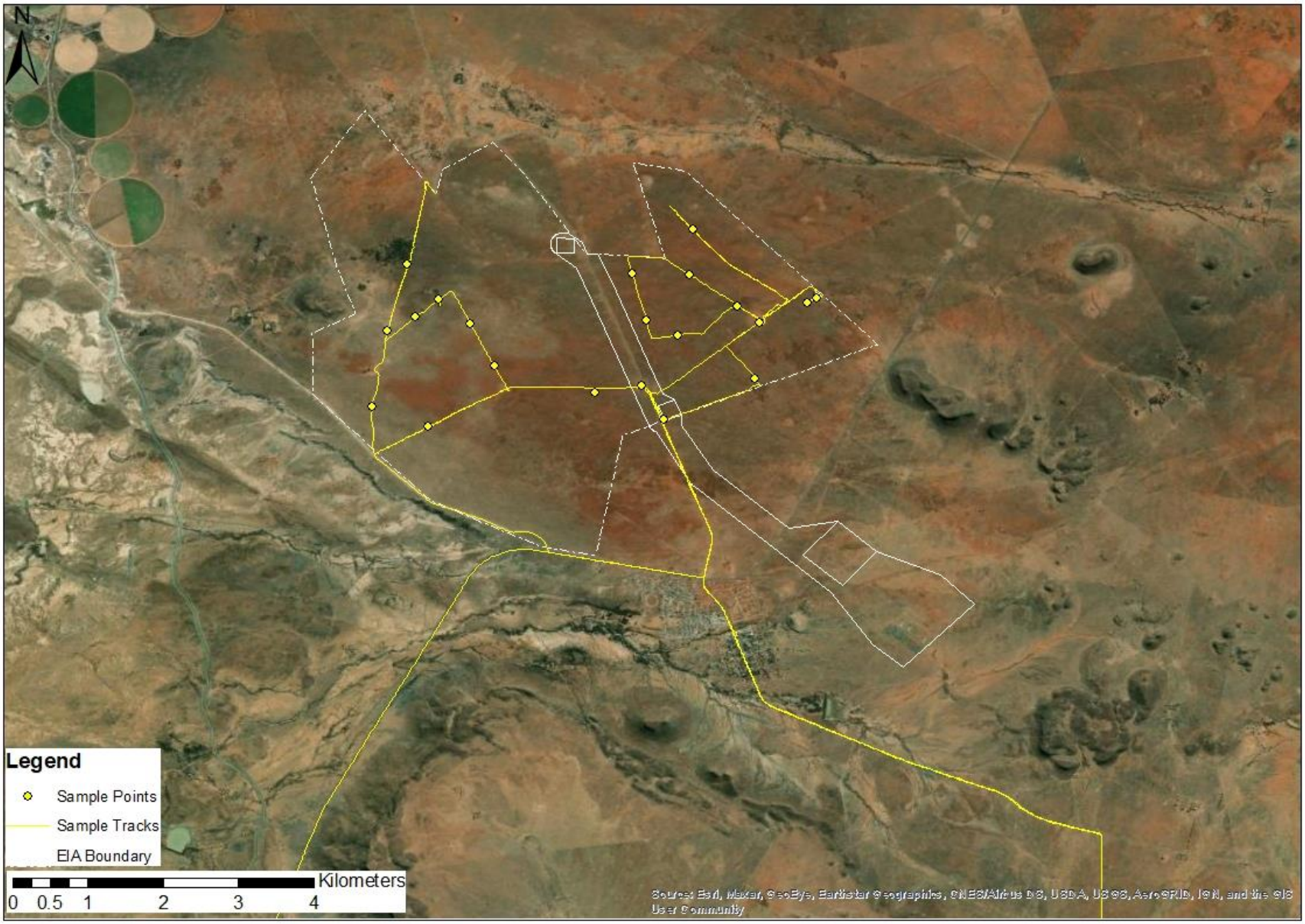

Figure 2.1: Map showing sample sites and tracks in relation to the study area

2.5. Site Sensitivity Assessment

The Species Environmental Assessment Guideline (SANBI, 2021) was applied to assess the Site Ecological Importance (SEI) of the project area. The habitats and the species of conservation concern in the project area were assessed based on their conservation importance, functional integrity and receptor resilience (Table 2.2). The combination of these resulted in a rating of SEI and interpretation of mitigation requirements based on the ratings.

The sensitivity map was developed using available spatial planning tools as well as by applying the SEI sensitivity based on the field survey.

Table 2.2: Criteria for establishing Site Ecological importance and description of criteria

Criteria	Description
Conservation Importance (CI)	*The importance of a site for supporting biodiversity features of conservation concern present e.g. populations of Threatened and Near-Threatened species (CR, EN, VU & NT), Rare, range-restricted species, globally significant populations of congregatory species, and areas of threatened ecosystem types, through predominantly natural processes.*
Functional Integrity (FI)	*A measure of the ecological condition of the impact receptor as determined by its remaining intact and functional area, its connectivity to other natural areas and the degree of current persistent ecological impacts.*
Biodiversity Importance (BI) is a function of Conservation Importance (CI) and the Functional Integrity (FI) of a receptor.	
Receptor Resilience (RR)	*The intrinsic capacity of the receptor to resist major damage from disturbance and/or to recover to its original state with limited or no human intervention.*
Site Ecological Importance (SEI) is a function of Biodiversity Importance (BI) and Receptor Resilience (RR)	

2.6. Description of impact analysis methodology used

2.6.1. Method of Environmental Assessment

The environmental assessment aims to identify the various possible environmental impacts that could result from the proposed activity. Different impacts need to be evaluated in terms of its significance and in doing so highlight the most critical issues to be addressed.

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale i.e., site, local, national or global whereas intensity is defined by the severity of the impact e.g., the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence. Significance is calculated as shown in Table 2.3.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

2.6.2. Impact Rating System

Impact assessment must take account of the nature, scale and duration of impacts on the environment whether such impacts are positive or negative. Each impact is also assessed according to the project phases:

- planning
- construction
- operation
- decommissioning

Where necessary, the proposal for mitigation or optimisation of an impact is detailed. A brief discussion of the impact and the rationale behind the assessment of its significance is included. The rating system is applied to the potential impacts on the receiving environment and includes an objective evaluation of the mitigation of the impact. In assessing the significance of each impact, the following criteria is used:

Table 2.3: The rating system

NATURE		
This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity.		
GEOGRAPHICAL EXTENT		
This is defined as the area over which the impact will be experienced.		
1	Site	The impact will only affect the site.
2	Local/district	Will affect the local area or district.
3	Province/region	Will affect the entire province or region.
4	International and National	Will affect the entire country.
PROBABILITY		
This describes the chance of occurrence of an impact.		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
DURATION		
This describes the duration of the impacts. Duration indicates the lifetime of the impact as a result of the proposed activity.		
1	Short term	The impact will either disappear with mitigation or will be mitigated through natural processes in a span shorter than the construction phase (0 – 1 years), or the impact will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).

2	Medium term	The impact will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 30 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered indefinite.
INTENSITY/ MAGNITUDE		
Describes the severity of an impact.		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/ component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired. Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.
REVERSIBILITY		
This describes the degree to which an impact can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures.
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource	The impact will not result in the loss of any resources.

2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
CUMULATIVE EFFECT		
This describes the cumulative effect of the impacts. A cumulative impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.		
1	Negligible cumulative impact	The impact would result in negligible to no cumulative effects.
2	Low cumulative impact	The impact would result in insignificant cumulative effects.
3	Medium cumulative impact	The impact would result in minor cumulative effects.
4	High cumulative impact	The impact would result in significant cumulative effects
SIGNIFICANCE		
Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The calculation of the significance of an impact uses the following formula: (Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity. The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.		
Points	Impact significance rating	Description
6 to 28	Negative low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive medium impact	The anticipated impact will have moderate positive effects.
51 to 73	Negative high impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 to 73	Positive high impact	The anticipated impact will have significant positive effects.
74 to 96	Negative very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
74 to 96	Positive very high impact	The anticipated impact will have highly significant positive effects.

3. DESCRIPTION OF THE RECEIVING ENVIRONMENT

Climate, topography, geology and soils all influence the vegetation types, faunal habitats and species present within an area. As such, a description of the biophysical features present within the site has been provided.

The project site is located within the Nama-Karoo Biome which is situated on the central plateau of the western half of South Africa extending into south-eastern Namibia (Mucina *et al.,* 2011). This region is characterised by an arid climate with most rainfall occurring over the summer months (December to April). Mean Annual Rainfall (MAR) increases from 70mm in the north-west (near the desert biome) to 500mm in the south-east with rainfall quantity and reliability increasing eastwards. The project site is located in the eastern portion of the biome and receives a MAR of 286 mm per annum (metoeblue.com, Accessed: 21-12-22) with mean annual highs reaching 32 ^{o}C and mean annual lows of 1^{o}C.

The Nama-Karoo is underlain by a succession of sedimentary rocks that includes the Cape Supergroup followed by Dwyka tillites and then other fossil rich sediments of the Karoo Supergroup (Mucina *et al.,* 2011). Volcanic activity in the area has resulted in intrusions of igneous rock resulting in the formation of ridges, hills and mountains. Igneous rock is more resistant to weathering than sedimentary rock resulting in the formation of mesas, buttes and plateaus within the biome. These features are often characterised by a higher species diversity than the low-lying flat areas. The topography of the project site is a combination of relatively flat open grassland plains interspersed with high lying rocky ridges, hills and slopes (Figure 3.1).

Soils that have arisen from the sedimentary and igneous rock are typically weakly structured and skeletal (Mucina *et al.,* 2011). The project area is characterised by moderately deep, calcareous, sandy-clay loams which contain calcrete and calcareous horizons in the flat areas and shallow soils on the slopes and plateaus of the hilly areas.

The climatic variation, geology and soils associated within this biome have given rise to plains dominated by dwarf succulent shrubs interspersed with grasses, geophytes and annual herbs (Mucina *et al.,* 2011). Variation in the timing of the rainfall and the amount received between years has resulted in variation in the structure, cover and productivity of the vegetation present as well as a diversity of plant forms that range from ephemerals, annuals, geophytes, C_3 and C_4 grasses, succulents, deciduous and evergreen perennial shrubs and trees.

Other factors that have influenced the structure and composition of the vegetation within the biome, and which are therefore ecological drivers, include grazing of domestic livestock and wildlife, fires and rainfall. Increased grazing pressure or fire events, followed by heavy rainfall makes this biome prone to erosion.

Figure 3.1: Photograph illustrating the typical topography of the site. Large expanses of flat areas surrounded by ridges and hills.

4. VEGETATION

4.1. Vegetation

Vegetation types and distributions specific to the project site are described based on the National Vegetation Map (Figure 4.1) and data gathered during the field survey (Figure 4.4). According to the National Vegetation Map, the entire site occurs within the vegetation type *Northern Upper Karoo.*

4.1.1. Northern Upper Karoo

The Northern Upper Karoo occurs in the Northern Cape and Free State Provinces and is described as a shrubland dominated by dwarf karoo shrubs, grasses and *Senegalia mellifera subsp. detinens* (Mucina *et al.,* 2011). It is associated with typically flat to gently sloping topography with isolated hills of Upper Karoo Hardeveld.

The Upper Karoo Hardeveld recorded on site is a matrix of grassland and karoo shrubland dominated by grass species such as *Eragrostis lehmanniana, Themeda triandra, Aristida adscensionis, Chloris virgata* and *Digitaria eriantha* and shrubs and herbs such as *Hertia pallens, Eriocephalus ericoides, Aptosimum marlothii, Senecio burchelli, Wahlenbergia albens* and *Zygophyllum lichtensteinianum.* There was one patch of shrubs/small trees within the site comprised of *Vachellia karoo, Ziziphus mucronata, Searsia burchelli, Searsia pyroides, Searsia lancea and Schinus mole.* The vegetation has been grazed and is of low diversity and is thus considered near-intact.

This vegetation type is listed as Least Concern with a conservation target of 21%. Although listed as not protected, current data indicates that 94% of this vegetation type remains intact (RLE, 2021).

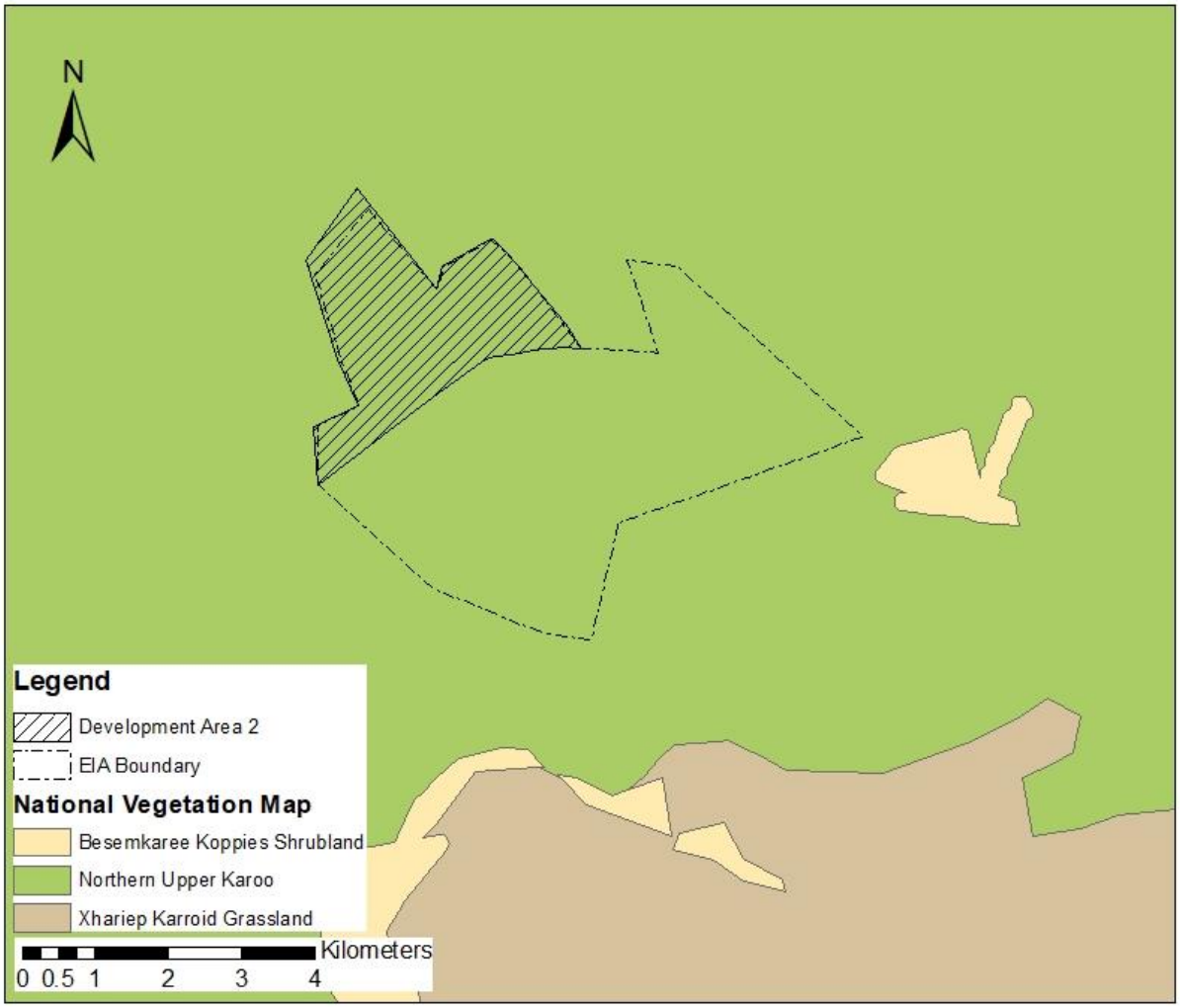

Figure 4.1: National vegetation map for the project site

Figure 4.2: Photograph illustrating the Northern Upper Karoo vegetation community

4.2. Floristics

4.2.1. Desktop Assessment

The desktop assessment identified two species of conservation concern that could occur within the project site and the likelihood of occurrence for each of these species assessed (Table 4.1):

- *Tridentia virescens*
- *Lithops salicola*

Both species were found to have a low likelihood of occurrence due to their habitat not occurring within the project site.

Table 4.1: Assessment of the likelihood of occurrence of SCC identified in the literature as possibly occurring within the site.

Name	Status	Habitat Preference	Likelihood of Occurrence
Tridentia virescens	Rare	This species is widespread occurring from Warmbad in southern Namibia to Kakamas and Prieska in the Northern Cape and east to Prince Albert and Aberdeen. *Tridentia virescens* is associated with stony ground, or hard loam in floodplains.	Low This habitat was not present within the project site.
Lithops salicola	NT	This species is range restricted (EOO 4874km^2) and estimated to occur at 10-15 locations within its range, which is between Koffiefontein and Kraankruil to Petrusville (Victor *et al.,* 2018). It is associated with low limestone ridges or slopes, typically along the edges of brackish pans.	Low This habitat was not present within the project site.

4.2.2. Site Verification

A total of 41 species from 18 families were recorded within the project site (Table 4.2) (a full species list has been included in Appendix 1). The Poaceae family had the highest number of species (eight species) followed by the Asteraceae family (six species), Scrophulariaceae family (five species), Anacardiaceae family (4 species). All other families had either one or two species present. Of the 41 recorded species, 38 species are listed as least concern and three as Not Evaluated. No Species of Conservation Concern (SCC) were recorded on site.

Although no SCC were recorded, two species (*Aloe broomii* and *Boophone disticha*) are listed as Schedule 6 species on the Free State Nature Conservation Ordinance (No. 8 of 1969). These species will require permits for their removal/destruction if impacted by project infrastructure.

Table 4.2: Number of families and species recorded within the project site during the field survey.

Family	No. of Species	Family	No. of Species
POACEAE	8	AMARANTHACEAE	1
ASTERACEAE	6	AMARYLLIDACEAE	1
SCROPHULARIACEAE	5	CAMPANULACEAE	1
ANACARDIACEAE	4	CONVOLVULACEAE	1
ASPARAGACEAE	2	CYPERACEAE	1
ASPHODELACEAE	2	PAPAVERACEAE	1
FABACEAE	2	RHAMNACEAE	1
MALVACEAE	2	SOLANACEAE	1
AIZOACEAE	1	ZYGOPHYLLACEAE	1

4.3. **Alien Species**

Three exotic species (*Schinus molle, Argemone ochroleuca* and *Cymbopogon pospischilii*) were recorded within the project site. *Argemone ochroleuca* is listed as a Category 1b species and must be removed from the project site. It is recommended that an alien invasive management plan is included within the EMPr to manage the spread of exotic and alien invasive species.

5. FAUNA

5.1. Faunal species in relation to the project area

All species have a unique geographic range which describes the spatial area where a species is found. This is a species distribution. Some species have a range which covers most of the earth, this is known as a cosmopolitan distribution and others a very limited geographic area known as an endemic distribution. However, just because an area may be within a species distribution the species may no longer inhabit the area or may not inhabit it permanently. For example, large carnivores such as Rhino have a distribution which include the project area, but these animals no longer occur outside of reserves and private game farms. Further, a species may occur in the broader area (QDS/Pentad) where habitat is available and if its preferred habitat is not present onsite it is unlikely to occur. Therefore, the number of species that could occur in the PAOI and in the project area is often far fewer than species distributions.

5.1.1. Amphibians

Of the 12 amphibian species with a distribution that includes the project area, 7 species have been confirmed within the same QDS as the study area, refer to Appendix 2 (IUCN, 2022; FitzPatrick, 2022; iNat, 2022).

Microhabitats important to amphibian species include terrestrial and aquatic habitats i.e., not all amphibians require permanent access to water, some species only require access to water for breeding and egg/tadpole development and some species do not require any water and are fully terrestrial.

The majority of the species confirmed within the same QDS as the study area are unlikely to permanently occur within the project area. Species that that do not require permanent water may occur e.g. Tremelo Sand Frog (Tomopterna cryptotis) is likely to occur and increase during the wet season.

5.1.2. Reptiles

Of the 46 reptile species with a distribution that includes the project area, 21 species have been confirmed within the same QDS as the study area, refer to Appendix 3 (IUCN, 2022; FitzPatrick, 2022; iNat, 2022).

5.1.3. Mammals

Of the 72 mammal species with a distribution that includes the project area, 33 species have been confirmed within the same QDS as the study area, refer to Appendix 4 (IUCN, 2022; FitzPatrick, 2022; iNat, 2022).

Mammal species likely to occur in the project area include rodents such as the Mice, Gerbils (*Gerbilliscus sp*.), Ground Squirrel (*Xerus inauris*) and Cape Porcupine (*Hystrix africaeaustralis*), small

carnivores such as Yellow Mongoose (*Cynictis penicillata*), Meerkat (*Suricata suricatta*) and Aardwolf (*Proteles cristata*), Hares (Scrub and Spring) and small antelope such as Steenbok.

Springbok and Black-backed Jackal (*Canis mesomela*) are often viewed as a pest by farmers as the springbok damage fences used to enclose livestock and other game and the Jackal preys on livestock, mainly lambs.

No rocky habitat was recorded on site thus no mammals related to this habitat are expected e.g. Rock Sengi (*Elephantulus sp*.) and Rock Hyrax (*Procavia capensis*).

5.2. Faunal Species of Conservation Concern

Species of conservation concern are those species that are either nationally threatened and listed as critically endangered, endangered, vulnerable or near-threatened and/or endemic and/or range restricted. It refers to a species that may require conservation of what individuals remain to ensure the longevity of the species.

5.2.1. Amphibians

None of the amphibian species that have a distribution which includes the project area are of conservation concern.

However, all amphibian species are protected under the Lists of Threatened and Protected Species issued in Terms of Section 56(1) of the National Environmental Management: Biodiversity Act, 2004.

5.2.2. Reptiles

None of the reptile species that have a distribution which includes the project area are of conservation concern.

5.2.3. Mammals

The study area intersects the distribution of 12 mammal species of conservation concern, six threatened and six near-threatened species.

- Threatened species includes the Black Rhino (*Diceros bicornis*) (CR), Mountain Reedbuck (*Redunca fulvorufula*) listed as endangered and the vulnerable listed Black-footed Cat (*Felis nigripes*), Cheetah (*Acinonyx jubatus*), Leopard (*Panthera pardus*) and Spotted-necked Otter (*Hydrictis maculicollis*).
- Near-threatened species includes the White Rhino (*Certotherium simum*), Brown Hyaena (*Parahyaena brunnea*), Cape Clawless Otter (*Aonyx capensis*), Vlei Rat (*Otomys auratus*), Serval (*Leptailurus serval*) and African Striped Weasel (*Poecilogale albinucha*).

The large mammal species would not occur in the project area unless stocked and therefore have not been assessed further. This includes the Black Rhino, Cheetah, Leopard and White Rhino.

The likelihood of occurrence for the remaining species has been assessed in the table below. Six species have a low likelihood of occurrence within the study area due to lack of available habitat. One species, the Black-footed Cat, has a moderate likelihood of occurrence in the study area and the African Striped Weasel (*Poecilogale albinucha*) has a high likelihood of occurrence in the study area.

Table 5.1: Mammal Species of Conservation Concern likelihood of occurrence within the study area

Name	Threat Status			Habitat	Likelihood of Occurrence
	Global (IUCN)	National (SA red list, 2016)	TOPS		
Southern Mountain Reedbuck *Redunca fulvorufula*	*EN	EN		Mountain Reedbuck are typically found in high altitude grasslands and rocky ridges and hillsides from 1,500 – 5,000m above sea level (IUCN, 2017 and Taylor *et al.*, 2016). They are predominantly grazers and occur in drier hilly areas (such as the Nama Karoo) utilising steep slopes and bases of hills that have a higher moisture content and therefore greener, softer grasses. They avoid open areas with no cover. The availability of drinking water is crucial to their survival and therefore existence. In 1999 this species was estimated to have a population of approximately 33,000 individuals but in 2016 was reported to have unexpectedly declined by 73% (IUCN, 2017; Taylor *et al.*, 2016).	**Low** No suitable habitat is present within the site.
Black-footed Cat *Felis nigripes*	*VU	VU	Protected	The Black-footed cat is typically a solitary, ground dweller that is crepuscular[1] and nocturnal (Sliwa *et al.'* 2016). During the day it makes use of dens, preferring hollowed termite mounds when available but also making use of burrows dug by other animals (e.g., Springhares, Ground Squirrels and Aardvark). It hunts small rodents and ground-dwelling birds found in short, open grasslands and is found in dry, open grasslands, savannah and karoo semi-desert. The estimated EOO is 930,000 km^2 and individual home ranges for males have been recorded to be approximately 16-20km^2 and for females were 9-10km^2.	**Moderate** Suitable habitat present within the site. The nearest record is 60km north (iNat, July 2022)
Spotted-necked Otter (*Hydrictis maculicollis*)	NT	VU		0-2500m asl Habitat requirements include streams, rivers, lakes (natural & manmade) and open waters which are unpolluted and are not silted. Shelters along water edges with cover provided by boulders, reeds, long grass, dense bushes and overhanging trees. Feed predominantly on fish and occasionally crabs, frogs, insects (esp. dragonfly larvae) and birds.	**Low** No suitable habitat is present within the site.

[1] (of an animal) appearing or active in twilight.

Brown Hyaena *Parahyaena brunnea*	NT	NT		Inhabits desert areas (<100 mm MAR), semi-desert, open scrub and open woodland savannah (<700 mm). Avoids developed areas but can survive close to them. It is estimated that there are 800–2,200 individuals in SA.	**Low** Suitable habitat is present within the site (i.e., grasslands and karoo scrub) but this species is sparely distributed and considered uncommon.
African Clawless Otter *Aonyx capensis*	NT	NT		This species is the most widely distributed otter species in Africa, with a range stretching from Senegal and Mali throughout most of West Africa to Sudan and Ethiopia, and then southwards throughout East Africa to the Western Cape of South Africa (Jacques *et al., 2021).* Provided freshwater (0.5–1.5 m deep) is av ailable this species can occur in a variety of habitats. Permanent habitation is dependent on the availability of prey and shelter and females may exhibit territoriality in these areas (Okes, et al., 2016). Although this species can tolerate high levels of pollution, eutrophication, and disturbance (traffic, dogs, etc) in developed areas this is only in moderation (Okes, et al., 2016).	**Low** No suitable habitat is present within the site.
Vlei Rat *Otomys auratus*	NT	NT		Inhabits mesic Highveld Grassland and associated with sedges and grasses adapted to densely vegetated wetlands with wet soils (Taylor, Baxter & Child, 2016).	**Low** No suitable habitat is present within the site.

Serval *Leptailurus serval*	LC	NT		This species depends on vegetation boarding water sources such as wetlands, marshland, rank grass and vleis as well as well-watered savannah with long-grass (Ramesh, *et al*., 2016). Servals prey on small mammals, birds, reptiles, fish, and rarely invertebrates. Their main diet consists of Vlei Rats (*Otomys sp.*) and Striped Mice (*Rhabdomys pumilio*).	**Low** No suitable habitat is present within the site (i.e., grasslands along water courses)
African Striped Weasel *Poecilogale albinucha*	LC	NT		0-2300m asl Wide habitat tolerance including fynbos, lowland rainforest, semi-desert grassland, pine plantations and agricultural fields but mainly found in savanna.	**High** Given its high habitat tolerance this species could occur on site.

*CR – Critical; EN -Endangered; VU – Vulnerable; NT -Near Threatened

6. SENSITIVITY ASSESSMENT

6.1. Free State Bioregional Plan

The proposed site falls within the Free State Province and as such their bioregional plan is applicable. It is our understanding that this plan is based on terrestrial data and that the aquatic data has not yet been added to the spatial planning tool data set.

Critical Biodiversity Areas (CBAs) are areas that are required to meet the regions biodiversity targets and there are no, or very few, other options available in the landscape to meet these targets. Such sites therefore need to remain in a largely natural state and land management objectives require that these areas are managed for no further degradation and that degraded areas are rehabilitated. A small portion of the southern section of the project area occurs within a CBA 1 and CBA 2 (Figure 6.1). The biodiversity features driving this are the vegetation type Northern Upper Karoo and the species, *Lithops salicola.* The field survey found that there was no suitable habitat within this area to support this species and as such is unlikely to negatively affect the functioning of this feature.

Ecological Support Areas (ESAs) are important for maintaining ecological processes on which CBAs depend and are important in delivering ecosystem services. These areas should remain in a largely functional state and land management objectives should support ecological processes. The project site occurs within an ESA 1 (Figure 6.1). The biodiversity feature driving the ESA is the vegetation type Northern Upper Karoo. Since 94% of this vegetation type remains intact, the development is unlikely to negatively affect the functioning of this feature.

6.2. Protected Areas

The project site does not occur within a formally protected area (Figure 6.2). However, Thanda Tula Private Reserve is situated directly north of the project boundary. Project infrastructure may cause a barrier for species moving south of the reserve. However, since the town of Luckhoff is situated south of the proposed project, there is already a barrier for species moving south.

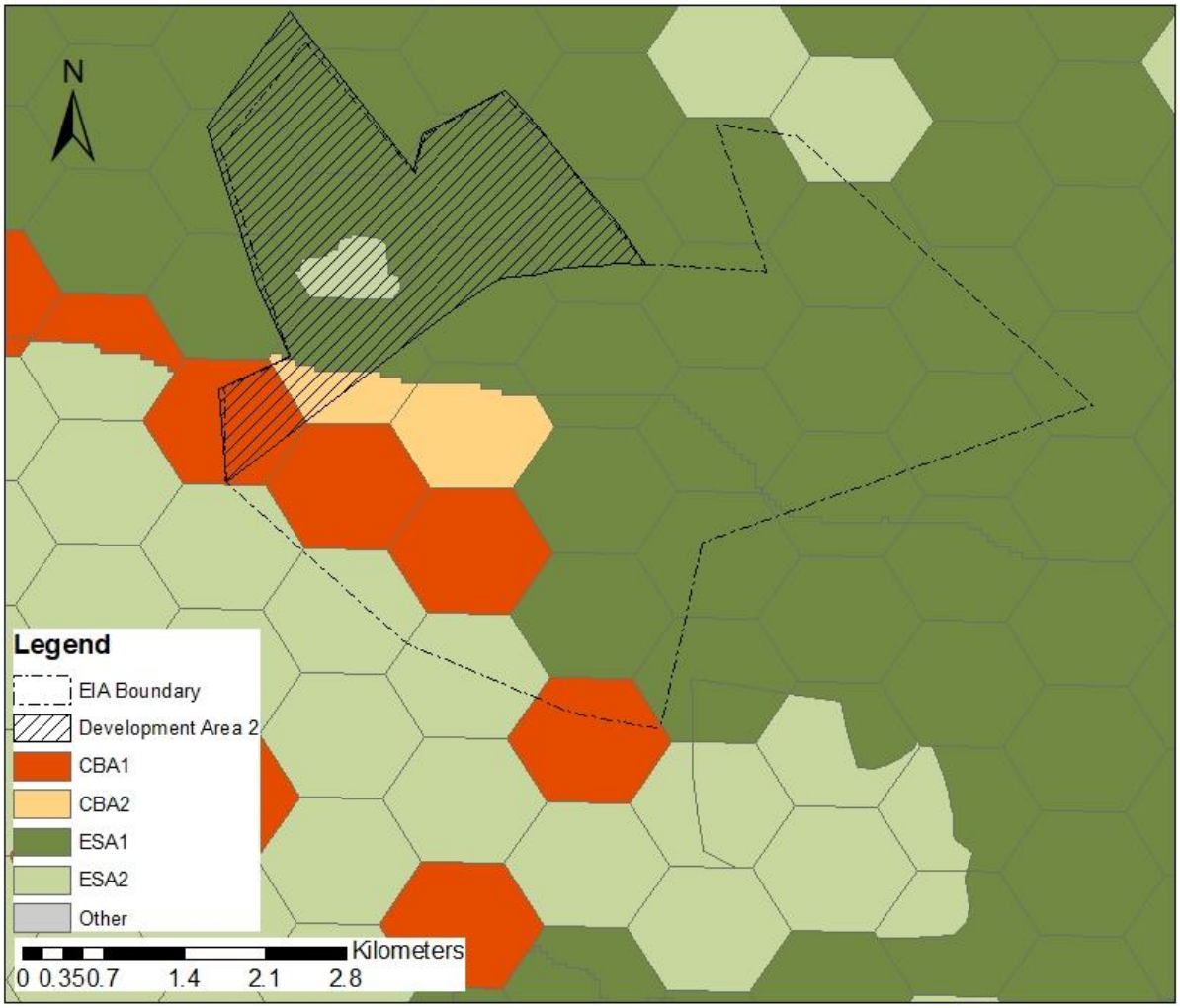

Figure 6.1: Map illustrating the project site in relation to CBAs and ESAs. The site falls within an ESA 1.

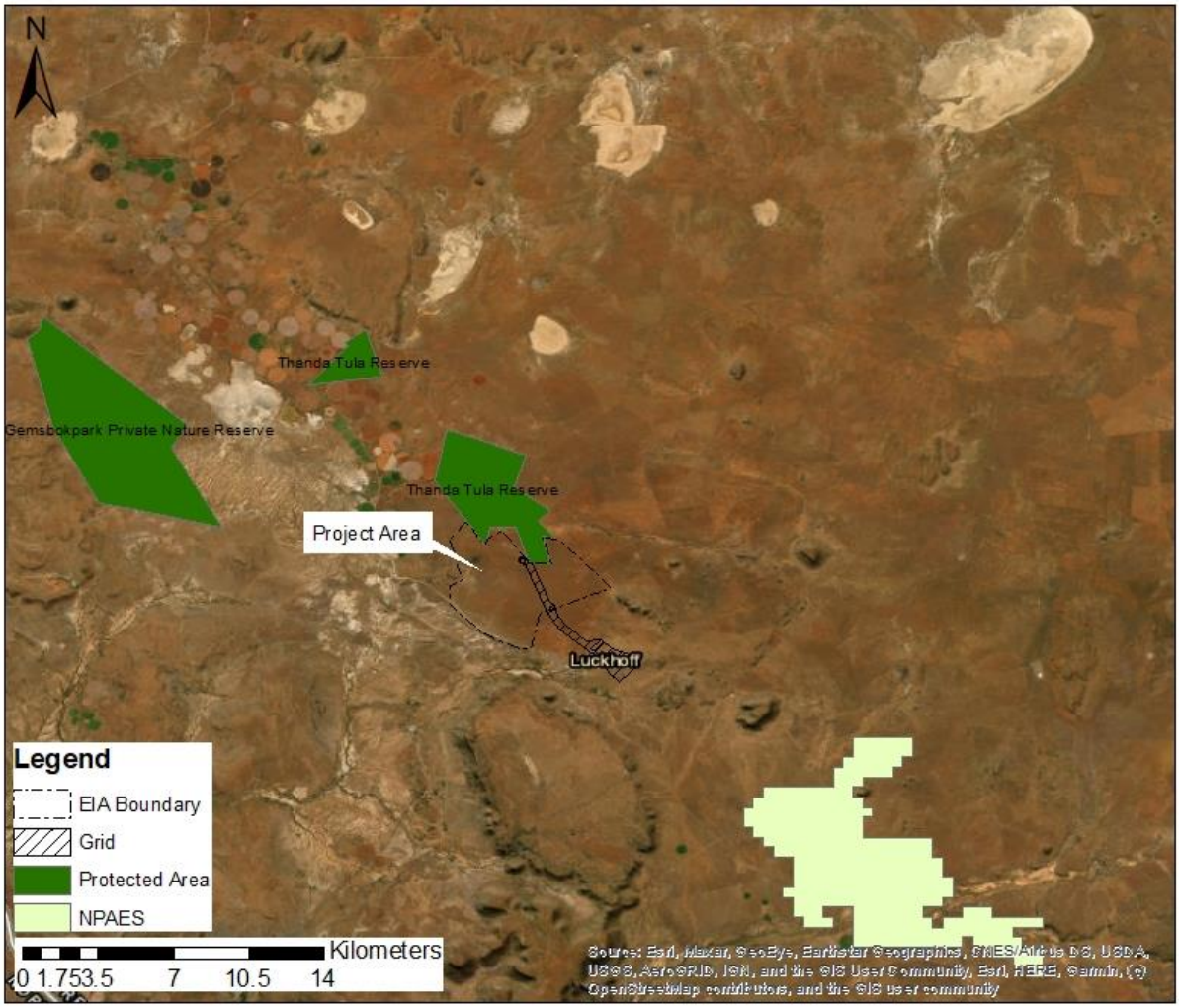

Figure 6.2: Map illustrating the project site in relation to protected areas.

6.3. Site sensitivity

The Species Environmental Assessment guideline (SANBI, 2021) was applied to assess the Site Ecological Importance (SEI) of the project area. The habitats and the species of conservation concern in the project area were assessed based on their conservation importance, functional integrity and receptor resilience (Table 6.1).

The Northern Upper Karoo was determined to have a low SEI. Although the vegetation present is near-intact with good ecological corridors and habitat connectivity, there is a low likelihood of occurrence of SCC and habitat is likely to recover easily to its current state. This vegetation type is also listed as Least Concern with 94% of the remaining extent intact.

Table 6.1: Sensitivity assessment for each vegetation type within the project site

Habitat / Species	Conservation Importance (CI)	Functional Integrity (FI)	BI	Receptor Resilience	SEI
Northern Upper Karoo	Low	High	Medium	High	**Low**
	No confirmed or highly likely populations of Species of Conservation Concern	Large area of intact vegetation with good habitat connectivity and functional ecological corridors.		Habitat can recover relatively quickly (5-10 years) to restore more than 70% of the original species composition and functionality of the site.	
Faunal SCC	Medium	High	Medium	High	**Low**
	The NT African Striped Weasel (*Poecilogale albinucha*) has a high likelihood of occurrence	Large area with good habitat connectivity.		Species is highly likely to return to site once the impact has been removed.	

7. IMPACT ASSESSMENT

7.1. Construction and Operational Phase Impacts

The clearing of vegetation for the construction of the photovoltaic solar facility, access roads and associated infrastructure could result in the following impacts:

- The direct and permanent loss of vegetation types and associated plant species, including species of conservation concern
- The direct and permanent loss of faunal habitat
- Clearing of vegetation resulting in breaks in habitat that will lead to habitat fragmentation and edge effects
- Clearing of vegetation and subsequent disturbance to the soil, and therefore seed bank, leading to the infestation of alien invasive plant species and other ruderal species.
- Heavy machinery associated with clearing of vegetation and construction of the photovoltaic solar facility and access roads causing an increase in dust emissions resulting in impacts on plant productivity.

Other impacts associated with project activities include:

- Faunal mortality due to roadkill, persecution and accidental collision with construction machinery.
- Disturbance to faunal species due to construction and operation activities that generate noise, dust, vibrations and lighting. This disturbance may cause faunal species to leave the area or disrupt foraging and/or breeding behaviour of those that remain.

The spatial extent, temporal scale and impact significance will vary for each impact, and these have therefore been individually assessed in table 7.1 below and appendix 2.

7.1.1. Botanical Impacts

Four impacts associated with the vegetation and flora present on site were identified. Given that the site sensitivity is low and there are no recorded or potential species of conservation concern present within the site, three of the impacts are of low significance and one is negligible.

7.1.2. Faunal Impacts

Four impacts associated with the fauna potentially present on site were identified. Three impacts are of low significance and one is medium before mitigation and all are of low significance after mitigation.

Table 7.1: Impacts associated with the vegetation and fauna

IMPACT	NATURE OF THE IMPACT	PRE-MITIGATION RATING	POST MITIGATION RATING	SUMMARY OF MITIGATION MEASURES
Construction Phase				
Impact 1: Loss of Northern Upper Karoo	The clearing of vegetation for the construction of the SEF and associated infrastructure will result in the permanent loss of approximately 480ha of Northern Upper Karoo. The extent of vegetation that will be impacted equates to 1.2% of the remaining extent of this vegetation unit. The loss of this vegetation type, which is listed as Least Concern, will have an overall impact of low significance. This impact is difficult to mitigate as the loss of vegetation is definite and permanent and as such the impact will remain of low significance even after mitigation measures have been implemented.	Negative Low	Negative Low	• Construction vehicles and machinery must not encroach into identified 'no-go' areas or areas outside the project footprint. • Topsoil (20 cm, where possible) must be collected and stored in an area of low (preferable) and medium sensitivity and used to rehabilitate impacted areas that are no longer required during the operational phase (e.g. laydown areas). • Only indigenous species must be used for rehabilitation. • Where possible, lay down areas must be located within previously disturbed sites. • Employees must be prohibited from making open fires during the construction phase. • Employees must be prohibited from collecting plants. It is recommended that spot checks of pockets and bags are done on a regular basis to ensure that no unlawful harvesting of plant species is occurring. • An alien invasive management plan for the site must be created. • An in-situ search and rescue plan must be developed and implemented for succulents and geophytes that will be impacted by the construction of the project site. • Plant translocation to adjacent suitable habitat may only be done for species that are not range restricted and for populations that have not been quantified as regionally significant.

				• In such cases that this is not feasible, any requirement for translocation must be discussed with the relative authorities prior to translocation taking place.
Impact 2: Loss of faunal habitat	The clearing of vegetation for the construction of project infrastructure will result in the permanent loss of approximately 480ha of faunal habitat. This impact is difficult to mitigate as the loss of habitat is definite and permanent and as such the impact will remain even after mitigation measures have been implemented.	Negative Low	Negative Low	• Existing roads must be used as far as possible and road networks consolidated. • Construction vehicles and machinery must not encroach into areas outside the project footprint. • Where possible, lay down areas must be located within previously disturbed sites. • Employees must be prohibited from making open fires during the construction phase.
Impact 3: Disturbance to terrestrial vertebrate faunal species that may use the site and immediate surrounds	Construction activities may generate noise, dust, vibrations and light pollution. This disturbance may cause faunal species to leave the area or disrupt foraging and/or breeding behaviour of those that remain.	Negative Low	Negative Low	• Any fencing required must be wildlife permeable especially at strategic places such as along drainage lines. This allows for small and small-medium sized animals to move between their natural habitat unencumbered. If electrified strands are to be used, there must be no strands within 30 cm of the ground. As an example, if a tortoise touches this strand it automatically retreats into its shell and does not move because it senses danger, and the repeated shocks eventually kill it (Arnot & Moteno, 2017). • Ensure walls allow access for small fauna (openings at the base at intervals) within the developed area. • External night lighting must be down lights, placed as low to the ground as possible and of low UV emitting lights, such as most LEDs. Lighting in open space areas within development must be minimised. This is to avoid attracting insects and their predators to the lights and minimising unnecessary mortalities.

				• Vehicles and machinery must meet best practice standards in terms of noise • Dust suppression techniques such as road watering required during windy periods • Minimise barriers to faunal movement (construct side walls of pavements, gutters, and trenches with a gradual slope and not at right angles to allow small faunal species to exit).
Impact 4: Loss of Plant Species of Conservation Concern	No restricted range species or CR, EN or VU species were recorded within the site during the field survey. Additionally, the desktop assessment did not identify any SCC with a high likelihood of occurrence within the site. The impact is therefore negligible.	Negligible	Negligible	N/A
Impact 5: Loss of faunal Species of Conservation Concern	Only one faunal SCC has a high likelihood of occurrence, the NT African Striped Weasel (*Poecilogale albinucha*). Although listed this species has a large distribution and considered locally common.	Negative Low	Negative Low	A clause must be included in contracts for all personnel working on site stating that: "*no wild animals will be hunted, killed, poisoned or captured. No wild animals will be imported into, exported from or transported in or through the province. No wild animals will be sold, bought, donated and no person associated with the development will be in possession of any live wild animal, carcass or anything manufactured from the carcass*." A clause relating to fines, possible dismissal and legal prosecution must be included should any of the above transgressions occur.
Impact 6: Disruption of Ecosystem Function and Process	Fragmentation is one of the most important impacts on vegetation as it creates breaks in previously continuous vegetation, causing a reduction in the gene pool and a decrease in species richness and diversity. This impact occurs when more and more areas are cleared,	Negative Low	Negative Low	In addition to the mitigation measures listed under impact 1, the following should be implemented: • Rehabilitate laydown areas • Use existing access roads and upgrade these where necessary

	resulting in the isolation of functional ecosystems, which results in reduced biodiversity and reduced movement due to the absence of ecological corridors. The infrastructure associated with the Photovoltaic Solar Facility, particularly the roads, will increase habitat fragmentation by creating breaks in the environment. However, the movement of species (fauna and seeds) will not be entirely prohibited due to the nature of the infrastructure and the ecological functioning of the site can still be maintained.			
Impact 7: Mortality of faunal species due to accidental death and/or persecution	Construction activities may inadvertently kill terrestrial vertebrate fauna during vegetation clearing, earth works and driving across the site. Fauna perceived as dangerous may be persecuted out of fear.	Negative medium	Negative Low	• During construction induction material must iterate safety to fauna and personnel through avoidance of wildlife. • Speed restrictions within the development for all vehicles (30km/h is recommended) should be in place to reduce the impact of killed fauna on the project roads. • Any terrestrial vertebrate fauna found on site during construction must be relocated to habitat immediately adjacent to the development and should these be SCC recorded on iNaturalist. • A snake handler should be on call to provide removal and relocation service should any snakes be found on site or in neighbouring homes, note that October is when snakes are most active as they emerge from hibernation.

				• Mortality of terrestrial vertebrate species on roads must be monitored and reported (carcasses need to be collected and frozen and circumstances of roadkill investigated).
Operational Phase				
Impact 8: Infestation of Alien Plant Species	If laydown areas and roads are not rehabilitated, these disturbed areas can become places for alien invasive species to become established, and if left unmitigated, these species can spread and establish themselves in intact vegetation, resulting in the displacement of indigenous species and possible local extinctions of SCC. Three exotic species (*Schinus molle, Argemone ochroleuca* and *Cymbopogon pospischilii*) were recorded within the project site. *Argemone ochroleuca* is listed as a Category 1b species.	Negative Low	Negative Low	• The site must be checked regularly for the presence of alien invasive species. When alien invasive species are found, immediate action must be taken to remove them. • *Argemone ochroleuca* currently noted on site must be removed and disposed of. • An alien invasive management plan must be incorporated into the EMPr. • The ECO must create a list with accompanying photographs of possible alien invasive species that could occur on site prior to construction. This photo guide must be used to determine if any alien invasive species are present.
Impact 9: Disturbance to terrestrial vertebrate faunal species	Operation activities may generate disturbance to faunal species disrupting foraging and/or breeding behaviour.	Negative Low	Negative Low	• Maintenance must be restricted to daylight hours • Vehicles must meet best practice standards in terms of noise • Dust suppression techniques such as road watering required during windy periods
Impact 10: Mortality of faunal species	Operation activities may kill terrestrial vertebrate fauna specifically driving across the site. Fauna perceived as dangerous may be persecuted out of fear.	Negative medium	Negative Low	• Speed restrictions within the development for all vehicles (30km/h is recommended) should be in place to reduce the impact of killed fauna on the project roads. • Mortality of terrestrial vertebrate species on roads must be monitored and reported (carcasses need to be collected and frozen and circumstances of roadkill investigated).

				• Only cleaning chemicals least harmful to faunal species should be used during landscaping. Runoff can cause chemical to enter aquatic systems and may impact on faunal species that inhabit them.
Decommissioning Phase				
Impact 11: Loss of Indigenous Vegetation	The decommissioning of the Photovoltaic Solar Facility will require laydown areas and will disrupt vegetation that has re-established around the areas that were disturbed during the construction phase. The loss of vegetation will be similar to the construction phase impacts.	Negative Low	Negative Low	Refer to mitigation measures listed under impact 1.
Impact 12: Disturbance to terrestrial vertebrate faunal species	Decommissioning activities may generate disturb faunal species disrupting foraging and/or breeding behaviour	Negative Low	Negative Low	Refer to mitigation measures listed under construction and operational impact.
Impact 13: Mortality of faunal species	Decommissioning activities may kill terrestrial vertebrate fauna specifically driving across the site. Fauna perceived as dangerous may be persecuted out of fear.	Negative medium	Negative Low	Refer to mitigation measures listed under construction and operational impact.

8. CONCLUSIONS AND RECOMMENDATIONS

8.1. Conclusions

The development is situated within Northern Upper Karoo which is widespread and listed as Least Concern with few SCC likely to be present. The SEI for this vegetation type was found to be of low sensitivity meaning that construction within these areas is permissible from an ecological perspective.

8.2. Recommendations

It is recommended that the following conditions are included in the Final EMPr as well as the conditions of the Environmental Authorisation (EA), if granted:

8.2.1. Botanical

- The remaining vegetation within the property should remain intact so that it can continue to function as an ecological corridor for species movement.
- All necessary plant permits must be obtained prior to the commencement of any construction activities.
- Where feasible, laydown areas must be placed in previously disturbed sites.
- A walkthrough of the final layout must be undertaken by a botanist and if populations of SCC will be impacted, infrastructure should be moved to avoid these areas. Where this is not feasible, a search and rescue plan will be required.
- If any SCC are to be impacted, these must be relocated to nearest appropriate habitat.
- Construction vehicles and machinery must not encroach into identified 'no-go' areas or areas outside the project footprint.
- Topsoil (20 cm, where possible) must be collected and stored in an area of low sensitivity and used to rehabilitate impacted areas that are no longer required during the operational phase (e.g. laydown areas).
- Employees must be prohibited from collecting any plants.
- Alien invasive plant clearing should be undertaken in line with an Alien Vegetation Management plan, which should be compiled as part of the EMPr and implemented with immediate effect.
- Only indigenous plant species typical of the local vegetation and approved by a botanist should be used for the rehabilitation of natural habitat.

8.2.2. Fauna

- Any terrestrial vertebrate fauna found on site during construction must be relocated to habitat immediately adjacent to the development and should these be SCC recorded the ECO must record the release site on iNaturalist.
- Development must be designed to allow unencumbered movement of this species. e.g., trenches with sloped side to allow faunal species to exit.
- The development must consolidate road networks to minimise the loss of faunal habitat.

- Laydown areas must be rehabilitated with specific measures to create fauna habitat.
- Speed restrictions within the development for all vehicles (30km/h is recommended) should be in place to reduce the impact of killed fauna on the project roads.
- In addition to all mitigations listed above a clause must be included in contracts for ALL personnel working on site stating that: “no wild animals will be hunted, killed, poisoned or captured. No wild animals will be imported into, exported from or transported in or through the province. No wild animals will be sold, bought, donated and no person associated with the development will be in possession of any live wild animal, carcass or anything manufactured from the carcass.” A clause relating to fines, possible dismissal and legal prosecution must be included should any of the above transgressions occur, especially for SCC.

8.3. Ecological Statement and Opinion of the Specialist

Impacts on the terrestrial plant species and faunal habitats can be reduced to acceptable levels through the implementation of mitigation measures. The specialist is therefore of the opinion that the development can proceed, provided the recommendations contained in this report are implemented.

9. REFERENCES

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APPENDIX 1: PLANT SPECIES RECORDED ON SITE

Family	Species	Red List Status	PNCO Status
AIZOACEAE	*Ruschia spinosa*	LC	-
AMARANTHACEAE	*Atriplex suberecta*	LC	-
AMARYLLIDACEAE	*Boophone disticha*	LC	Schedule 6
ANACARDIACEAE	*Schinus molle*	NE	-
ANACARDIACEAE	*Searsia burchelli*	LC	-
ANACARDIACEAE	*Searsia lancea*	LC	-
ANACARDIACEAE	*Searsia pyroides*	LC	-
ASPARAGACEAE	*Asparagus retrofractus*	LC	-
ASPARAGACEAE	*Asparagus suaveolens*	LC	-
ASPHODELACEAE	*Aloe broomii*	LC	Schedule 6
ASPHODELACEAE	*Trachyandra saltii*	LC	-
ASTERACEAE	*Eriocephalus ericoides*	LC	-
ASTERACEAE	*Hertia pallens*	LC	-
ASTERACEAE	*Pentzia incana*	LC	-
ASTERACEAE	*Pentzia sphaerocephala*	LC	-
ASTERACEAE	*Pseudognaphalium luteo-album*	LC	-
ASTERACEAE	*Senecio burchellii*	LC	-
CAMPANULACEAE	*Wahlenbergia albens*	LC	-
CONVOLVULACEAE	*Convolvulus boedeckerianus*	LC	-
CYPERACEAE	*Cyperus usitatus*	LC	-
FABACEAE	*Acacia karoo*	LC	-
FABACEAE	*Senna italica*	LC	-
MALVACEAE	*Hermannia comosa*	LC	-
MALVACEAE	*Hibiscus marlothianus*	LC	-
PAPAVERACEAE	*Argemone ochroleuca*	NE	-
POACEAE	*Aristida adscensionis*	LC	-
POACEAE	*Aristida congesta*	LC	-
POACEAE	*Cloris virgata*	LC	-
POACEAE	*Cymbopogon pospischilii*	NE	-
POACEAE	*Digitaria eriantha*	LC	-
POACEAE	*Eragrostis lehmanniana*	LC	-
POACEAE	*Schmidtia pappophoroides*	LC	-
POACEAE	*Themeda triandra*	LC	-
RHAMNACEAE	*Ziziphus mucronata*	LC	-
SCROPHULARIACEAE	*Aptosimum marlothii*	LC	-
SCROPHULARIACEAE	*Chaenostoma halimifolium*	LC	-
SCROPHULARIACEAE	*Jamesbrittenia aurantiaca*	LC	-
SCROPHULARIACEAE	*Jamesbrittenia tysonii*	LC	-

SCROPHULARIACEAE	*Selago geniculata*	LC	-
SOLANACEAE	*Lycium cinereum*	LC	-
ZYGOPHYLLACEAE	*Zygophyllum lichtensteinianum*	LC	-

APPENDIX 2: IMPACT MATRIX

LISTED ACTIVITY (The Stressor)	ASPECTS OF THE DEVELOPMENT /ACTIVITY	POTENTIAL IMPACTS			SIGNIFICANCE AND MAGNITUDE OF POTENTIAL IMPACTS							MITIGATION OF POTENTIAL IMPACTS		
		Receptors		Impact description / consequence	Minor	Major	Extent	Duration	Probability	Reversibility	Irreplaceable loss of resources	Possible Mitigation	Possible mitigation measures	Level of residual risk
CONSTRUCTION PHASE														
Activity 11(i) (GN.R. 327): *"The development of facilities or infrastructure for the transmission and distribution of electricity outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts."* Activity 24 (ii) (GN.R 327): *"The development of a road (ii) with reserve wider than 13,5 meters, or where no reserve exists where the road is wider than 8 meters"* Activity 28 (ii) (GN.R. 327): *"Residential, mixed, retail, commercial, industrial or institutional developments where such land was used for agriculture or afforestation on or after 1998 and where such development (ii) will occur outside an urban area, where the total land to be developed is bigger than 1 hectare."* Activity 56 (ii) (GN.R 327): *"The widening of a road by more than 6 metres, or the lengthening of a road by more*	Site clearing and preparation Certain areas of the site will need to be cleared of vegetation and some areas may need to be levelled. Civil works The main civil works are: • Terrain levelling if necessary– Levelling will be minimal as the potential site chosen is relatively flat. • Laying foundation- The structures will be connected to the ground through cement pillars, cement slabs or metal screws. The exact method will depend on the detailed geotechnical analysis. • Construction of access and inside roads/paths – existing paths will be used were reasonably possible. Additionally, the turning circle for trucks will also be taken into consideration. Transportation and installation of PV panels into an Array The panels are assembled at the supplier's premises and will be transported from the factory to the	BIOPHYSICAL ENVIRONMENT	Flora	**Impact 1: Loss of Northern Upper Karoo Vegetation** The clearing of vegetation for the construction of the SEF and associated infrastructure will result in the permanent loss of approximately 480ha of Northern Upper Karoo. The extent of vegetation that will be impacted equates to 1.2% of the remaining extent of this vegetation unit. The loss of this vegetation type, which is listed as Least Concern, will have an overall impact of low significance. This impact is difficult to mitigate as the loss of vegetation is definite and permanent and as such the impact will remain of low significance even after mitigation measures have been implemented.	-		S	LT	P	BR	ML	No	- Construction vehicles and machinery must not encroach into identified 'no-go' areas or areas outside the project footprint. - Topsoil (20 cm, where possible) must be collected and stored in an area of low (preferable) and medium sensitivity and used to rehabilitate impacted areas that are no longer required during the operational phase (e.g. laydown areas). - Only indigenous species must be used for rehabilitation. - Where possible, lay down areas must be located within previously disturbed sites. - Employees must be prohibited from making open fires during the construction phase. - Employees must be prohibited from collecting plants. It is recommended that spot checks of	L

than 1 kilometre (ii) where no reserve exists, where the existing road is wider than 8 metres…" Activity 1 (GN.R 325): *"The development of facilities or infrastructure for the generation of electricity from a renewable resource where the electricity output is 20 megawatts or more."* Activity 15 (GN.R 325): *"The clearance of an area of 20 hectares or more of indigenous vegetation."* Activity 4 (b)(i)(ee)(GN.R 324): " *"The development of a road wider than 4 metres with a reserve less than 13,5 metres (b) in the Free State, (i) outside urban areas and within (ee) critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans."* Activity 10 (b)(i)(ee)(hh) (GN.R 324): ""*The development and related operation of facilities or infrastructure for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of 30 but not exceeding 80 cubic metres (b) in the Free State (i) outside urban areas and within (ee) Critical Biodiversity Areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans."*	site on trucks. The panels will be mounted on metal structures which are fixed into the ground either through a concrete foundation or a deep-seated screw. Wiring to the Central Inverters Sections of the PV array would be wired to central inverters which have a maximum rated power of 2000kW each. The inverter is a pulse width mode inverter that converts DC electricity to alternating electricity (AC) at grid frequency.												pockets and bags are done on a regular basis to ensure that no unlawful harvesting of plant species is occurring. - An alien invasive management plan for the site must be created. - An in-situ search and rescue plan must be developed and implemented for succulents and geophytes that will be impacted by the construction of the project site. - Plant translocation to adjacent suitable habitat may only be done for species that are not range restricted and for populations that have not been quantified as regionally significant. - In such cases that this is not feasible, any requirement for translocation must be discussed with the relative authorities prior to translocation taking place.	
			Flora	**Impact 2: Loss of Plant Species of Conservation Concern** No restricted range species or CR, EN or VU species were recorded within the site during the field survey. Additionally, the desktop assessment did not identify any SCC with a high likelihood of occurrence within the site. The impact is therefore negligible.	Negligible		Not Applicable as impact is negligible							N/A	L
			Fauna and Flora	Fragmentation is one of the most important impacts on vegetation as it creates breaks in previously continuous	-		L	L	Pr	PR	ML	Yes	In addition to the mitigation measures listed under impact 1, the	L

<u>Activity 12 (b)(i)(ii)(iv) (GN.R 324):</u> *"The clearance of an area of 300 square metres or more of indigenous vegetation… …(b) in the Free State (i) within any critically endangered or endangered ecosystem listed in terms of section 52 of the NEMBA or prior to the publication of such a list, within an area that has been identified as critically endangered in the National Spatial Biodiversity Assessment 2004, (ii) within critical biodiversity areas identified in bioregional plans."* <u>Activity 18 (b)(i)(ee)(hh) (GN.R 324):</u> *"The widening of a road by more than 4 metres, or the lengthening of a road by more than 1 kilometre (b) in the Free State (i) outside urban areas and within (ee) Critical biodiversity areas or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans."*				vegetation, causing a reduction in the gene pool and a decrease in species richness and diversity. This impact occurs when more and more areas are cleared, resulting in the isolation of functional ecosystems, which results in reduced biodiversity and reduced movement due to the absence of ecological corridors. The infrastructure associated with the Photovoltaic Solar Facility, particularly the roads, will increase habitat fragmentation by creating breaks in the environment. However, the movement of species (fauna and seeds) will not be entirely prohibited due to the nature of the infrastructure and the ecological functioning of the site can still be maintained.									following should be implemented: • Rehabilitate laydown areas • Use existing access roads and upgrade these where necessary	
			Fauna	**Impact: Loss of faunal habitat** The clearing of vegetation for the construction of project infrastructure will result in the permanent loss of approximately 480ha of faunal habitat. This impact is difficult to mitigate as the loss of habitat is definite and permanent and as such the impact will remain even after mitigation measures have been implemented.			L	LT	D	BR	ML	No	• Existing roads must be use as far as possible and road networks consolidated. • Construction vehicles and machinery must not encroach into identified 'no-go' areas or areas outside the project footprint. • Where possible, lay down areas must be located within previously disturbed sites. • Employees must be prohibited from making open fires during the construction phase.	L
			Fauna	**Impact: Disturbance to Faunal Species** Construction activities may generate noise, dust, vibrations and light pollution. This disturbance may cause faunal species to leave the area or disrupt foraging and/or breeding behaviour of those that remain.			L	LT	Pr	BR	ML	No	• Any fencing required must be wildlife permeable especially at strategic places such as along drainage lines. This allows for small and small-medium sized animals to move between their natural habitat unencumbered. If electrified strands are to be used, there must be no strands within 30 cm of the ground. As an example, if a tortoise touches this strand it automatically retreats into its shell and does not move because it senses danger, and the repeated shocks eventually kill it (Arnot & Moteno, 2017).	L

													• Ensure walls allow access for small fauna (openings at the base at intervals) within the developed area. • External night lighting must be down lights, placed as low to the ground as possible and of low UV emitting lights, such as most LEDs. Lighting in open space areas within development must be minimised. This is to avoid attracting insects and their predators to the lights and minimising unnecessary mortalities. • Vehicles and machinery must meet best practice standards in terms of noise • Dust suppression techniques such as road watering required during windy periods • Minimise barriers to faunal movement (construct side walls of pavements, gutters, and trenches with a gradual slope and not at right angles to allow small faunal species to exit).	
			Fauna	**Impact: Mortality of faunal species** Construction activities may inadvertently kill terrestrial vertebrate fauna during vegetation clearing, earth works and driving across the site. Fauna perceived as dangerous may be persecuted out of fear.			L	P	Po	I	ML	Yes	• During construction induction material must iterate safety to fauna and personnel through avoidance of wildlife. • Speed restrictions within the development for all vehicles (30km/h is recommended) should be in place to reduce the impact of killed fauna on the project roads. • Any terrestrial vertebrate fauna found on site during construction must be relocated to habitat immediately adjacent to the development and should these be SCC recorded on iNaturalist. • A snake handler should be on call to provide removal and relocation service should any snakes be found on site or in	M

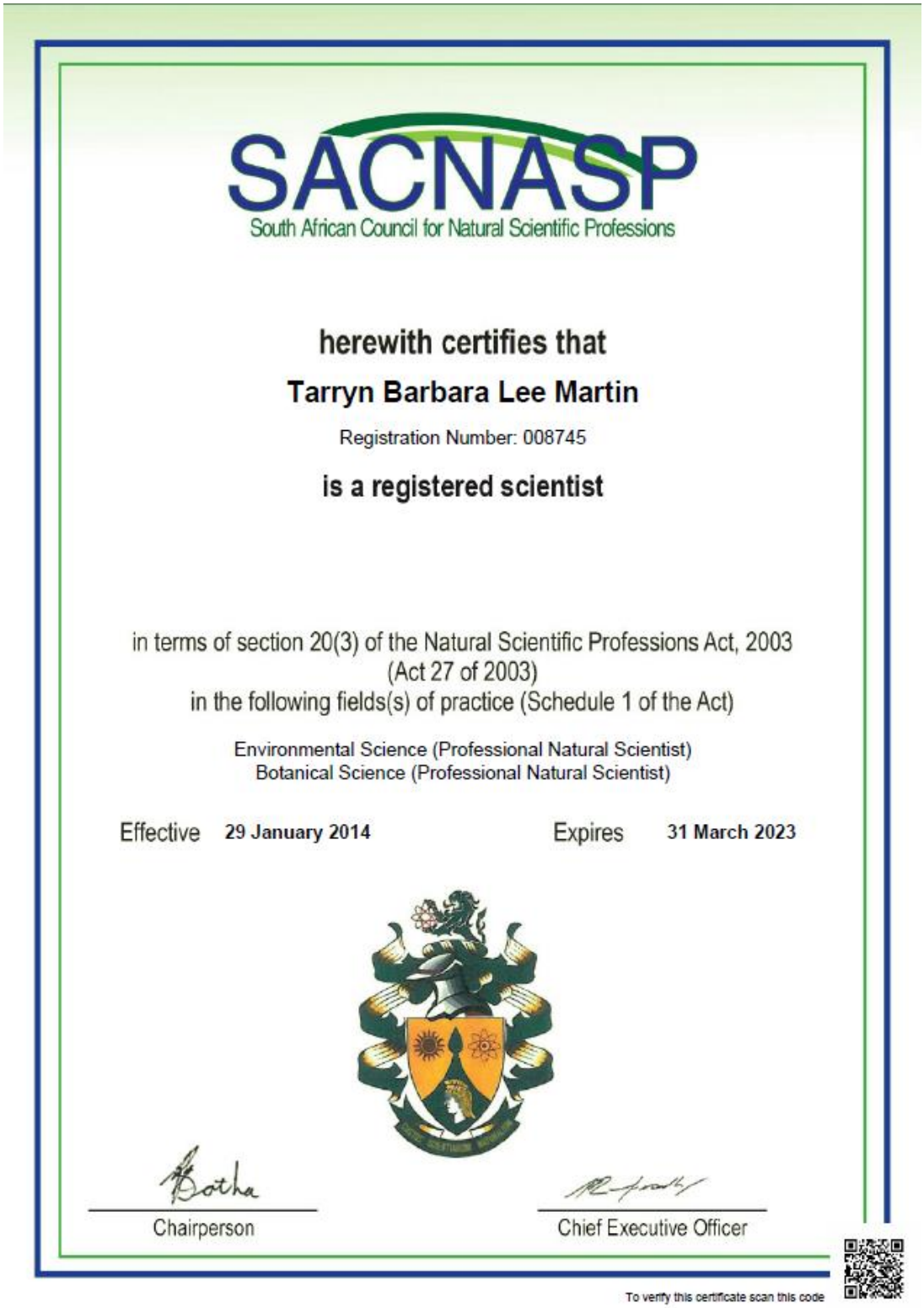
														neighbouring homes, note that October is when snakes are most active as they emerge from hibernation. • Mortality of terrestrial vertebrate species on roads must be monitored and reported (carcasses need to be collected and frozen and circumstances of roadkill investigated).	
			Fauna	**Impact: Loss of faunal species of conservation concern**			L	LT	Po	I	SL	Yes	• In addition to all recommendations listed in above a clause must be included in contracts for all personnel working on site stating that: "*no wild animals will be hunted, killed, poisoned or captured. No wild animals will be imported into, exported from or transported in or through the province. No wild animals will be sold, bought, donated and no person associated with the development will be in possession of any live wild animal, carcass or anything manufactured from the carcass.*" A clause relating to fines, possible dismissal and legal prosecution must be included should any of the above transgressions occur.	L
OPERATIONAL PHASE															

Same as above	Habitat disturbance as a result of construction and operational activities	BIOPHYSICAL ENVIRONMENT	Flora	**Impact 4: Infestation of Alien Plant Species** If laydown areas and roads are not rehabilitated, these disturbed areas can become places for alien invasive species to become established, and if left unmitigated, these species can spread and establish themselves in intact vegetation, resulting in the displacement of indigenous species and possible local extinctions of SCC. Three exotic species (*Schinus molle, Argemone ochroleuca* and *Cymbopogon pospischilii*) were recorded within the project site. *Argemone ochroleuca* is listed as a Category 1b species.	-		L	M	Po	CR	SL	YES	• The site must be checked regularly for the presence of alien invasive species. When alien invasive species are found, immediate action must be taken to remove them. • *Argemone ochroleuca* currently noted on site must be removed and disposed of. • An alien invasive management plan must be incorporated into the EMPr. • The ECO must create a list with accompanying photographs of possible alien invasive species that could occur on site prior to construction. This photo guide must be used to determine if any alien invasive species are present.	L
			Fauna	**Impact: Disturbance to Faunal Species** Operation activities may generate disturb faunal species disrupting foraging and/or breeding behaviour.			L	LT	Pr	BR	ML	Yes	• Maintenance must be restricted to daylight hours • Vehicles must meet best practice standards in terms of noise • Dust suppression techniques such as road watering required during windy periods	L

			Fauna	**Impact: Mortality of faunal species** Operation activities may kill terrestrial vertebrate fauna specifically driving across the site. Fauna perceived as dangerous may be persecuted out of fear.			L	P	Po	I	ML	Yes	• Speed restrictions within the development for all vehicles (30km/h is recommended) should be in place to reduce the impact of killed fauna on the project roads. • Mortality of terrestrial vertebrate species on roads must be monitored and reported (carcasses need to be collected and frozen and circumstances of roadkill investigated). • Only cleaning chemicals least harmful to faunal species should be used during landscaping. Runoff can cause chemical to enter aquatic systems and may impact on faunal species that inhabit them.	M
DECOMISSIONING PHASE														
Same as above	Same as for the construction phase.	BIOPHYSICAL ENVIRONMENT	Flora	**Impact 5: Loss of Indigenous Vegetation** The decommissioning of the Photovoltaic Solar Facility will require laydown areas and will disrupt vegetation that has re-established around the areas that were disturbed during the construction phase. The loss of vegetation will be similar to the construction phase impacts.	-		S	LT	P	BR	ML	Yes	Refer to mitigation measures listed under impact 1.	L
			Fauna	**Impact: Disturbance to Faunal Species** Decommissioning activities may generate disturb faunal species disrupting foraging and/or breeding behaviour.			L	LT	Pr	BR	ML	Yes	Refer to mitigation measures listed under operational impact.	L

			Fauna	**Impact: Mortality of faunal species** Decommissioning activities may kill terrestrial vertebrate fauna specifically driving across the site. Fauna perceived as dangerous may be persecuted out of fear.			L	P	Po	I	ML	Yes	Refer to mitigation measures listed under operational impact.	M

APPENDIX 3: PROOF OF SACNASP REGISTRATION AND HIGHEST QUALIFICATION



SACNASP
South African Council for Natural Scientific Professions

herewith certifies that

Tarryn Barbara Lee Martin

Registration Number: 008745

is a registered scientist

in terms of section 20(3) of the Natural Scientific Professions Act, 2003
(Act 27 of 2003)
in the following fields(s) of practice (Schedule 1 of the Act)

Environmental Science (Professional Natural Scientist)
Botanical Science (Professional Natural Scientist)

Effective **29 January 2014** Expires **31 March 2023**

Chairperson

Chief Executive Officer

To verify this certificate scan this code

RHODES UNIVERSITY

THIS IS TO CERTIFY THAT

TARRYN BARBARA LEE MARTIN

WAS THIS DAY AT A CONGREGATION OF THE UNIVERSITY
ADMITTED TO THE DEGREE OF

MASTER OF SCIENCE

IN

BOTANY

WITH DISTINCTION

VICE CHANCELLOR

DEAN OF THE FACULTY OF SCIENCE

REGISTRAR

GRAHAMSTOWN
10 APRIL 2010

Application for Professional Natural Science in the field of Zoology is currently awaiting approval.

SACNASP

South African Council for Natural Scientific Professions

herewith certifies that

Amber Leah Jackson
Registration number: 100125/12

is registered as a

Candidate Natural Scientist

in terms of section 20(3) of the Natural Scientific Professions Act, 2003
(Act 27 of 2003)
in the following field(s) of practice (Schedule I of the Act)

Environmental Science **15 August 2012**

15 August 2012
Pretoria

President

Executive Director

University of Cape Town • iYunivesithi yaseKapa • Universiteit van Kaapstad

SPES BONA

we certify that

Amber Leah Jackson

was admitted to the degree of

Master of Philosophy

in Environmental Management

on 9 June 2011

Vice-Chancellor

UNIVERSITY OF CAPE TOWN MDCCCLXVIII

Hugh Amoore

Registrar

APPENDIX 4: CV

CONTACT DETAILS

Name	**Tarryn Martin**
Name of Company	**Biodiversity Africa**
Designation	Director
Profession	Botanical Specialist and Environmental Manager
E-mail	tarryn@biodiversityafrica.com
Office number	+27 (0)71 332 3994
Education	2010: Master of Science with distinction (Botany) 2004: Bachelor of Science (Hons) in African Terrestrial Vertebrate Biodiversity 2003: Bachelor of Science
Nationality	**South African**
Professional Body	**SACNASP**: South African Council for Natural Scientific Profession: Professional Natural Scientist (400018/14) **SAAB**: Member of the South African Association of Botanists **IAIASa**: Member of the International Association for Impact Assessments South Africa Member of Golden Key International Honour Society
Key areas of expertise	• Biodiversity Surveys and Impact Assessments • Environmental Impact Assessments • Critical Habitat Assessments • Biodiversity Management and Monitoring Plans

PROFILE

Tarryn has over ten years of experience working as a botanist, nine of which are in the environmental sector. She has worked as a specialist and project manager on projects within South Africa, Mozambique, Lesotho, Zambia, Tanzania, Cameroon and Malawi.

She has extensive experience writing botanical impact assessments, critical habitat assessments, biodiversity management plans, biodiversity monitoring plans and Environmental Impact Assessments to International Standards, especially to those of the International Finance Corporation (IFC). Her experience includes working on large mining projects such as the Kenmare Heavy Minerals Mine, where she monitored forest health, undertook botanical impact assessments for their expansion projects and designed biodiversity management and monitoring plans. She has also project managed Environmental Impact Assessments for graphite mines in northern Mozambique and has a good understanding of the Mozambique Environmental legislation and processes.

Tarryn holds a BSc (Botany and Zoology), a BSc (Hons) in African Vertebrate Biodiversity and an MSc with distinction in Botany from Rhodes University. Tarryn's Master's thesis examined the impact of fire on the recovery of C_3 and C_4 Panicoid and non-Panicoid grasses within the context of climate change for which she won the Junior Captain Scott-Medal (Plant Science) for producing the top MSc of 2010 from the South African Academy of Science and Art as well as an Award for Outstanding Academic Achievement in Range and Forage Science from the Grassland Society of Southern Africa. Tarryn is a professional member of the South African Council for Natural Scientific Professionals (since 2014).

EMPLOYMENT EXPERIENCE

Director and Botanical Specialist, Biodiversity Africa

July 2021 - present

- Botanical and ecological assessments for local and international EIAs in Southern Africa
- Identifying and mapping vegetation communities and sensitive areas
- Designing and implementing biodiversity management and monitoring plans
- Designing rehabilitation plans
- Designing alien management plans
- Critical Habitat Assessments
- Large ESIA studies
- Managing budgets

Principal Environmental Consultant, Branch Manager and Botanical Specialist, Coastal and Environmental Services

May 2012-June 2021

- Botanical and ecological assessments for local and international EIAs in Southern Africa
- Identifying and mapping vegetation communities and sensitive areas
- Designing and implementing biodiversity management and monitoring plans
- Designing rehabilitation and biodiversity offset plans
- Designing alien management plans
- Critical Habitat Assessments
- Large ESIA studies
- Managing budgets
- Cape Town branch manager
- Coordinating specialists and site visits

Accounts Manager, Green Route DMC

October 2011- January 2012

- Project and staff co-ordination
- Managing large budgets for incentive and conference groups travelling to southern Africa
- Creating tailor-made programs for clients
- Negotiating rates with vendors and assisting with the ground management of inbound groups to ensure client satisfaction.

Camp Administrator and Project Co-ordinator, Windsor Mountain International Summer Camp, USA

April 2011 - September 2012

- Co-ordinated staff and camper travel arrangements, main camp events and assisted with marketing the camp to prospective families.

Freelance Project Manager, Green Route DMC

November 2010 - April 2011

- Project and staff co-ordination
- Managing large budgets for incentive and conference groups travelling to southern Africa
- Creating tailor-made programs for clients
- Negotiating rates with vendors and assisting with the ground management of inbound groups to ensure client satisfaction.

Camp Counselor, Windsor Mountain Summer Camp, USA

June 2010 - October 2010

NERC Research Assistant, Botany Department, Rhodes University, Grahamstown in collaboration with Sheffield University, Sheffield, England

April 2009 - May 2010

- Set up and maintained experiments within a common garden plot experiment
- collected, collated and entered data
- Assisted with the analysis of the data and writing of journal articles

Head Demonstrator, Botany Department, Rhodes University

March 2007 - October 2008

Operations Assistant, Green Route DMC

September 2005 - February 2007

- Project and staff co-ordination
- Managing large budgets for incentive and conference groups travelling to southern Africa
- Creating tailor-made programs for clients
- Negotiating rates with vendors and assisting with the ground management of inbound groups to ensure client satisfaction

PUBLICATIONS

- Ripley, B.; Visser, V.; Christin, PA.; Archibald, S.; Martin, T and Osborne, C. Fire ecology of C_3 and C_4 grasses depends on evolutionary history and frequency of burning but not photosynthetic type. *Ecology.* 96 (10): 2679-2691. 2015
- Taylor, S.; Ripley, B.S.; Martin, T.; De Wet, L-A.; Woodward, F.I.; Osborne, C.P. Physiological advantages of C_4 grasses in the field: a comparative experiment demonstrating the importance of drought. *Global Change Biology*. 20 (6): 1992-2003. 2014
- Ripley, B; Donald, G; Osborne, C; Abraham, T and Martin, T. Experimental investigation of fire ecology in the C3 and C4 subspecies of *Alloteropsis semialata. Journal of Ecology.* 98 (5): 1196 - 1203. 2010
- South African Association of Botanists (SAAB) conference, Grahamstown. Title: Responses of C3 and C4 Panicoid and non-Panicoid grasses to fire. January 2010
- South African Association of Botanists (SAAB) conference, Drakensberg. Title: Photosynthetic and Evolutionary determinants of the response of selected C3 and C4 (NADP-ME) grasses to fire. January 2008

COURSES

- Rhodes University and CES, Grahamstown
- EIA Short Course 2012
- Fynbos identification course, Kirstenbosch, 2015.
- Photography Short Course, Cape Town School of Photography, 2015.
- Using Organized Reasoning to Improve Environmental Impact Assessment, 2018, International IAIA conference, Durban

CONSULTING EXPERIENCE

International Projects

- 2020 – 2021: Project manager for the 2Africa subsea cable ESIA in Mozambique.
- 2020 – 2021: Project manager for the Category B EIA for the Wihinana Graphite Mine, Cabo delgado, Mozambique
- 2020 – 2021: Project manager for the category B exploration ESIA for Sofala Heavy Minerals Mine, Inhambane, Mozambique
- 2020: Critical Habitat Assessment for a graphite mine in Cabo Delgado, Mozambique. This assessment was to IFC standards.
- 2020: Analysed the botanical dataset for Lurio Green Resources and provided comment on the findings and gaps.
- 2020: Biodiversity Management Plan and Monitoring Plan for mine at Pilivilli in Nampula Province, Mozambique. This assessment was to IFC standards.
- 2019: Botanical Assessment for a cocoa plantation, Tanzania. This assessment was to IFC standards.

- 2019: Critical Habitat Assessment, Biodiversity Management Plan and Ecosystem Services Assessment for JCM Solar Farm in Cameroon. This assessment was to IFC standards.
- 2019: Undertook the Kenmare Road and Infrastructure Botanical Baseline Survey and Impact Assessment for an infrastructure corridor that will link the existing mine at Moma to the new proposed mine at Pillivilli in Nampula Province, Mozambique. This assessment was to IFC standards.
- 2012 – Present: Kenmare Terrestrial Monitoring Program Project Manager and Specialist Survey, Nampula Province, Mozambique.
- 2018: Conducted a field survey and wrote a botanical report to IFC standards for the proposed Balama Graphite Mine Environmental and Social Impact Assessment (ESIA) in Cabo Delgado Province, Mozambique.
- 2018: Co-authored the critical habitat assessment chapter for the proposed Kenmare Pilivilli Heavy Minerals Mine.
- 2018: Authored the Conservation Efforts chapter for the Kenmare Pilivilli Heavy Minerals Mine.
- 2017-2018: Co-authored and analysed data for the Kenmare Bioregional Survey of *Icuria dunensis* (species trigger for critical habitat) in Nampula Province, Mozambique. This was for a mining project that needed to be IFC compliant.
- 2017: Conducted a field survey and wrote a botanical report to IFC standards for the proposed Ancuabe Graphite Mine Environmental and Social Impact Assessment (ESIA) in Cabo Delgado Province, Mozambique.
- 2017-2018: Managed the Suni Resources Montepuez Graphite Mine Environmental Impact Assessment. This included the management of ten specialists, the co-ordination of their field surveys, regular client liaison and the writing of the Environmental Impact Assessment Report which summarised the specialists findings, assessed the impacts of the proposed mine on the environment and provided mitigation measures to reduce the impact.
  I was also the lead botanist for this baseline survey and impact assessment and undertook the required field work and analysed the data and wrote the report.
- 2017: Undertook the botanical baseline survey and impact assessment for the proposed Kenmare Pilivili Heavy Mineral Mine in Nampula Province, Mozambique. This was to IFC Standards.
- 2017: Ecological Survey for the Megaruma Mining Limitada Ruby Mine Exploration License, Cabo Delgado, Mozambique.
- 2016: Undertook the botanical baseline survey and impact assessment, wrote an alien invasive management plan and co-authored the biodeiveristy monitoring plan for this farm. The project was located in Zambezia Province, Mozambique.
- 2015-2016: Conducted the Triton Minerals Nicanda Hills Graphite Mine Botanical Survey and Impact Assessment. Was also the project manager and specialist co-ordinator for this project. The project was located in Cabo Delgado Province, Mozambique.
- 2015: Was part of the team that undertook a Critical Habitat Assessment for the Nhangonzo Coastal Stream site at Inhassora in Mozambique that Sasol intend to establish drill pads at. This project needed to meet the IFC standards.
- 2014: Lurio Green Resources Wood Chip Mill and Medium Density Fibre-board Plant, Project Manager and Ecological Specialist, Nampula Province, Mozambique. 2014-2015.
- 2013-2014: LHDA Botanical Survey, Baseline and Impact assessment, Lesotho.
- 2014: Biotherm Solar Voltaic Ecological Assessment, Zambia.
- 2013-2014: Lurio Green Resources Plantation Botanical Assessment, Vegetation and Sensitivity Mapping, Specialist Co-ordination, Nampula Province, Mozambique.
- 2013: Syrah Resources Botanical Baseline Survey and Ecological Assessment., Cabo Delgado Mozambique.
- 2013-2014: Baobab Mining Ecological Baseline Survey and Impact Assessment, Tete, Mozambique.

South African Projects

- 2021 - Present: Project Manager for the Sturdee Energy Solar PV facility, Western Cape
- 2021: Ecological Assessment for the Sturdee Energy Solar PV facility, Western Cape
- 2021: Rehabilitation plan for a housing development (Hope Village)
- 2020: Ecological Assessment for the Eskom Juno-Gromis Powerline deviation, Western Cape
- 2020: Project Manager for the Basic Assessment for SANSA development at Matjiesfontein (Western Cape). Project received authorization in 2021.
- 2020: Ecological Assessment for construction of satellite antennae, Matjiesfontein, Western Cape
- 2019: Ecological Assessment for a wind farm EIA, Kleinzee, Northern Cape
- 2019: Ecological Assessment for two housing developments in Zeerust, North West Province
- 2019: Botanical Assessment in Retreat, Cape Town for the DRDLR land claim.
- 2019: Cape Agulhas Municipality Botanical Assessment for the expansion of industrial zone, Western Cape, South Africa, 2019.
- 2018: Ecological Assessment for the construction of a farm dam in Greyton, Western Cape.
- 2018: Conducted the Ecological Survey for a housing development in Noordhoek, Cape Town
- 2018: Conducted the field survey and developed an alien invasive management plan for the Swartland Municipality, Western Cape.
- 2017: Undertook the field survey and co-authored a coastal dune study that assesses the impacts associated with the proposed rezoning and subdivision of Farm Bookram No. 30 to develop a resort.
- 2017: Project managed and co-authored a risk assessment for the use of Marram Grass to stabilise dunes in the City of Cape Town.
- 2015-2016: iGas Saldanha to Ankerlig Biodiversity Assessment Project Manager, Saldanha.
- 2015: Innowind Ukomoleza Wind Energy Facility Alien Invasive Management Plan, Eastern Cape Province, South Africa.
- 2015: Savannah Nxuba Wind Energy Facility Powerline Ecological Assessment, ground truthing and permit applications, Eastern Cape South Africa.
- 2014: Cob Bay botanical groundtruthing assessment, Eastern Cape, South Africa.
- 2013-2016: Dassiesridge Wind Energy Facility Project Manager, Eastern Cape, South Africa.
- 2013: Harvestvale botanical groundtruthing assessment, Eastern Cape, South Africa.
- 2012: Tsitsikamma Wind Energy Facility Community Power Line Ecological Assessment, Eastern Cape, South Africa.
- 2012: Golden Valley Wind Energy Facility Power Line Ecological Assessment, Eastern Cape, South Africa.
- 2012: Middleton Wind Energy Facility Ecological Assessment and Project Management, Eastern Cape, South Africa.
- 2012: Mossel Bay Power Line Ecological Assessment, Western Cape, South Africa.
- 2012: Groundtruthing the turbine sites for the Waainek Wind Energy Facility, Eastern Cape, South Africa.
- 2012: Toliara Mineral Sands Rehabilitation and Offset Strategy Report, Madagascar.

CONTACT DETAILS

Name	**Amber Jackson**
Name of Company	**Biodiversity Africa**
Designation	Director
Profession	Faunal Specialist and Environmental Manager
E-mail	amber@biodiversityafrica.com
Office number	+27 (0)78 340 6295
Education	2011 M. Phil Environmental Management (University of Cape Town) 2008 BSc (Hons) Ecology, Environment and Conservation (University of the Witwatersrand) 2007 BSc 'Ecology, Environment and Conservation' and Zoology (WITS)
Nationality	**South African**
Professional Body	**SACNASP**: South African Council for Natural Scientific Profession (100125/12) **ZSSA**: Zoological Society of Southern Africa **HAA**: Herpetological Association of Southern Africa **IAIASa**: Member of the International Association for Impact Assessments South Africa
Key areas of expertise	• Biodiversity Surveys and Impact Assessments • Environmental Impact Assessments • Critical Habitat Assessments • Biodiversity Management and Monitoring Plans

PROFILE

Amber has over ten years' experience in environmental consulting and has managed projects across various sectors including mining, agriculture, forestry, renewable energy, housing, coastal and wetland recreational infrastructure. Most of these projects required lender finance and therefore met both in-country, lender and sector specific requirements.

Amber completed the IFC lead and Swiss funded programme in Environmental and Social Risk Management course in 2018. The purpose of the course was to upskill Sub-Saharan African environmental consultants to increase the uptake of E&S standards by Financial Institutions.

Amber specialises in terrestrial vertebrate faunal assessments. She has conducted large scale faunal impact assessments that are to international lender's standards in Mozambique, Tanzania, Lesotho and Malawi. In South Africa her faunal impact assessments comply with the protocols for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial biodiversity and follows the SANBI Species Environmental Assessment Guideline. Her specialist input goes beyond impact assessments and includes faunal opportunities and constraints assessments, Critical Habitat Assessments, Biodiversity related Management Plans and Biodiversity Monitoring Programmes.

Amber holds a BSc (Zoology and Ecology, Environment & Conservation) and BSc (Hons) in Ecology, Environment & Conservation from WITS University and an MPhil in Environmental Management from University of Cape Town. Amber's honours focused on the landscape effects on Herpetofauna in Kruger National Park and her Master's thesis focused on the management of social and natural aspects of environmental systems with a dissertation in food security that investigated the complex food system of informal and formal distribution markets

EMPLOYMENT EXPERIENCE

Director and Faunal Specialist, Biodiversity Africa

July 2021 - present

- Faunal assessments for local and international EIAs in Southern Africa
- Identifying and mapping habitats and sensitive areas
- Designing and implementing biodiversity management and monitoring plans
- Critical Habitat Assessments
- Large ESIA studies
- Managing budgets

Principal Environmental Consultant and Faunal,

Coastal and Environmental Services

September 2011-June 2021

- Faunal and ecological assessments for local and international EIAs in Southern Africa
- Identifying and mapping habitat and sensitive areas
- Designing and implementing biodiversity management and monitoring plans
- Critical Habitat Assessments
- Large ESIA studies
- Coordinating specialists and site visits
- Faunal Impact Assessment
- Project Management, including budgets, deliverables and timelines.
- Environmental Impact Assessments and Basic Assessments project
- Environmental Control Officer
- Public/client/authority liaison
- Mentoring and training of junior staff

COURSES

- **Herpetological Association of Southern Africa Conference- Cape St Frances** September 2019
- **International Finance Corporation Environmental and Social Risk Management (ESRM) Program** January – November 2018
- **IAIA WC EMP Implementation Workshop** 27 February 2018
- **IAIAsa National Annual Conference** August 2017
  Goudini Spa, Rawsonville.
- **Biodiversity & Business Indaba, NBBN** April 2017
  Theme: Moving Forward Together (Partnerships & Collaborations)
- **Snake Awareness, Identification and Handling course, Cape Reptile Institute (CRI)** November 2016
- **Coaching Skills programme, Kim Coach** November 2016
- **Western Cape Biodiversity Information Event, IAIAsa** May 2016
  Theme: Biodiversity offsets & the launch of a Biodiversity Information Tool
- **Photography Short Course** 2015.
  Cape Town School of Photography,
- **Mainstreaming Biodiversity into Business: WHAT, WHY, WHEN and HOW** June 2014 Hosted by Dr Marie Parramon Gurney on behalf of the NBBN at the Rhodes Business School
- **IAIAsa National Annual Conference** September 2013
  Thaba'Nchu Sun, Bloemfontein
- **St Johns Life first aid course** July 2012

CONSULTING EXPERIENCE

International Projects

- 2018-Crooks Brothers Post EIA Work- Environmental and Social EMPr, Policies, E&S Management Plans and Monitoring Programmes
- 2018-Triton Ancuabe Graphite Mine (ESHIA), Mozambique. IFC Standards.
- 2016-Bankable Feasibility Study of Simandou Infrastructure Project – Port and Railway Summary of critical habitat, biodiversity offset plan and monitoring and evaluation plan.
- 2016-Lurio Green Resources Forestry Projects ESIA project upgrade to Lender standards including IFC, EIB, FSC and AfDB.
- 2014-Green Resources Woodchip and MDF plant (EPDA).
- 2014-Niassa Green Resources Forestry Projects ESIA to Lender standards including IFC, EIB, FSC and AfDB.

- 2020-Kenmare Faunal Biodiversity Management Plan, Mozambique.
- 2020-Kenmare Faunal Monitoring Pogramme (year 1)- Baseline, Mozambique.
- 2019-Kenmare addendum ESIA Faunal Impact Assessment, Mozambique.
- 2019-Kenmare infrastructure corridor ESIA Faunal Impact Assessment, Mozambique.
- 2019/20-Olam Cocoa Plantation Faunal Impact Assessment, Tanzania.
- 2019-JCM Solar Voltaic project Faunal desktop critical habitat assessment, Cameroon.
- 2018-Suni Resources Balama Graphite Mine Project Faunal Impact Assessment, Mozambique.
- 2017/18-Battery Minerals Montepuez Graphite Mine Project Faunal Impact Assessment, Mozambique.
- 2017-Triton Minerals Nicanda Hills Graphite Mine Project Faunal Impact Assessment, Mozambique.
- 2017-Sasol Biodiversity Assessment, Mozambique.
- 2014-Lesotho Highlands Water Project Faunal Impact Assessment, Lesotho.
- 2012-Malawi Monazite mine Projects (ESIA) EMP ecological management contribution
- Liberia Palm bay & Butow (ESIA)
- PGS Seismic Project (ESIA), Mozambique.

South African Projects

- 2018-Port St Johns Second Beach Coastal Infrastructure Project - E&S Risk Assessment
- 2015-Blouberg Development Initiative- E&S Risk Assessment
- 2019-Boulders Powerline BA Faunal desktop impact assessment, WC, SA.
- 2019-Ramotshere housing development BA Faunal desktop impact assessment, NW, SA.
- 2019-Cape Agulhas Municipality Industrial development faunal impact assessment, WC, SA.
- 2019-SANSA Solar PV BA Faunal desktop impact assessment, WC, SA.
- 2019-Wisson Coal to Urea Faunal desktop assessment, Mpumalanga.
- 2019-Assessment Boschendal Estate Faunal Opportunities and Constraints, WC, SA.
- 2019-Ganspan-Pan Wetland Reserve Recreational and Tourist Development Avifaunal Impact Assessment, NC, SA.
- 2018-City of Johannesburg Municipal Reserve Proclamation for Linksfield Ridge and Northcliff Hill Faunal Assessment, South Africa.
- 2017-Augrabies falls hydro-electric project Hydro-SA Faunal Impact Assessment.
- Port St Johns Second Beach Coastal Infrastructure Project (EIA), South Africa.
- Woodbridge Island Revetment checklist.
- Belmont Valley Golf Course and Makana Residential Estate (EIA)
- Belton Farm Eco Estate (BA).
- Ramotshere housing development (BA).
- G7 Brandvalley Wind Energy Project (EIA)
- G7 Rietkloof Wind Energy Project (EIA)
- G7 Brandvalley Powerlines (BA)
- G7 Rietkloof Powerlines (BA)
- Boschendal wine estate Hydro-electric schemes (BA, 24G and WULA)
- Mossel Bay Wind Energy Project (EIA)
- Mossel Bay Powerline (BA) 132kV interconnection
- Inyanda Farm Wind Energy (EIA)
- Middleton Wind Energy (EIA)
- Peddie Wind Energy (EIA)

- Cookhouse Wind Energy Project (EIA)
- Haverfontein Wind Energy Project (EIA)
- Plan 8 Wind Energy Project (EIA)
- Brakkefontein Wind Energy Project (EIA)
- Grassridge Wind Energy Project (EIA) (Coega)
- St Lucia Wind Energy Project (EIA)
- ACSA ECO CT (Lead ECO)
- Enel Paleisheuwel Solar farm (Lead ECO)
- NRA Caledon road upgrade ECO
- Solar Capital DeAar Solar farm annual audits
- Eskom Pinotage substation WUL offset compliance