

# APPENDIX E

---

## SPECIALIST REPORTS

## **APPENDIX E1: Freshwater Aquatic Impact Assessment**

---



**Freshwater Assessment for the proposed Mooivlei Solar 2 PV Facility, Free State  
Province, South Africa**

**12 MAY 2023**

**KROONSTAD SOLAR PV CLUSTER, FREE STATE PROVINCE**

Prepared by

**Dr Divan van Rooyen (Can. Nat. Sci.  
Aquatic Science)**

Nitai Consulting (Pty) Ltd.

147 Bram Fischer Drive

Ferndale

2194



Authors	Qualification	Date	Signature	Version No.
Dr Divan van Rooyen	Ph.D. Environmental Science (NWU) (Can. Nat. Sci. Aquatic Science 151272)	11 May 2023		1.3
Reviewed by	Qualification	Date	Signature	Version No.
Elzet Human	M-Tech Nature Conservation (TUT) (Pri. Sci. Nat. Conservation Science 147031)	12 May 2023		2.0
Antoinette Bootsma	M.Sc. Environmental Science (UNISA) (Pri. Sci. Nat. Ecology & Botany 400222-09)	28 May 2023		3.0
<b>Prepared for</b>	<p>Nemai Consulting (Pty) Ltd.  147 Bram Fischer Drive, Ferndale  Randburg, 2194</p> 			



# Executive Summary

Nitai Consulting (Pty) Ltd. was appointed by Nemai Consulting (Pty) Ltd. to undertake a freshwater aquatic assessment for the proposed 240 Mega Watt (MW) Mooivlei Solar 2 Photovoltaic (PV) Facility, Free State Province, South Africa.

The terms of reference for this study are as follows:

- Identify and delineate of all associated wetlands within the proposed study area;
- Classify each watercourse according to the National Wetland Classification Systems;
- Compile a baseline description of all the potentially impacted aquatic environments according to Government Notice (GN) No. 320, March 2020;
- Assess the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) of all identified wetlands; and
- Comply with Appendix 6 of the EIA Regulations by undertaking a risk assessment and identifying suitable mitigation measures.

According to the National Web Based Environmental Screening Tool of the Department of Forestry, Fisheries and the Environment, the proposed site has a very high sensitivity due to watercourses (wetlands, rivers, Strategic Water Source Areas, and Ecological Support 1 and 2 areas). The proposed 240 MW Mooivlei Solar 2 PV Facility is located within a Channelled Valley-Bottom wetland and is also located within the channel of one non-perennial river. Furthermore, the PV footprint is encroaching into the buffer zones of the non-perennial river separating the upper and lower portions of the PV footprint (see Figure 1 below). The non-perennial river is flowing in a northerly direction into the Vals River well north of the proposed development.

Several vegetation species indicating signs of wetness were found within the non-perennial river and the Depression wetlands. In addition, augered soil samples indicated signs of wetness in the form of gleyed soil types as well as white and red mottling.

The Present Ecological Category of the Depressions and Channelled Valley-Bottom within and adjacent to the study area was calculated as C (Moderately modified), while the Ecological Importance and Sensitivity was also determined as Moderate (C). The Depression wetlands has a moderate importance for biodiversity maintenance while a low importance for cultivated foods. The Channelled Valley-Bottom wetland is moderately-high important for sediment trapping and phosphate assimilation. Furthermore, the wetland is moderately important for toxicant assimilation and biodiversity maintenance. Both wetlands are situated within Ecological Support Areas 1 and 2. Ecological Support Areas increases its importance in supporting the ecological functioning of critical biodiversity areas and/or in delivering ecosystem services that support socio-economic development, such as water provision, flood mitigation or carbon sequestration.

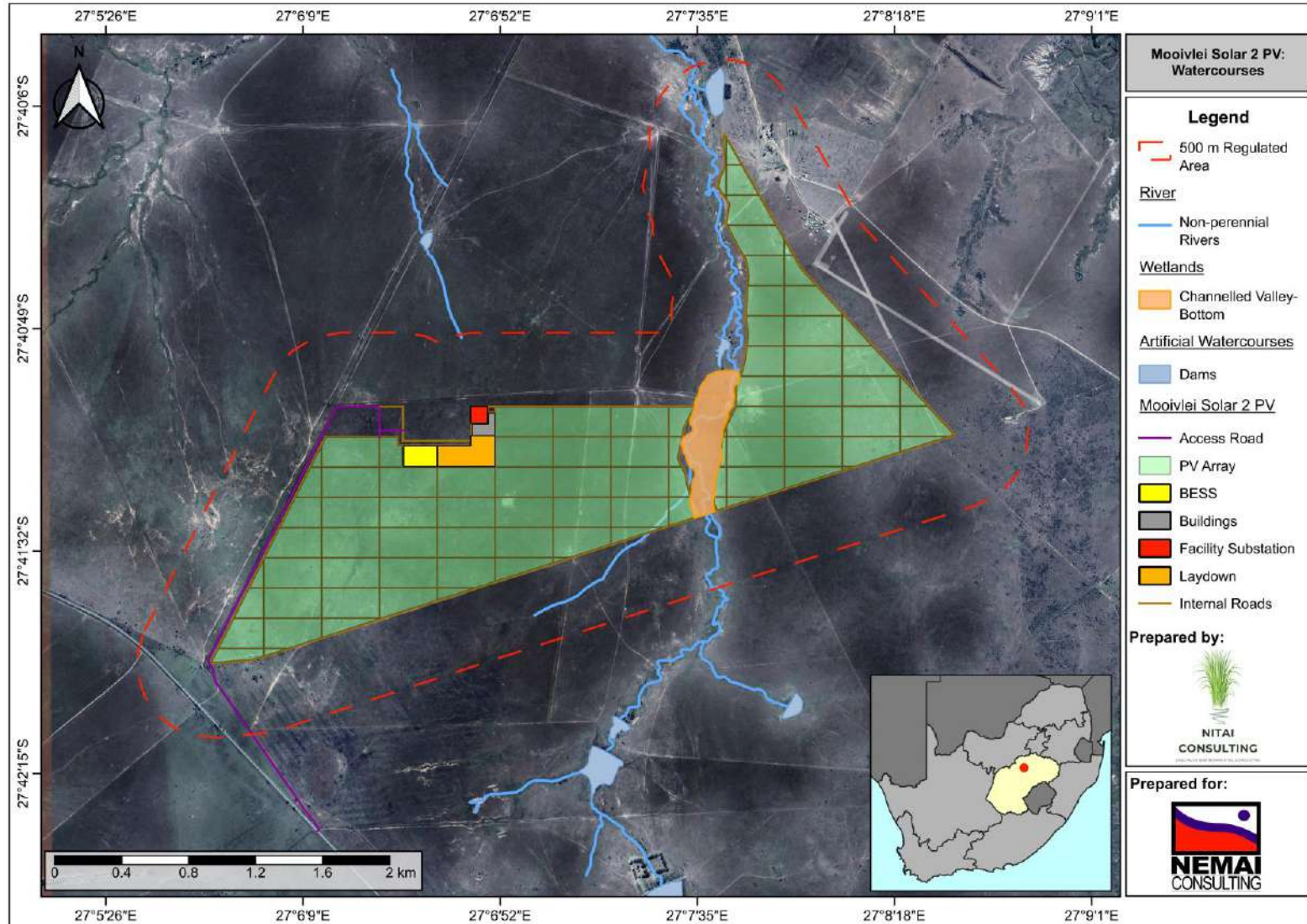


Figure 1: All watercourses associated with the Alternative 1 layout of the Mooivlei Solar 2 PV Facility



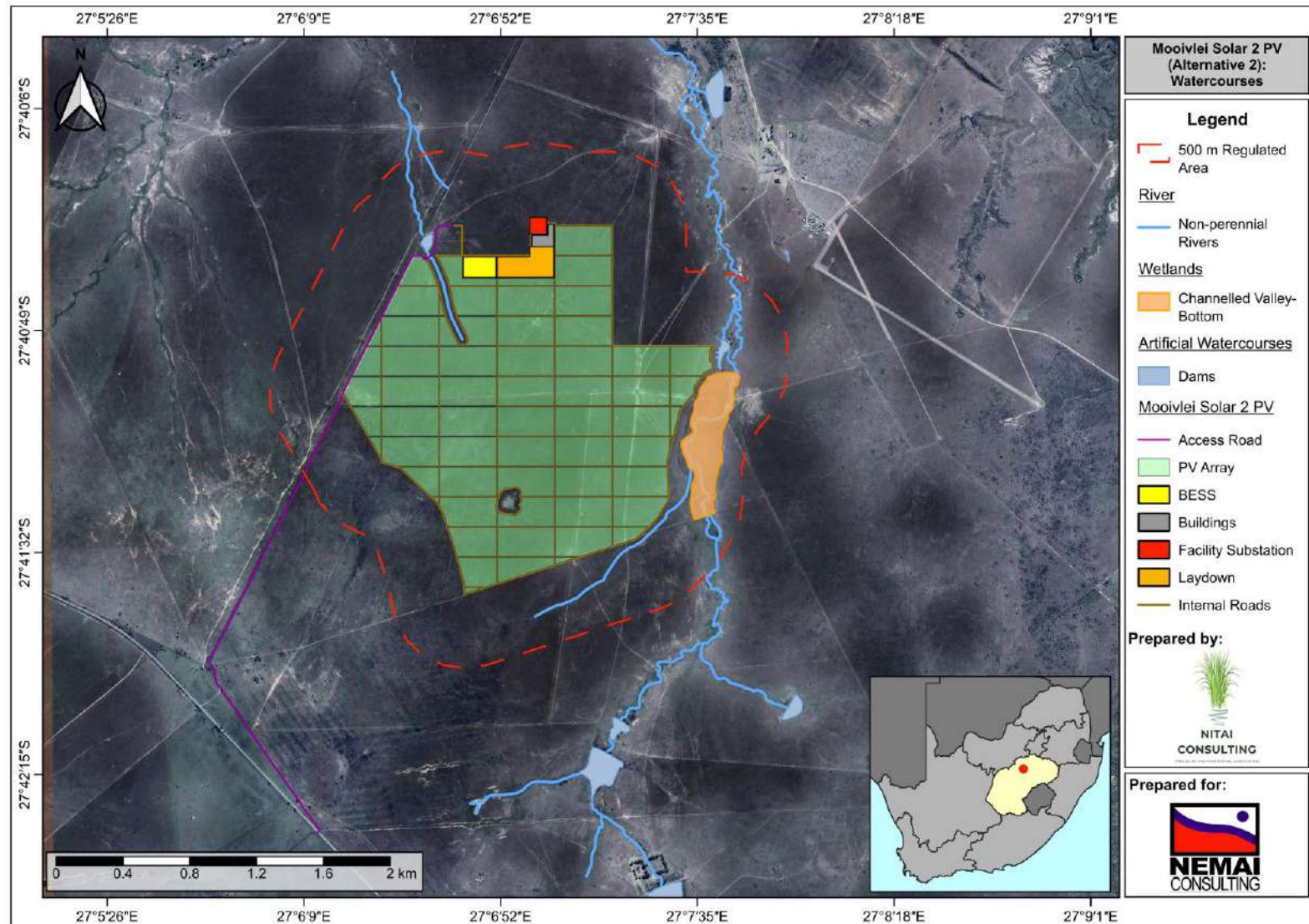


Figure 2: All watercourses associated with the proposed Alternative 2 and Preferred layout for the Mooivlei Solar 2 PV Facility

As a result of the very high sensitivity according to the Department of Forestry, Fisheries and the Environment Screening Tool, a Risk-based Impact Assessment was conducted in order to minimise and mitigate possible pollution, change in sediment characteristics, loss of watercourse habitat and ecological structure as well as introduction and spread of alien and invasive species during the construction and operational phases of Mooivlei Solar 2 PV. Possible pollution impacts with the proposed development includes hydrocarbon and chemical spillages, wet concrete as well as chemical substances that could lead to infiltration into the sediment and groundwater or wash down to the watercourse. In addition, there is an increase in possibility for the introduction and spread of alien and invasive species through the removal and movement of soil and vegetation. Furthermore, erosion is increased due to disturbances on slopes, clearing of vegetation and removal of soil. The impact on the wetlands and rivers is perceived to be low and can be further lowered if mitigation measures described in this report are followed.

The DFFE Screening Tool has identified the area as a **Very High** sensitivity from an Aquatic Biodiversity Theme perspective. This was confirmed (if Alternative 1 layout is used) by the specialist. Importantly, if the Alternative 2 (Preferred layout) layout is used, the site sensitivity for the proposed Mooivlei Solar 2 PV facility is **Low**. **As such, the specialist recommends that the development of the PV facility with the use of Alternative 2 as layout may proceed with low impacts on the freshwater features.**

# Table of Contents

<b>1</b>	<b>INTRODUCTION</b>	<b>1</b>
1.1	Background	1
1.2	Importance of wetlands	2
1.3	Terms of Reference	3
1.4	Structure of the report	3
<b>2</b>	<b>LEGISLATION</b>	<b>7</b>
2.1	South African Legislation	7
2.1.1	Constitution of the Republic of South Africa (Act 108 of 1996)	7
2.2	National Environmental Management Act (NEMA, Act 107 of 1998)	8
2.3	Legislation Governing Watercourses	8
2.3.1	National Water Act (NWA, Act 36 of 1998)	8
2.3.2	National Environmental Management: Biodiversity Act (NEM:BA, Act 10 of 2004)	9
2.3.3	National Environmental Management: Protected Areas Act (NEM:PA, Act 57 of 2003)	9
<b>3</b>	<b>PROJECT DESCRIPTION</b>	<b>10</b>
3.1	Study location	10
3.2	Project Description	10
<b>4</b>	<b>METHODOLOGY</b>	<b>14</b>
4.1	Approach	14
4.1.1	Desktop Study	14
4.1.2	Spatial Data Consulted	14
4.1.3	Identification and mapping of wetlands	14
4.1.4	Present Ecological State (PES) of associated watercourses	15
4.1.5	Ecological Importance and Sensitivity (EIS) of associated watercourses	16
4.1.6	The National Wetland Classification System (NWCS)	16
4.1.7	Determination of Buffer Zones	17
4.1.8	Risk Assessment of associated watercourses	17
4.1.9	Assumptions and limitations	17
<b>5</b>	<b>STATUS QUO ANALYSIS</b>	<b>18</b>
5.1	Regional context	18
5.1.1	Climate	18
5.1.2	Ecoregion	18

5.1.3	Soils and Geology _____	19
5.1.4	Vegetation characteristics _____	22
5.1.5	Water Management Areas and Quaternary Catchment _____	23
5.2	Conservation context _____	25
5.2.1	National Conservation Priorities _____	25
5.2.1.1	National Threatened Ecosystems _____	25
5.2.1.2	National Protected Area Expansion Strategy (NPAES) _____	26
5.2.1.3	Watercourses _____	26
5.2.1.4	Strategic Water Source Areas (SWSA's) _____	30
5.2.2	Regional context _____	31
5.2.2.1	Critical Biodiversity Areas (CBA's) _____	31
5.2.2.2	Ecological Support Areas (ESA's) _____	31
<b>6</b>	<b>FINDINGS OF THE ASSESSMENT _____</b>	<b>32</b>
6.1	Desktop mapping and identifying resources _____	32
6.2	Available information (rivers and wetlands) _____	33
6.3	Ecological findings of the Assessment _____	34
6.3.1	Wetlands _____	37
6.3.1.1	Alternative 1 _____	37
6.3.1.2	Alternative 2 _____	37
6.3.2	Rivers _____	37
6.3.2.1	Alternative 1 _____	37
6.3.2.2	Alternative 2 _____	37
6.3.3	Other watercourses _____	43
6.3.4	Vegetation characteristics _____	46
6.3.5	Soil characteristics _____	46
6.3.6	Present Ecological State (PES): Wetlands _____	49
6.3.7	Ecological Importance and Sensitivity (EIS) _____	49
6.3.8	Wetland Ecosystems Services _____	50
6.4	Site Sensitivity Verification and Buffer Zones _____	52
6.4.1	Desktop sensitivity assessment (DFFE Screening Tool) _____	52
6.4.2	Ground Truthing _____	53
6.4.3	Buffer Zones _____	56
<b>7</b>	<b>RISK-BASED IMPACT ASSESSMENT _____</b>	<b>59</b>
7.1	Impacts and Mitigation Framework _____	59
7.1.1	NEMA (2014) Impact Assessment _____	61
<b>8</b>	<b>CONCLUSION AND RECOMMENDATIONS _____</b>	<b>68</b>

<b>9</b>	<b>REFERENCES</b>	<b>69</b>
	<b>APPENDIX 1: SPECIALIST DETAILS, QUALIFICATIONS AND EXPERTISE</b>	<b>72</b>
	<b>APPENDIX 2: REVIEWERS DETAILS, QUALIFICATIONS AND EXPERTISE (ELZET HUMAN)</b>	<b>77</b>
	<b>APPENDIX 2: REVIEWERS DETAILS, QUALIFICATIONS AND EXPERTISE (ANTOINETTE BOOTSMA)</b>	<b>81</b>
	<b>APPENDIX 3: SIGNED DECLARATION INDEPENDENCE</b>	<b>83</b>

## List of Tables

Table 1: Compliance with Appendix 6 and criteria and minimum requirements for the various environmental themes as published in GN 320, March 2020	4
Table 2: Present Ecological State categories and Impact Scores (adapted from Macfarlane et al., 2009)	16
Table 3: Ecological Importance and Sensitivity Categories (Adapted from Rountree et al., 2013)	16
Table 4: Significance ratings, classes and management description of the DWS water use authorisation risk assessment matrix	17
Table 5: Description of the Ecoregion classified for the study area	18
Table 6: Wetland Classification as per SANBI Guidelines (Ollis et al., 2013)	40
Table 7: Rivers flowing adjacent to the study area as well as within 500 m regulated area	43
Table 8: Present Ecological State scores calculated for the two HGM units	49
Table 9: Ecological Importance and Sensitivity of the two HGM units	49
Table 10: Wetland Ecosystem Services calculated for the two HGM units	50
Table 11: Importance Category ratings	51
Table 12: Probability descriptors, definitions and rating scores	59
Table 13: Duration descriptors, definitions and rating scores	59
Table 14: Extent descriptors, definitions and rating scores	60
Table 15: Magnitude descriptors, definitions and rating scores	60
Table 16: Impacts to hydrological function	61
Table 17: Impacts to sediment	63
Table 18: Introduction and spread of alien and invasive species	64
Table 19: Activities causing pollution	66

## List of Figures

Figure 1: All watercourses associated with the Alternative 1 layout of the Mooivlei Solar 2 PV Facility .....	2
Figure 2: All watercourses associated with the proposed Alternative 2 and Preferred layout for the Mooivlei Solar 2 PV Facility .....	3
Figure 3: Study area locality in relation to South Africa .....	2
Figure 4: Regional Locality of the proposed study area (Alternative 1).....	11
Figure 5: Proposed Alternative 1 layout of the Mooivlei Solar 2 PV Facility .....	12
Figure 6: Proposed Alternative 2 and Preferred layout of the Mooivlei Solar 2 PV Facility ..	13
Figure 7: Cross-section through a wetland, indicating how soil wetness and vegetation indicators changes as one moves along a gradient (Extracted from DWAF 2005). .....	15
Figure 8: Map indicating the location of the Ecoregion relevant to the study area (Alternative 1) .....	19
Figure 9: Map indicating the various Geology types associated with the study area (Alternative 1) .....	20
Figure 10: Map indicating the extent of the various different Geology groups associated with the study area (Alternative 1) .....	21
Figure 11: Soil map indicating the various different soil forms associated with the study area (Alternative 1) .....	21
Figure 12: Vegetation type associated with the study area (Alternative 1).....	22
Figure 13: Water Management Area associated with the study area (Alternative 1).....	24
Figure 14: Quaternary Catchments associated with the study area (Alternative 1).....	24
Figure 15: Map showing the location of the study area (Alternative 1) in relation of the estimated remaining extent of the identified Threatened Ecosystems (SANBI, 2021) ..	25
Figure 16: Map showing the study area (Alternative 1) in relation to the National Protected Areas Expansion Strategy.....	26
Figure 17: Map showing watercourses (NFEPA rivers, non-perennial rivers and Dams) associated with the study area (Alternative 1) .....	27
Figure 18: Map indicating the NBA 2018 NWM 5 wetland hydrogeomorphic units associated with the study area (Alternative 1).....	28
Figure 19: Map indicating the NBA 2018 NWM 5 wetland threat status surrounding the study area (Alternative 1) .....	29
Figure 20: Map indicating the NBA 2018 NWM 5 wetland protection level surrounding the study area (Alternative 1).....	29
Figure 21: Map indicating the Strategic Water Source Areas in relation to the study area (Alternative 1) .....	30
Figure 22: Map indicating the Free State Biodiversity Plan in relation to the study area (Alternative 1) .....	32
Figure 23: Map indicating the flagged potential wetland areas within the study area (Alternative 1) .....	33



Figure 24: All watercourses associated with Alternative 1 of the Mooivlei Solar 2 PV Facility as well as the 500 m regulated area..... 35

Figure 25: All watercourses associated with Alternative 2 of the Mooivlei Solar 2 PV Facility as well as the 500 m regulated area..... 36

Figure 26: All identified wetlands within the Alternative 1 Layout..... 38

Figure 27: All identified wetlands within the Alternative 2 and Preferred Layout ..... 39

Figure 28: All identified rivers within the Alternative 1 Layout of the study area..... 41

Figure 29: All identified rivers within the Alternative 2 and Preferred Layout of the study area ..... 42

Figure 30: Map showing the location of the dams in and around the study area..... 43

Figure 31: Photographs showing some of the dams located within and around the study area ..... 44

Figure 32: Photographs indicating the general environment around areas of interest within the study area ..... 45

Figure 33: Vegetation characteristics associated with the study area. Photographs highlight the different species (a) *Cyperus congestus*, (b) *Paspalum dilatatum*, (c) *Cyperus fastigiatus* and (d) *Juncus effesus*..... 47

Figure 34: Soil samples collected showing the presence of white and red-yellow mottling within the 50 cm layer. Photographs (a) and (b) shows the Bonheim soil type observed on site with red mottling, photographs (c) shows the Arcadia soil types while photographs (d), (e), and (f) shows the Valsrivier soil type with red and white mottling ..... 48

Figure 35: Lower portion of the Alternative 1 layout for the Mooivlei Solar 2 PV’s Aquatic Biodiversity Sensitivity Theme from the Department of Forestry, Fisheries & the Environment Screening Tool ..... 52

Figure 36: Upper portion of the Alternative 1 layout for the Mooivlei Solar 2 PV’s Aquatic Biodiversity Sensitivity Theme from the Department of Forestry, Fisheries & the Environment Screening Tool ..... 53

Figure 37: Freshwater Sensitivities associated with the proposed Alternative 1 layout for the Mooivlei Solar 2 PV Facility ..... 54

Figure 38: Freshwater Sensitivities associated with the proposed Alternative 2 and Preferred layout for the Mooivlei Solar 2 PV Facility ..... 55

Figure 39: Buffer zones determined for all watercourses associated with the Alternative 1 Layout..... 57

Figure 40: Buffer zones determined for all watercourses associated with the Alternative 2 and Preferred Layout ..... 58

# List of Abbreviations

BA	Basic Assessment
BESS	Battery Energy Storage System
CBA	Critical Biodiversity Area
CR	Critical
CVB	Channel Valley-Bottom
C-Plan	Conservation Plan
Dep	Depression
DFFE	Department of Forestry, Fisheries & the Environment
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EC	Ecological Category
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMPr	Environmental Management Programme
EN	Endangered
ESA	Ecological Support Area
F	Floodplain
FL	Flat
FS	Free State
GIS	Geographic Information System
GN	Government Notice
ha	Hectares
HGM	Hydrogeomorphic
km	Kilometer (1 000m)
kV	Kilovolt
LC	Least Concern
LILO	Loop In-Loop Out
MAP	Mean Annual Precipitation
m	Meters
MW	Mega Watt
MTS	Main Transmission Substation
NBA	National Biodiversity Assessment
NEMA	National Environmental Management Act (No. 107 of 1998)

NFEPA	National Freshwater Priority Areas
NWA	National Water Act
NWCS	National Wetland Classification System
NWM	National Wetland Map
NW	North West
PES	Present Ecological State
PV	Photovoltaic
REC	Recommended Ecological Category
REMP	River Ecostatus Monitoring Program
S	Seep
SAIIEA	South Africa Inventory of Inland Aquatic Ecosystems
SANBI	South African National Biodiversity Institute
SRTM	Shuttle Radar Topography Mission
SWA	Strategic Water Areas
UCVB	Unchanneled Valley-Bottom
VEGRAI	Riparian Vegetation Response Assessment Index
VU	Vulnerable
WMA	Water Management Area
WRC	Water Research Commission
WUL	Water Use License
WULA	Water Use License Application
WSS	Water Supply Scheme
WTW	Water Treatment Works

# 1 INTRODUCTION

## 1.1 Background

Mooivlei Solar 2 (Pty) Ltd. (hereafter referred to as the proponent) proposes the 240MW Mooivlei Solar 2 PV Facility (hereafter referred to as the study area) near Kroonstad, Free State Province, South Africa (Figure 3). South Africa has committed itself to contribute to the global effort to address the challenge of climate change through the Paris Agreement. Therefore, with South Africa's heavy reliance on coal to produce electricity, this has increased the carbon footprint and electricity generation sources need to be diversified to ensure security of supply and reduction of its carbon footprint. As such, with the ever-increasing demand of electricity in Southern Africa, alternative measures to generate electricity needs to be employed to meet these demands. One of these alternative measures South Africa is exploring is Solar energy (Naicker, 2023). Nitai Consulting was appointed to conduct a wetland delineation and risk assessment as part of the Environmental Impact Assessment (EIA) of the proposed Mooivlei Solar 2 PV Facility.

The presence of possible wetlands within the development area triggers the need for wetland delineation and risk assessment. Moreover, this assessment was done in accordance with the Environmental Impact Regulations (EIA) that were published under GN No. 982 in Gazette No. 38282 of 4 December 2014 and amended by GN 326 of 7 April 2017 published in Gazette No. 40772 (hereafter referred to as "the EIA Regulations") promulgated in terms of the National Environmental Management Act (Act No. 107 of 1998) (NEMA). Furthermore, the findings of this report are in accordance with the requirements of Appendix 6 of the EIA Regulations or to the Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes (GN No. 320 in Government Gazette No. 43110 of 20 March 2020) (see Table 1 for the minimum requirements and criteria for Appendix 6 and Aquatic Biodiversity Themes).

The National Water Act (Act No. 36 of 1998) (NWA) ensures that South Africa's water resources are "protected, used, developed, conserved, managed and controlled." As such, any activity taking place within the regulated area of a watercourse, as defined in GN 509 published in the Government Gazette 40229 of 26 August 2016, would require authorisation in terms of NWA.

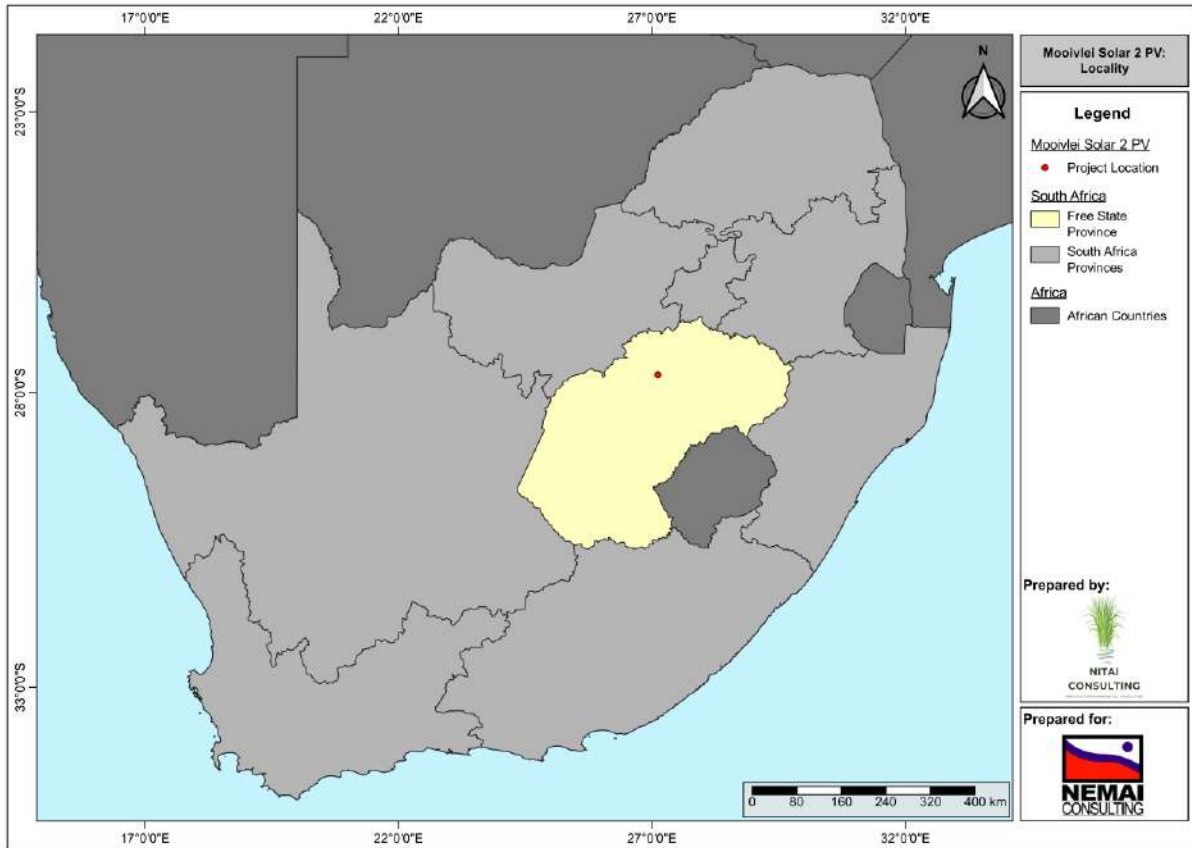


Figure 3: Study area locality in relation to South Africa

## 1.2 Importance of wetlands

A wetland is defined as per the NWA as “land that is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which in normal circumstances supports or would support vegetation typically adapted to life in saturated soil” (NWA, 1998).

The term “Wetlands” describes a variety of aquatic ecosystems, ranging from rivers, springs, seeps and mires in the upper catchment, to midlands marshes, pans and floodplains, to coastal lakes, mangrove swamps and estuaries at the bottom of the catchment (DWAF, 2005).

For an ecosystem to be identified as a wetland, it should comprise the following attributes:

- Hydromorphic soils that display characteristics resulting from prolonged saturation;
- Presence, at least occasionally, of water loving plants (hydrophytes); and,
- A high-water table that results in saturation at or near the surface, leading to anaerobic conditions developing in the top 50cm of the soil.

Wetlands play valuable functions in the landscape and more importantly, they also provide a wide range of ecosystem goods and services such as (DWAF, 2008) such as:

- Flood attenuation;

- Sediment trapping and stabilisation;
- Biodiversity support; and,
- Water quality improvement.

The primary task of wetlands is to regulate runoff and process water. They act as sponges where they hold water during floods and releases it during the dry periods. Therefore, during flooding, wetlands regulate water flows to reduce flood damage and aids in preventing soil erosion. Wetlands recharge groundwater resources and also removes pollutants from water. They are natural filters and aid in purifying water through trapping many pollutants, including sediment, heavy metals and disease-causing organisms (DWAF, 2005).

### **1.3 Terms of Reference**

The aim of the study was to provide a baseline wetland delineation and risk assessment of all associated wetlands within the study area. This was achieved through the following:

- Identify and delineate of all associated wetlands within the proposed study area;
- Classify each watercourse according to the National Wetland Classification Systems;
- Compile a baseline description of all the potentially impacted aquatic environments according to GN No. 320, March 2020 (Table 1);
- Assessing the PES and EIS for all identified wetlands; and
- Comply with Appendix 6 of the EIA Regulations by undertaking a risk assessment and identifying suitable mitigation measures.

### **1.4 Structure of the report**

The report has been structured as follows:

- Introduction;
- Legislation;
- Project Description;
- Methodology;
- Status Quo Analysis;
- Findings of the Assessment; and
- Conclusion.

**Table 1: Compliance with Appendix 6 and criteria and minimum requirements for the various environmental themes as published in GN 320, March 2020**

Nr.	Content	Reference
a	A specialist report prepared in terms of these Regulations must contain— details of— i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	Appendix 1
2.7	SACNASP Qualification and field of practice	Appendix 1
b	A declaration that the specialist is independent in a form as may be specified by the competent authority;	Appendix 1
2	The assessment must be undertaken on the preferred site and within the proposed development footprint	Section 3.2
2,3	Threat status of the ecosystem and species as identified by the DEA screening tool	Section 6.4.1
c	An indication of the scope of, and the purpose for which, the report was prepared;	Section 1
cA	An indication of the quality and age of base data used for the specialist report;	Section 2 and Section 4.1.2
cB	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 7
d	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 6.3
e	A description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 4
2.3	Description of the aquatic biodiversity and ecosystems on the site including: <ul style="list-style-type: none"> <li>• aquatic ecosystem types</li> <li>• Presence of aquatic species, and compositions of aquatic species communities their habitat, distribution and movement patterns</li> </ul>	Section 6.3
2,3,4	A description of the ecological importance and sensitivity of the aquatic ecosystem including: <ul style="list-style-type: none"> <li>• a) The description (spatially if possible) of the ecosystem process that operate in relation to the aquatic ecosystems on and immediately adjacent to the site (e.g. movement of</li> </ul>	Section 6.3.7

	<p>surface water and subsurface water, recharge, discharge, sediment transport etc.);</p> <ul style="list-style-type: none"> <li>• b) The historic ecological condition (reference) as well as present ecological state of rivers (in-stream, riparian and floodplain habitat), wetlands and or estuaries in terms of possible changes to channel and flow regime (surface and groundwater)</li> </ul>	
f	<p>Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;</p>	<p>Section 6 and Section 7</p>
g	<p>An identification of any areas to be avoided, including buffers;</p>	<p>Section 6.4.2 and 6.4.3</p>
h	<p>A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;</p>	<p>Section 6.4.3</p>
i	<p>A description of any assumptions made and any uncertainties or gaps in knowledge;</p>	<p>Section 4.1.9</p>
j	<p>A description of the findings and potential implications of such findings on the impact of the proposed activity (including identified alternatives on the environment) or activities;</p>	<p>Executive Summary, Section 6</p>
	<p>The following questions should be answered:</p> <ul style="list-style-type: none"> <li>• Is the proposed development consistent with maintaining the priority aquatic ecosystem in its current state and according to the stated goal?</li> <li>• Is the proposed development consistent with maintaining the resource quality objectives for the aquatic ecosystems present?</li> </ul>	<p>Section 6</p>
	<p>How will the development impact on fixed and dynamic ecological processes that operate within or across the site:</p> <ul style="list-style-type: none"> <li>• a. Impacts on hydrological functioning at a landscape level and across the site which can arise from changes to flood regimes (e.g. suppression of floods, loss of flood attenuation capacity, unseasonal flooding or destruction of floodplain processes); and</li> <li>• b) Change in the sediment regime (e.g. sand movement, meandering river mouth /estuary, changing flooding or sedimentation patterns) of the aquatic ecosystem and its sub-catchment;</li> <li>• c) The extent of the modification in relation to the overall aquatic ecosystem (i.e. at the source, upstream or downstream portion, in the temporary, seasonal, permanent zone of a wetland, in the riparian zone or within the channel of a watercourse, etc.).</li> </ul>	<p>Section 7.1.1</p>



	<ul style="list-style-type: none"> <li>d) to what extent will the risk associated with water uses and related activities change?</li> </ul>	
2,5	<p>How will the proposed development impact on the functioning of the aquatic feature? This must include:</p> <ul style="list-style-type: none"> <li>a) Base flows (e.g. too little/too much water in terms of characteristics and requirements of system)</li> <li>b) Quantity of water including change in the hydrological regime or hydroperiod of the aquatic ecosystem (e.g. seasonal to temporary or permanent; impact of over - abstraction or instream or off -stream impoundment of a wetland or river)</li> <li>c) Change in the hydrogeomorphic typing of the aquatic ecosystem (e.g. change from an unchannelled valley -bottom wetland to a channelled valley -bottom wetland).</li> <li>d) Quality of water (e.g. due to increased sediment load, contamination by chemical and /or organic effluent, and /or eutrophication)</li> <li>e) Fragmentation (e.g. road or pipeline crossing a wetland) and loss of ecological connectivity (lateral and longitudinal).</li> <li>f) The loss or degradation of all or part of any unique or important features (e.g. waterfalls, springs, oxbow lakes, meandering or braided channels, peat soils, etc.) associated with or within the aquatic ecosystem.</li> </ul>	Section 7.1.1
2,5	<p>How will the development impact on key ecosystem regulating and supporting services especially:</p> <ul style="list-style-type: none"> <li>a) Flood attenuation</li> <li>b) Stream flow regulation</li> <li>c) Sediment trapping</li> <li>d) Phosphate assimilation</li> <li>e) Nitrate assimilation</li> <li>f) Toxicant assimilation</li> <li>g) Erosion Control</li> <li>h) Carbon Storage?</li> </ul>	Section 7.1.1
2,5	<p>How will the proposed development impact community composition (numbers and density of species) and integrity (condition, viability, predator - prey ratios, dispersal rates, etc.) of the faunal and vegetation communities inhabiting the site?</p>	Refer to Terrestrial Biodiversity Report
k	Any mitigation measures for inclusion in the EMPr;	Section 7.1.1
l	Any conditions for inclusion in the environmental authorisation;	Section 7.1.1
m	Any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 7.1.1
n	A reasoned opinion—	Executive Summary

	i. [as to] whether the proposed activity, activities or portions thereof should be authorised; <u>(iA) regarding the acceptability of the proposed activity or activities; and</u> ii. if the opinion is that the proposed activity, <u>activities</u> or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	and Section 8
o	A description of any consultation process that was undertaken during the course of preparing the specialist report;	N/A
p	A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A
q	Any other information requested by the competent authority.	None

## 2 LEGISLATION

### 2.1 South African Legislation

In South Africa, there are a wealth of policies and legislation dealing directly or indirectly with environmental protection and management. Aquatic ecosystems, and in particular wetlands, have been protected and management over the years through various policies and legislation. These include:

- Constitution of the Republic of South Africa (Act 108 of 1996);
- NEMA;
- EIA Regulations
- NWA;
- General Authorisations (GA's);
- National Environmental Management: Biodiversity Act (Act 10 of 2004); and
- National Environmental Management: Protected Areas Act (Act 57 of 2003).

#### 2.1.1 **Constitution of the Republic of South Africa (Act 108 of 1996)**

The Constitution of the Republic of South Africa (Act 108 of 1996) aims to provide an environment that is protected, for the benefit of the present and future generations, through reasonable legislative and other measures that –

- Prevent pollution and ecological degradation;
- Promote conservation; and,
- Secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

## **2.2 National Environmental Management Act (NEMA, Act 107 of 1998)**

The aims of the NEMA are “to provide for co-operative environmental governance by establishing principles for decision-making on matters affecting the environment, institutions that will promote cooperative governance and procedures for co-ordinating environment functions exercised by organs of state; to provide for certain aspects of the administration and enforcement of other environmental management laws; and to provide for matters connected therewith”.

NEMA and the EIA Regulations, states that prior to any development, an Environmental Authorisation (EA) application process should be followed. For an EA application, either a Basic Assessment (BA) process or an EIA process can be followed depending on the scale of the Environmental Impact. On 20 March 2020, new regulations were gazetted (GN No. 43110) that has replaced the requirements of Appendix 6 of the EIA Regulations and therefore provides criteria and minimum requirements for the various environmental themes in terms of Section 24(5)(a) and (h) and Section 44 of the NEMA when applying for an EA (refer back to Table 1).

## **2.3 Legislation Governing Watercourses**

### **2.3.1 National Water Act (NWA, Act 36 of 1998)**

The NWA aims to achieve a balance between the use and protection of the country’s water resources, where the entire aquatic ecosystem – not merely the water it provides – is recognised as “the water resource”. Moreover, the NWA has redefined the concept of water resource use and protection so that it not only includes water but the full range of goods and services that aquatic ecosystems provide (DWAF, 2008).

A watercourse is defined as:

- River or spring;
- A natural channel in which water flows regularly or intermittently;
- A wetland, lake or dam into which, or from which, water flows; and,
- Any collection of water which the Minister may, by notice in the *Gazette*, declare to be a watercourse.

According to the Water Use Registration Regulations published under GN R1352 in Government Gazette 20606 of 12 November 1999, any person who uses water as contemplated under Section 21 of the NWA must, register the relevant water use. The registration of a water use must be done by notifying the DWS and complete the registration process. According to the Act and Section 21, water uses include:

- (a) Taking water from a water resource;
- (b) Storage of water;
- (c) Impeding or diverting the flow of water in a watercourse;

- (d) Engaging in a stream flow reduction activity contemplated in Section 36;
- (e) Engaging in a controlled activity identified as such in Section 37(1) or declared under Section 38(1);
- (f) Discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit;
- (g) Disposing of waste in a manner which may detrimentally impact on a water resource;
- (h) Disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process;
- (i) Altering the bed, banks, course or characteristic of a watercourse;
- (j) Removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people; and,
- (k) Using water for recreational purposes.

The regulated area of a watercourse for Section 21(c) and (i) water uses is defined as follows in Government Gazette No. 40229 of 26 August 2016:

- The outer edge of the 1 in 100 year flood line and /or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam;
- In the absence of a determined 1 in 100 year flood line or riparian area the area within 100m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench (subject to compliance to Section 144 of the NWA);  
or
- A 500 m radius from the delineated boundary (extent) of any wetland or pan.

### **2.3.2 National Environmental Management: Biodiversity Act (NEM:BA, Act 10 of 2004)**

The main aim of NEM:BA is to protect species and ecosystems while promoting the sustainable use of indigenous biological resources. Moreover, the act addresses the need for protecting threatened ecosystems. Furthermore, the act aims to provide the South African National Biodiversity Institute (SANBI) the tools to assist in achieving the objectives of this act.

### **2.3.3 National Environmental Management: Protected Areas Act (NEM:PA, Act 57 of 2003)**

The aim of NEM:PA is to provide the declaration and management of protected areas (within the framework of national legislation, including NEMA). In addition, the act aims to effect a national system of protected areas in South Africa as part of a strategy to manage and conserve its biodiversity. Also, NEM:PA wants to promote sustainable utilisation of protected areas in such a way that it would preserve the ecological character of protected areas.

## 3 PROJECT DESCRIPTION

### 3.1 Study location

The proposed 240MW Mooivlei Solar 2 PV Facility is situated west of Kroonstad, Free State Province, South Africa (see Figure 4 below). Moreover, the proposed study area is located within the Fezile Dabi District Municipality and the Moqhaka Local Municipality. The study area can be accessed via the R713 (off the R34).

### 3.2 Project Description

The proponent proposes two Alternative layouts for the development of the 240MW Mooivlei Solar 2 PV Facility located on Portion 0 of the Farm Mooivlei No. 284, and an access road crossing Portion 1 of Farm No. 1475 and the Farm Leidzaamheid No. 213 which is west of Kroonstad, in the Free State Province (Figure 5 and Figure 6).

The proposed Solar PV Facility will be comprised of the following:

- PV panel arrays, which are the subsystems which convert incoming sunlight into electrical energy;
- Several PV modules (up to 300 hectares (ha)) and mounting structures that will consist of either Monofacial or Bifacial PV panels, mounted on either fixed-tilt, single-axis tracking, and/or double-axis tracking systems;
- Inverters and transformers (37 ha);
- A Battery Energy Storage System (BESS) (up to 5 ha),
- Operation and Maintenance buildings, security building, control centre, offices, warehouses, workshops (up to 1.5 ha);
- A grid connection infrastructure. It is estimated that the maximum size of the facility substation will not exceed 1 ha. The facility substation will collect power from the facility and transform it from medium voltage (up to 33 kilovolt (kV)) to high voltage (132 kV). Additional 33 kV or 132 kV cabling or powerlines will connect the facility substation to the proposed Eskom substation/switching station;
- Temporary construction laydown area (up to 5 ha);
- Permanent laydown area (up to 1 ha) and located within the demarcated temporary laydown area;
- Internal roads (up to 6 m wide) providing access to Solar PV panels; and finally,
- Main access road (up to 8 m wide).



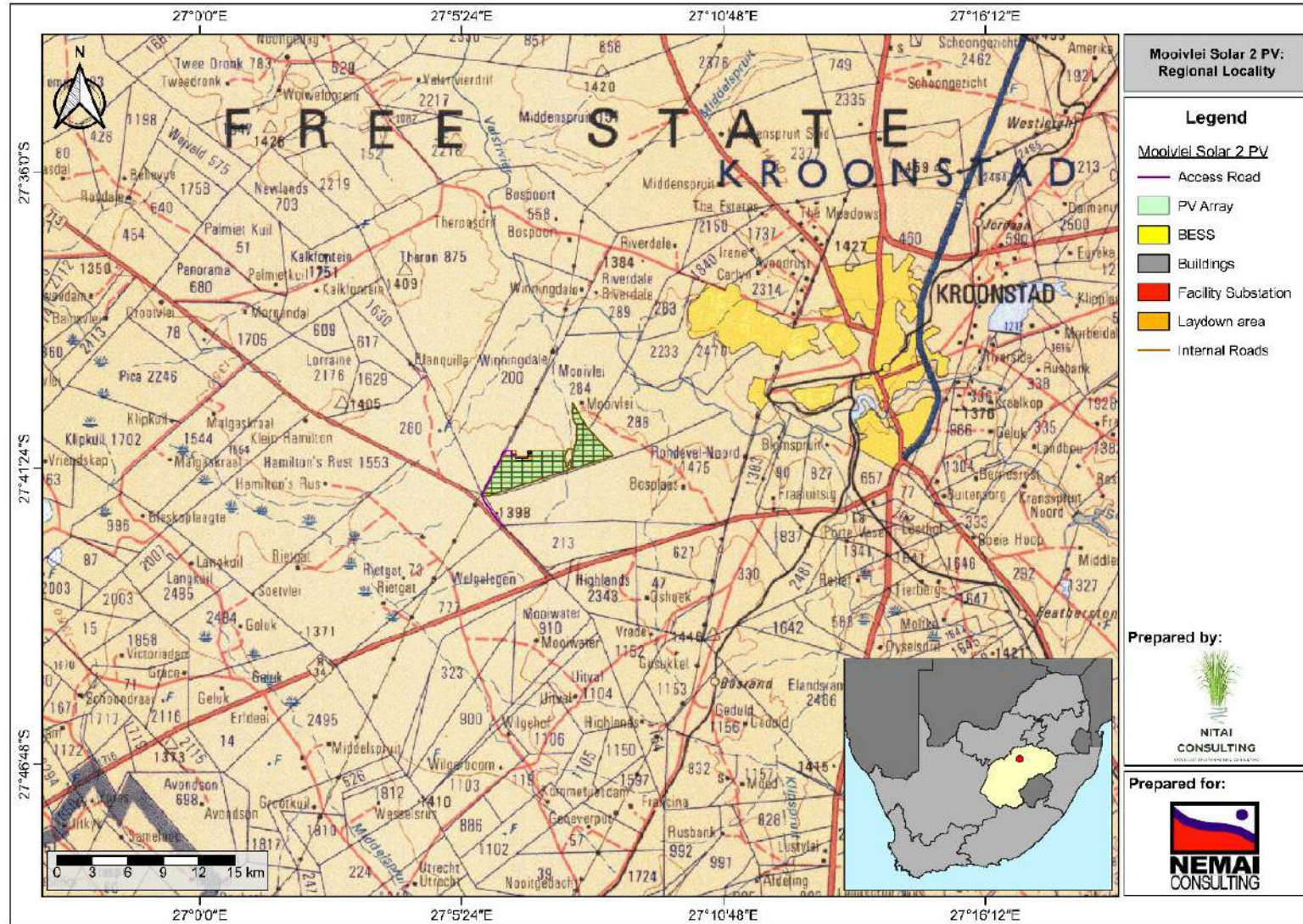
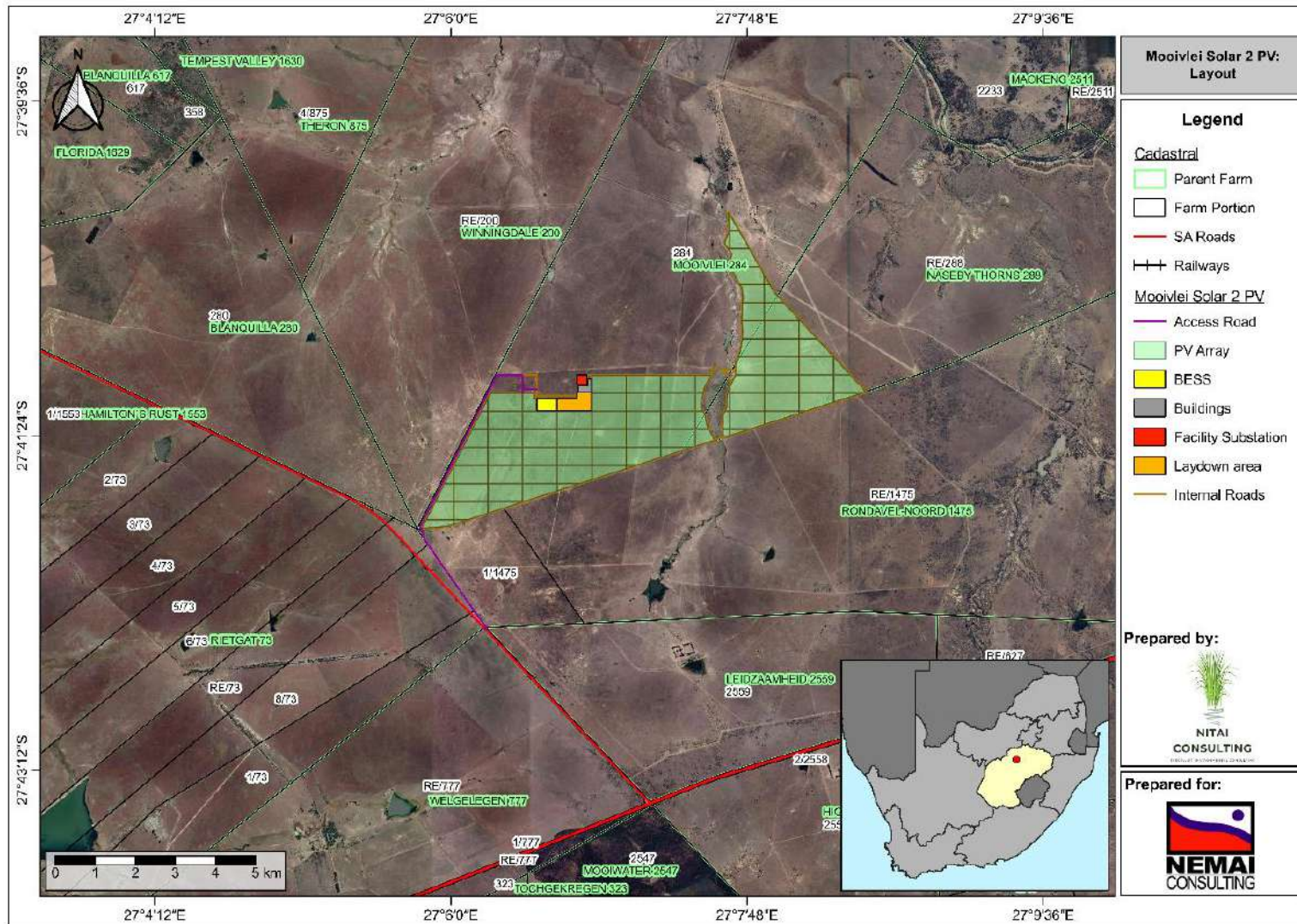


Figure 4: Regional Locality of the proposed study area (Alternative 1)





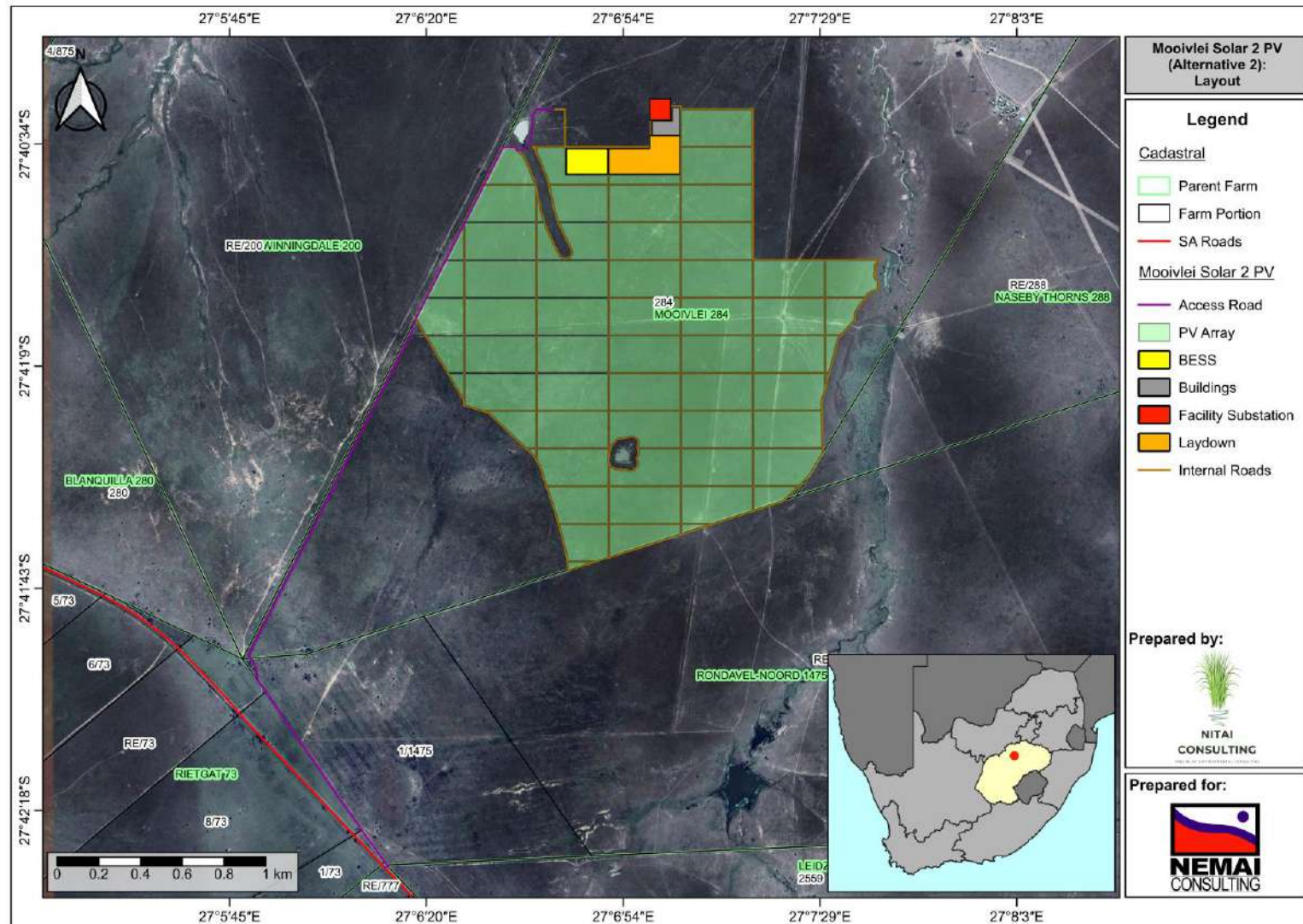


Figure 6: Proposed Alternative 2 and Preferred layout of the Mooivlei Solar 2 PV Facility



## 4 METHODOLOGY

The following sections provide an overview of the methodology used for this assessment.

### 4.1 Approach

#### 4.1.1 Desktop Study

The preliminary mapping and classification of rivers and wetlands within the proposed footprint of Mooivlei Solar 2 PV Facility was undertaken using the latest and historic aerial imagery (Google Earth Pro).

#### 4.1.2 Spatial Data Consulted

The spatial data used over the course of the assessment include the following:

- Aerial imagery (Google Earth Pro);
- National Freshwater Ecosystem Priority Areas (NFEPA) (rivers and wetlands) (Nel *et al.*, 2011);
- South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (van Deventer *et al.*, 2018);
- South African Inventory of Inland Aquatic Ecosystems (van Deventer *et al.*, 2019);
- 5m Contours;
- Geology;
- South African Vegetation Map (Mucina & Rutherford 2018);
- Free State Critical Biodiversity Areas (CBA's) and Ecological Support Areas (ESA's) (Collins, 2016);
- Strategic Water Source Areas (SWA's) (Nel *et al.*, 2013);
- Protected Areas and Protected Areas Expansion Strategy; and,
- DWA Eco-Regions (Kleynhans *et al.*, 2005).

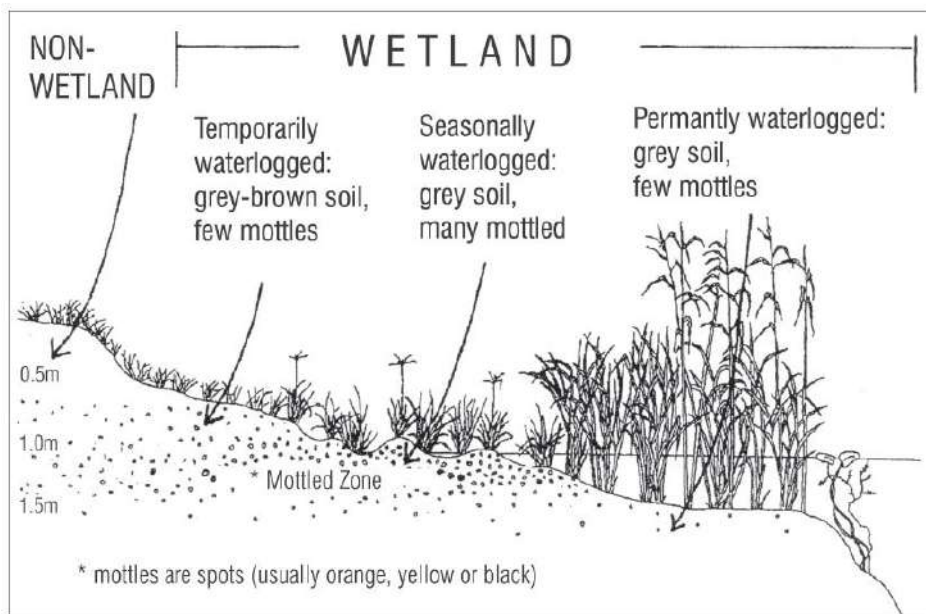
#### 4.1.3 Identification and mapping of wetlands

The South African National Biodiversity Institute developed the National Wetland Classification Systems (NWCS) that was considered for this assessment. This is a system that is comprised of a hierarchical classification process that defines a wetland based on the principles of the hydrogeomorphic (HGM) approach.

Wetlands are delineated based on the guidelines set out by DWAF (2005) in their Updated Manual for the Identification and Delineation of Wetlands and Riparian Areas. As stated earlier, wetlands are a land that is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface (see Figure 7 on a cross-section through a wetland). The outer edge of a wetland is delineated by means of considering the following four wetland indicators:

- The Terrain Unit Indicator: Helps to identify those parts of the landscape where wetlands are more likely to occur;
- The Soil Form Indicator: Identifies the soil forms, as defined by the Soil Classification Working Group (1991), which are associated with prolonged and frequent saturation;
- The Soil Wetness Indicator: Identifies the morphological “signatures” developed in the soil profile as a result of prolonged and frequent saturation;
- The Vegetation Indicator: Identifies hydrophilic vegetation associated with frequently saturated soils.

According to the NWA, vegetation is the primary indicator, which must be present under normal circumstances. However, in practice the soil wetness indicator tends to be the most important, and the other three indicators are used in a confirmatory role.



**Figure 7: Cross-section through a wetland, indicating how soil wetness and vegetation indicators changes as one moves along a gradient (Extracted from DWAF 2005).**

#### 4.1.4 Present Ecological State (PES) of associated watercourses

The approach is to quantify the impacts of human activity or clearly visible impacts on wetland health and then convert it to impact scores to a PES score (Table 2). The PES scores provide an overall indication of the health or integrity of biophysical attributes which is determined through a comparison of the current condition to the natural (or close to natural), so-called “reference” condition (DWAF, 2007). The PES scores are calculated based on four key inter-related drivers namely; hydrology, geomorphology, water quality and vegetation. Moreover, the PES is assessed through evaluating the extent to which anthropogenic activities have altered wetland characteristics across the four inter-related components of wetland health (Macfarlane *et al.*, 2020).

**Table 2: Present Ecological State categories and Impact Scores (adapted from Macfarlane et al., 2009)**

PES	Description	Impact Score Range	Impact Category
A	Unmodified, natural.	0 to 0.9	None
B	Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1.0 to 1.9	Small
C	Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact.	2.0 to 3.9	Moderate
D	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred.	4.0 to 5.9	Large
E	The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	6.0 to 7.9	Serious
F	Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8.0 to 10.0	Critical

#### 4.1.5 Ecological Importance and Sensitivity (EIS) of associated watercourses

To determine the EIS, the method of Rountree *et al.* (2013): Manual for the Rapid Ecological Reserve Determination of Inland Wetlands (Version 2.0) was used. This is specifically important to identify those systems that provide higher than average ecosystem services, biodiversity support functions or are especially sensitive to impacts. The determination of the EIS category takes into account the PES scores calculated for WET-Health together with the function and service provision that enables the assessor to determine the EIS category for the wetland or group being assessed. The method uses a scale from 0 to 4 to determine the EIS category where 0 to  $\leq 1$  is low/marginal importance;  $>1$  to  $\leq 2$  is moderate;  $>2$  and  $\leq 3$  is high and  $>3$  to  $\leq 4$  is very high (Rountree *et al.*, 2013).

**Table 3: Ecological Importance and Sensitivity Categories (Adapted from Rountree et al., 2013)**

Recommended Ecological Management Class	Range of Mean	EIS Category
A	3.0 to 4.0	Very High
B	2.0 to 3.0	High
C	1.0 to 2.0	Moderate
D	0 to 1.0	Low/marginal

#### 4.1.6 The National Wetland Classification System (NWCS)

The SANBI together with the Water Research Commission (WRC) developed the NWCS will be used for this assessment. The basis of this Classification System uses a hierarchical system of defining a wetland based on the HGM units. The wetland HGM units considered are as follows (Ollis *et al.*, 2013):

- Unchanneled valley bottom wetland (UCVB);
- Channelled valley bottom wetland (CVB);
- Seep (S);
- Floodplain (F);
- Depression (D); and
- Flat (FL).

#### 4.1.7 Determination of Buffer Zones

The appropriate buffer zones for the proposed Mooivlei Solar 2 PV Facility were determined using the “Preliminary Guideline for the Determination of Buffer Zones for Rivers, Wetlands, and Estuaries” by Macfarlane and Bredin (2017).

#### 4.1.8 Risk Assessment of associated watercourses

The Risk-Based Assessment was conducted in accordance with the DWS water use authorisation risk assessment matrix guidelines. The significance ratings were calculated according to Table 4:

*Table 4: Significance ratings, classes and management description of the DWS water use authorisation risk assessment matrix*

Rating	Class	Management Description
1 – 55	(L) Low Risk	Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated.
56 – 169	(M) Moderate Risk	Risk and impact on watercourses are notably and require mitigation measures on a higher level, which costs more and require specialist input.
170 – 300	(H) High Risk	Watercourse(s) impacts by the activity are such that they impose a long-term threat on a large scale and lowering of the Reserve. License required.

#### 4.1.9 Assumptions and limitations

The following assumptions and limitations accompany this assessment:

- This report is based on the information and layout received from the proponent;
- The findings, observations, conclusions and recommendations are based on the author’s best professional and scientific knowledge; and
- **The assessment of wetlands presented in this report is limited to the proposed project footprint and does not include the extended 500 m radius regulated area of the Mooivlei Solar 2 PV Facility. Therefore, this report cannot be used for WUL application.**

## 5 STATUS QUO ANALYSIS

The following sections provide context of the aquatic environment in relation to the proposed Mooivlei Solar 2 PV Facility.

### 5.1 Regional context

#### 5.1.1 Climate

The study area is characterised with summer-rainfall region with very dry winters with an overall Mean Annual Precipitation (MAP) ranging between 550 – 750 mm. Frost frequent in winter with less on the ridges and hills (Mucina & Rutherford, 2018).

#### 5.1.2 Ecoregion

South Africa is a geologically, geomorphologically, climatically and ecologically complex country that has a diverse range of ecosystems, including freshwater wetlands and rivers (Kleynhans *et al.*, 2005). It is important to understand the biophysical drivers that affect the characteristics of water resources in the region when analysing the ecology of any area. River ecoregional classification or “typing” will allow the grouping of rivers according to similarities based on a top-down nested hierarchy. This aids in simplifying and contextualising assessments and statements on ecological water requirements. One of the big advantages of this systems is the extrapolation of information from data rich rivers to data poor rivers within the same hierarchical typing context (Kleynhans *et al.*, 2005).

Ecological regions are regions within which there is relative similarity in the mosaic of ecosystems and ecosystem components (biotic and abiotic, aquatic and terrestrial) (Kleynhans *et al.*, 2005). The proposed study is located within the **Highveld** ecoregion. A summary of this ecoregion is provided in Table 5 with the location and extent shown in Figure 8.

**Table 5: Description of the Ecoregion classified for the study area**

Ecoregion (Level I)	Ecoregion (Level II)	Description
11	11.08	<b>Highveld:</b> Plains with moderate to low relief, as well as various grassland vegetation types (with moist types present towards the east and drier types towards the west and south), define this high lying region.

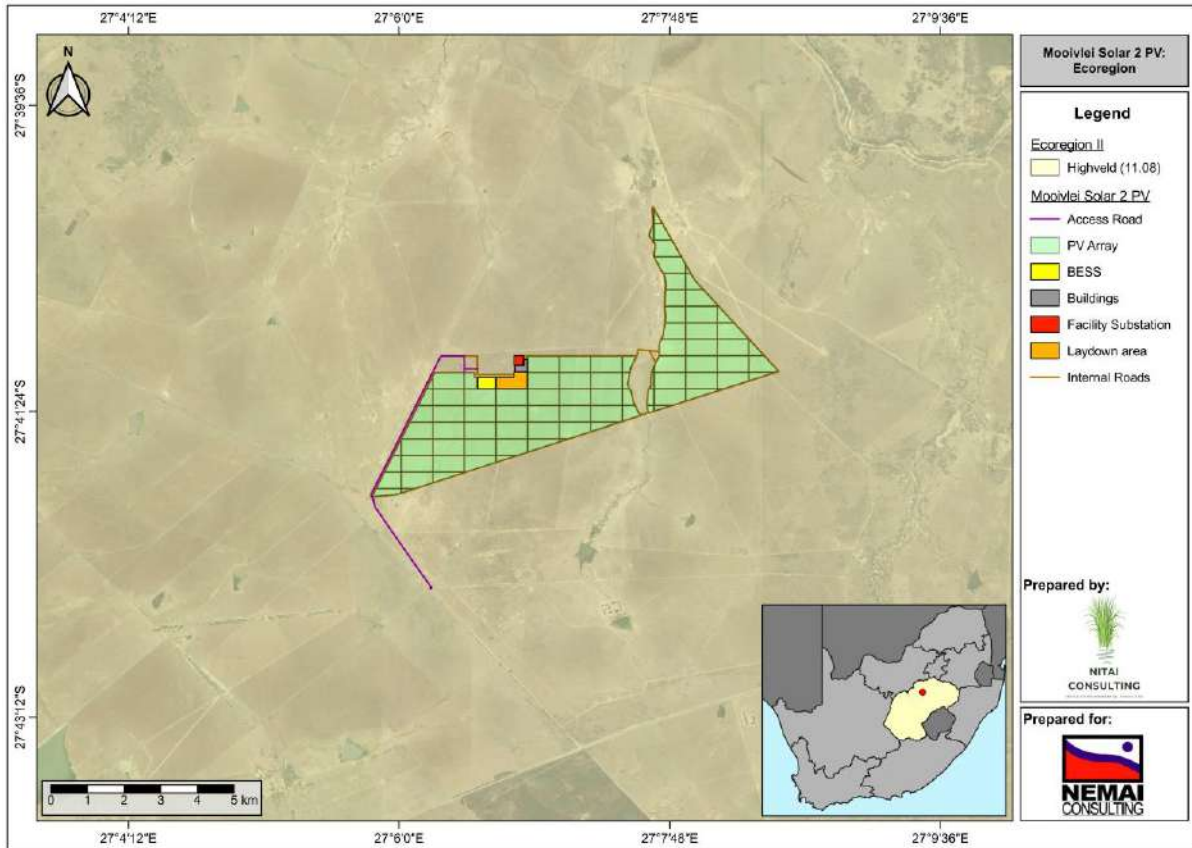


Figure 8: Map indicating the location of the Ecoregion relevant to the study area (Alternative 1)

### 5.1.3 Soils and Geology

The geology within of the study area are comprised of various different types and formations. The study area is mostly comprised of Shale and Mudstone of the Karoo Supergroup formation (mostly Ecca Group) (Figure 9 and Figure 10) (Mucina & Rutherford, 2006). Furthermore, these geological formations and types gives rise to vertic, melanic and red soils (typical soil forms of Arcadia, Bonheim, Kroonstad, Valsrivier and Rensburg). This is typical of a Dc land type (Mucina & Rutherford, 2006). In addition, soil forms such as Clovelly, Avalon and Westleigh also occurs. The dominant land type is Bd, but Bc, Ae and Ba land types also occurs (Mucina & Rutherford, 2006).

Soil types associated with most of the study area is Valsrivier, Swartland, Westleigh, Bonheim, Mispah and Kroonstad (Figure 11). In addition, Avalon, Hutton and Clovelly soils forms occur within other portion of the PV site and access road (Figure 11).

The soil moisture regimes vary between the different land types. Soil moisture within the Ae land type is leaching from profiles and one of free drainage. Soils from the Ae land type don't exhibit mottling or redox morphology. Wetlands could occur within these land types, however, they are rather limited to the immediate watercourse in depressions (van der Waals *et al.*, 2019). Within the B land type, the soil moisture regime is dominated by the presence of restricting rock layers at depths that leads to perching of water in localised water tables and



lateral seepage zones. As such, the soils have distinctive zones of water fluctuation, prolonged saturation zones that expresses clear redox morphology as well as zones where water manifests close to the surface (van der Waals *et al.*, 2019). The red soil dominated plinthic land types (i.e. Ba and Bc) tend to exhibit smaller wetland soil distributions than the bleached and yellow soil dominated plinthic landscapes (i.e. Bb and Bd). The D land type is characterised as Duplex soils with distinct differences between saturated and unsaturated hydraulic connectivity. Within this land type, wetlands are often in areas identified with E horizons and shallow lateral seepage as a result of perching of the water on the structure subsoil (van der Waals *et al.*, 2019).

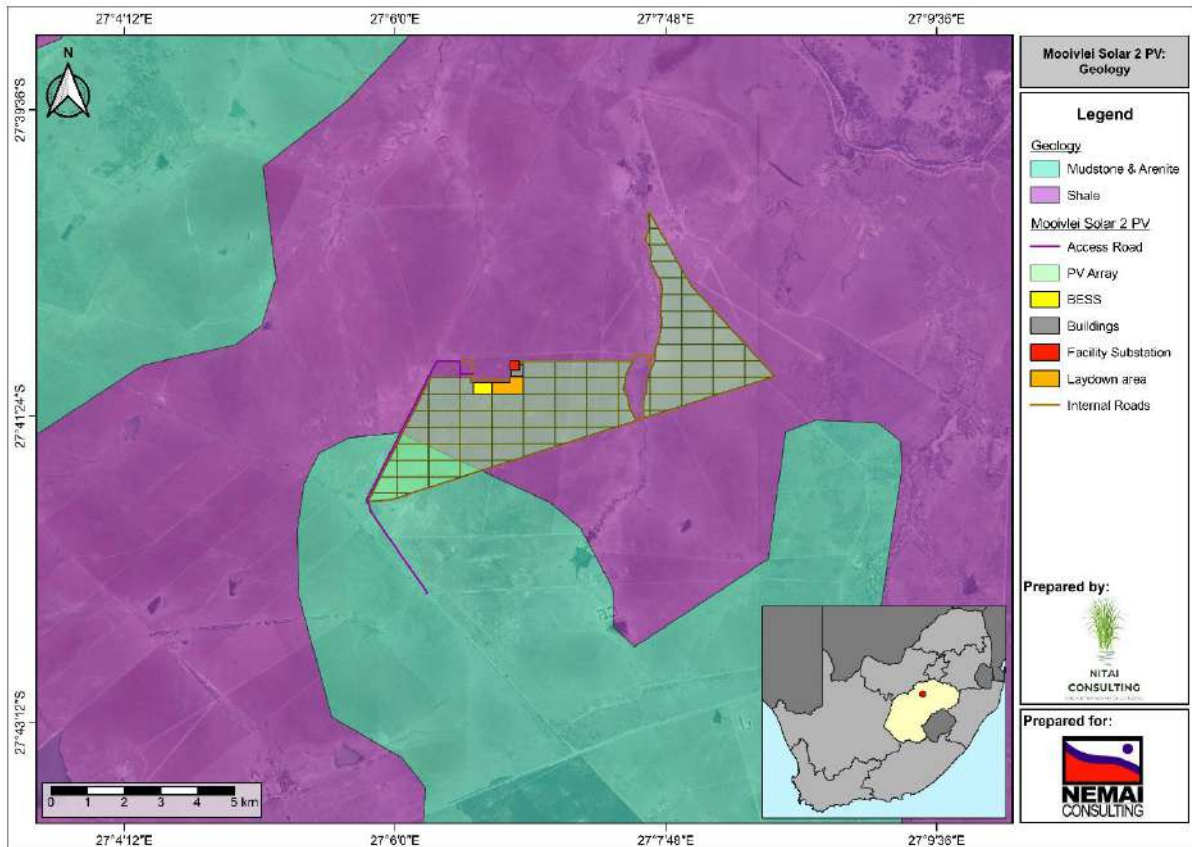


Figure 9: Map indicating the various Geology types associated with the study area (Alternative 1)

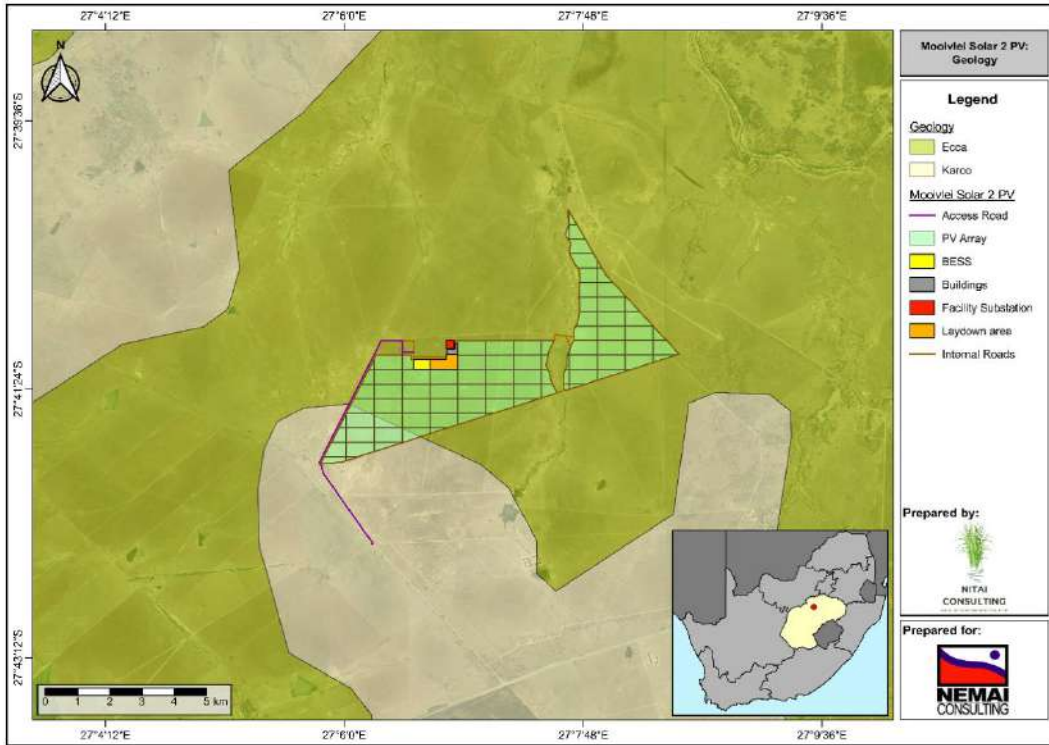


Figure 10: Map indicating the extent of the various different Geology groups associated with the study area (Alternative 1)

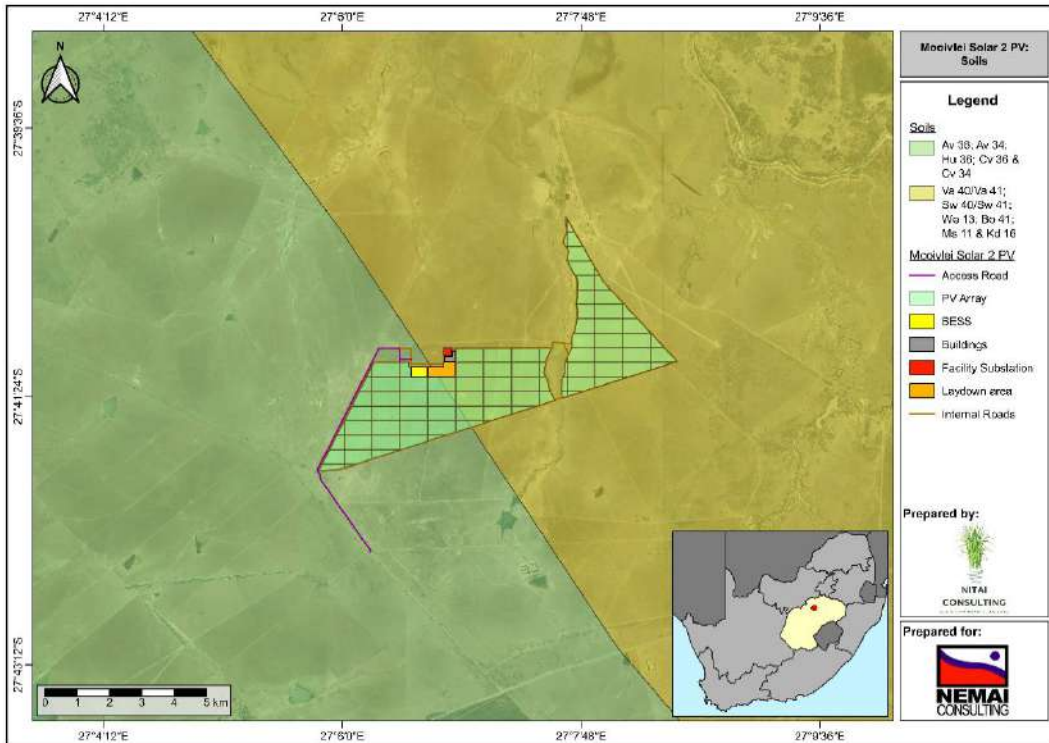


Figure 11: Soil map indicating the various different soil forms associated with the study area (Alternative 1)



### 5.1.4 Vegetation characteristics

The study area falls within the Dry Highveld Grassland Bioregion (Gh6 and Gh10) and is mostly characterized as the Central Free State Grassland while the access road and the other portion of the PV site falls within the Vaal-Vet Sandy Grassland (Figure 12). The Central Free State Grassland is characterized as undulating plains supporting short grassland, in natural condition dominated by *Themeda triandra* while *Eragrostis curvula* and *E. chloromelas* become dominant in degraded habitats (Mucina & Rutherford, 2006). The dwarf karoo bushes establish in several degraded clayey bottomlands while in heavy clayey the encroachment of *Acacia karroo* are very prominent in overgrazed and trampled low-lying areas (Mucina & Rutherford, 2006).

The Vaal-Vet Sandy Grassland is characterized as plains-dominated landscape with some scattered, slightly irregular undulating plains and hills. In addition, this vegetation type is mainly low-tussock grasslands with an abundant karroid element. *Themeda triandra* is very dominant and is the most important feature of this vegetation type. Low cover of *T. triandra* and the associated increase in *Elionurus muticus*, *Cymbopogon pospischilii* and *Aristida congesta* is as a result of heavy grazing and/or erratic rainfall in local areas (Mucina & Rutherford, 2006).

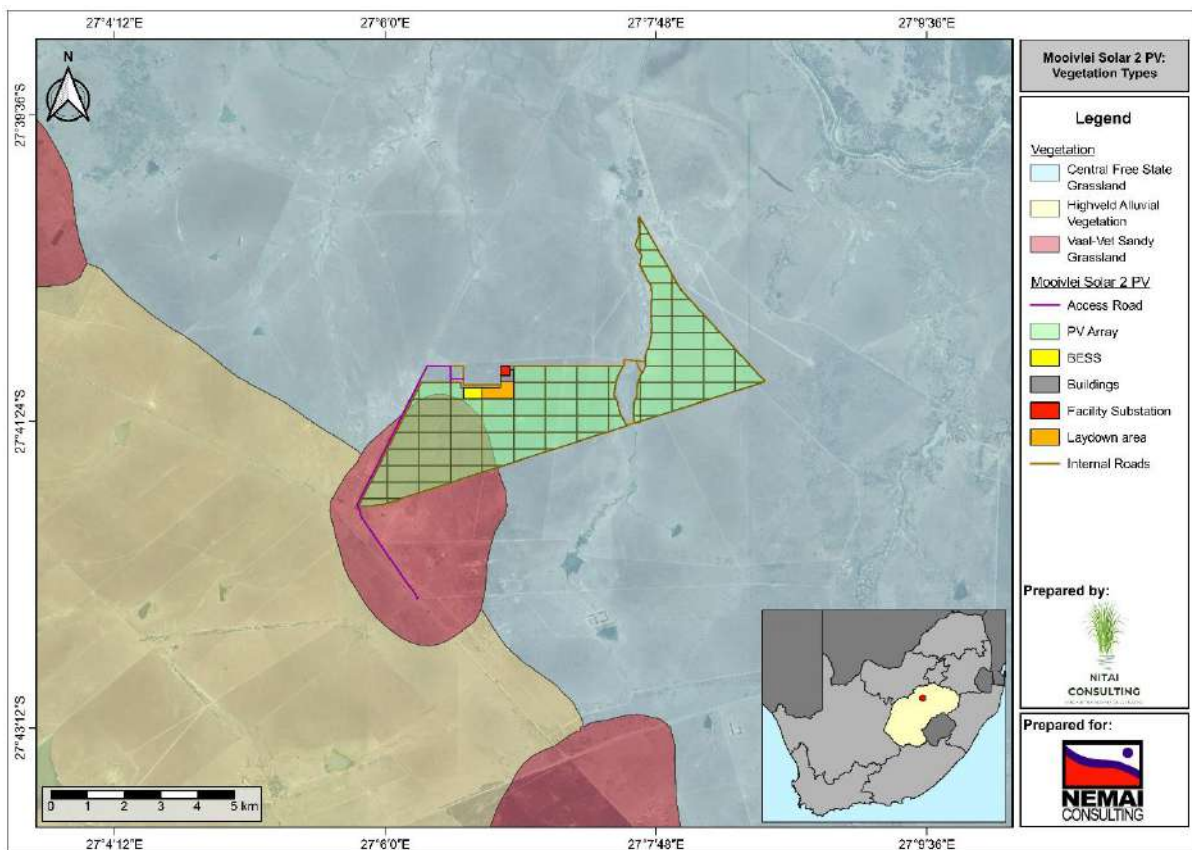


Figure 12: Vegetation type associated with the study area (Alternative 1)

### 5.1.5 Water Management Areas and Quaternary Catchment

Previously, the Vaal Water Management Area (WMA) was divided into three categories, namely the Lower Vaal, Middle Vaal and the Upper Vaal WMA's (DWAF, 2004a). However, under the most recent GN 1056 No. 40279 of 16 September 2016, the WMA's has been refined into Limpopo, Olifants, Inkomati-Usuthu, Pongola-Mtamvuna, Vaal, Orange, Mzimvubu-Tsitsikamma, Breede-Gouritz and Berg-Olifants. The study area is located within two WMA's. The proposed study area is situated within the middle region of the Vaal WMA (Figure 13). The middle region is part of a large water supply system which includes adjacent WMA's. It is situated downstream of the confluence of the Vaal and Rietspruit rivers and upstream of Bloemhof Dam. The region extends to the headwaters of the Schoonspruit River in the north and the Vet River in the south (DWAF, 2002). The land use within the middle region is characterized by agriculture (irrigation crops – wheat, groundnuts, sorghum and sunflowers). In addition, extensive gold mining activities are located within the Middle Vaal region (DWAF, 2004b).

The major rivers within this region are the Schoonspruit, Rhenoster, Vals, Vet and Vaal rivers and the Middle Vaal comprises of C24, C25, C41, C43, C60 and C70 quaternary catchments (DWAF, 2004b). The Middle Vaal is very much dependent on the water releases from the Upper Vaal region to meet its bulk water requirements for urban, mining, and industrial sectors. In addition, local resources are mainly being used for irrigation and smaller towns (DWAF, 2004b). Within the Vaal WMA, mining activities (gold mines) threatens water quality while large volumes of water are returned via treated effluent to the river systems from the urban areas and mine dewatering which further places stress on the water quality of this sub-catchment (DWAF, 2004b).

The study area is mostly located within the C60G Quaternary Catchment (Vals River sub-catchment) with a very small section of the PV site and remaining part of the access road falling within the C60H Quaternary Catchment (Otterspruit sub-catchment) (see Figure 14). The DWS has determined PES and EIS scores for each Quaternary Catchment area in Southern Africa back in 2014 (DWS, 2014). As such, for the C60G Quaternary Catchment, DWS has determined a PES as C (Moderately modified). In addition, the EIS was determined as B (High Ecological Importance) and C (Moderate sensitivity) (DWS, 2014). The PES and EIS for the C60H Quaternary Catchment was determined as D (Largely Modified) and C (Moderate Ecological Importance and Sensitivity), respectively (DWS, 2014). According to the Classes and Resource Quality Objectives of Water Resources for Catchments of the Middle Vaal (GN No. 469 in Government Gazetted No. 39943 published on 22 April 2016), the Recommended Ecological Category (REC) for the Vals River sub-catchment has been determined as C (Moderate).

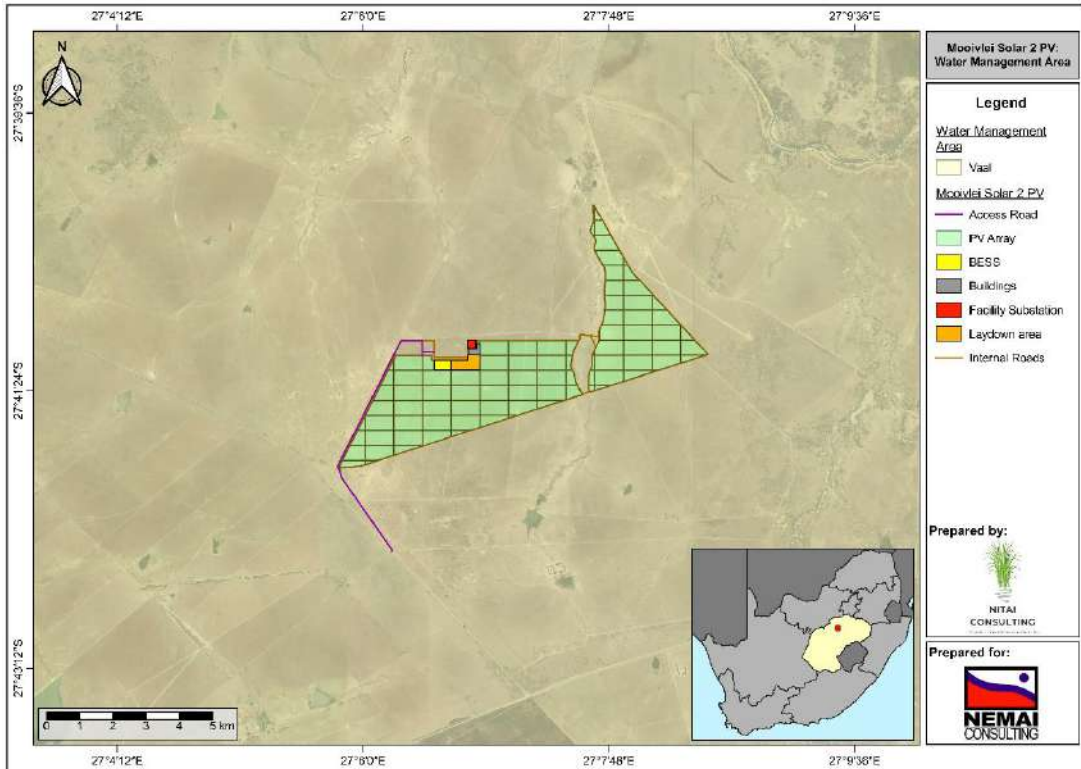


Figure 13: Water Management Area associated with the study area (Alternative 1)

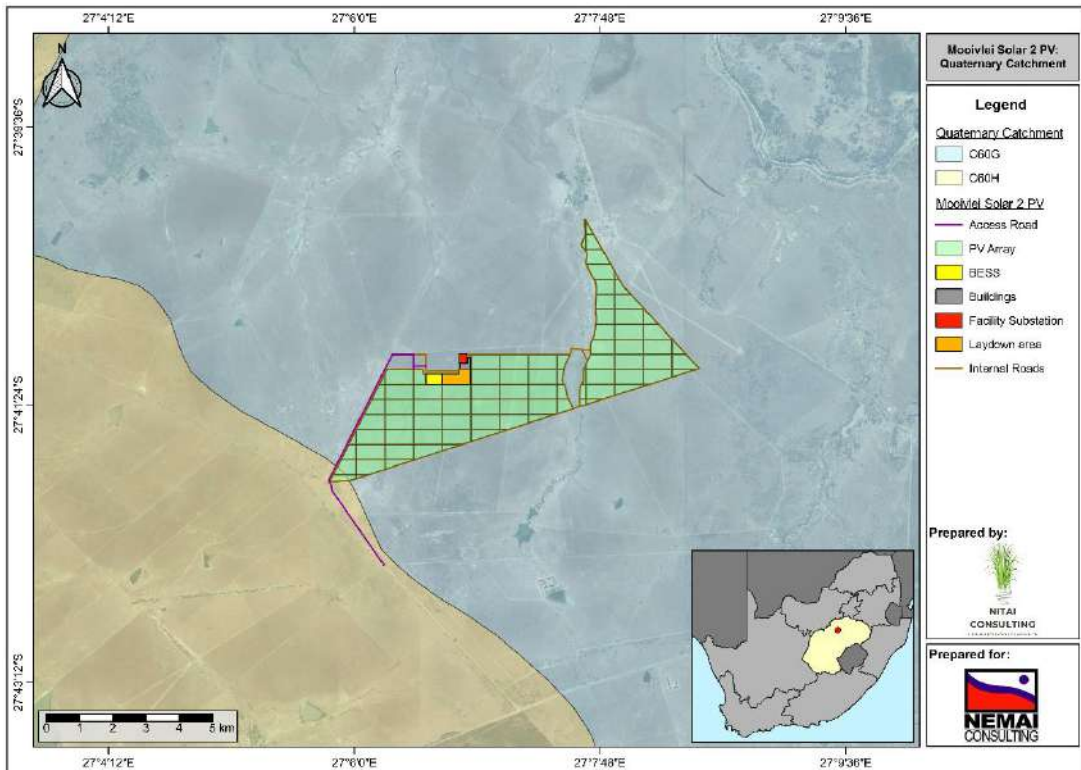


Figure 14: Quaternary Catchments associated with the study area (Alternative 1)



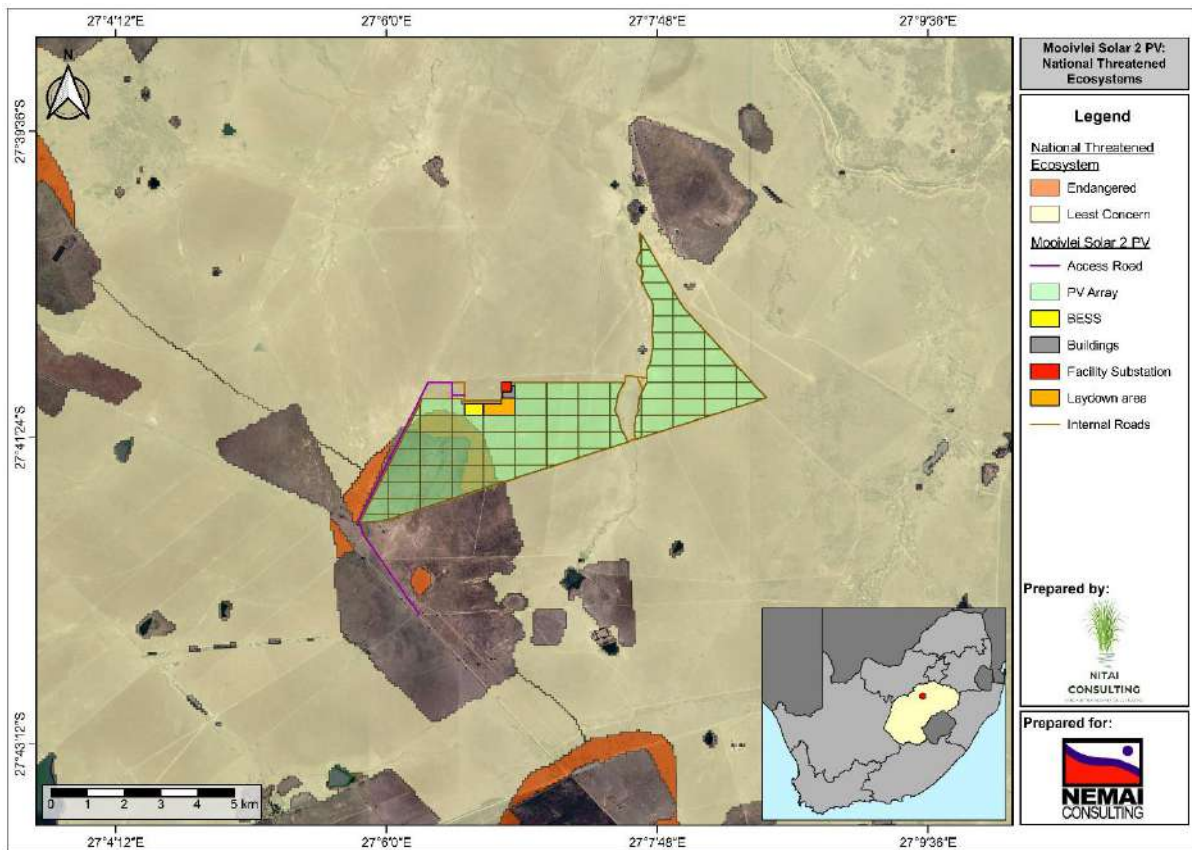
## 5.2 Conservation context

### 5.2.1 National Conservation Priorities

#### 5.2.1.1 National Threatened Ecosystems

A list of threatened ecosystems that are currently under threat of being transformed by other land uses has been identified in a national process. A few different versions of the list of threatened ecosystems have been released since the first release back in December 2011 (NEM:BA: National list of ecosystems that are threatened and in need of protection, G34809, GN 1002, December 2011). The main aim of identifying the threatened ecosystems is to reduce the rate of ecosystem and species extinction by preventing further degradation and loss of structure, function and composition of threatened ecosystems (SANBI, 2011). The NEMA has divided ecosystems into four groups namely; Critically Endangered (CR), Endangered (EN), Vulnerable (VU) or protected.

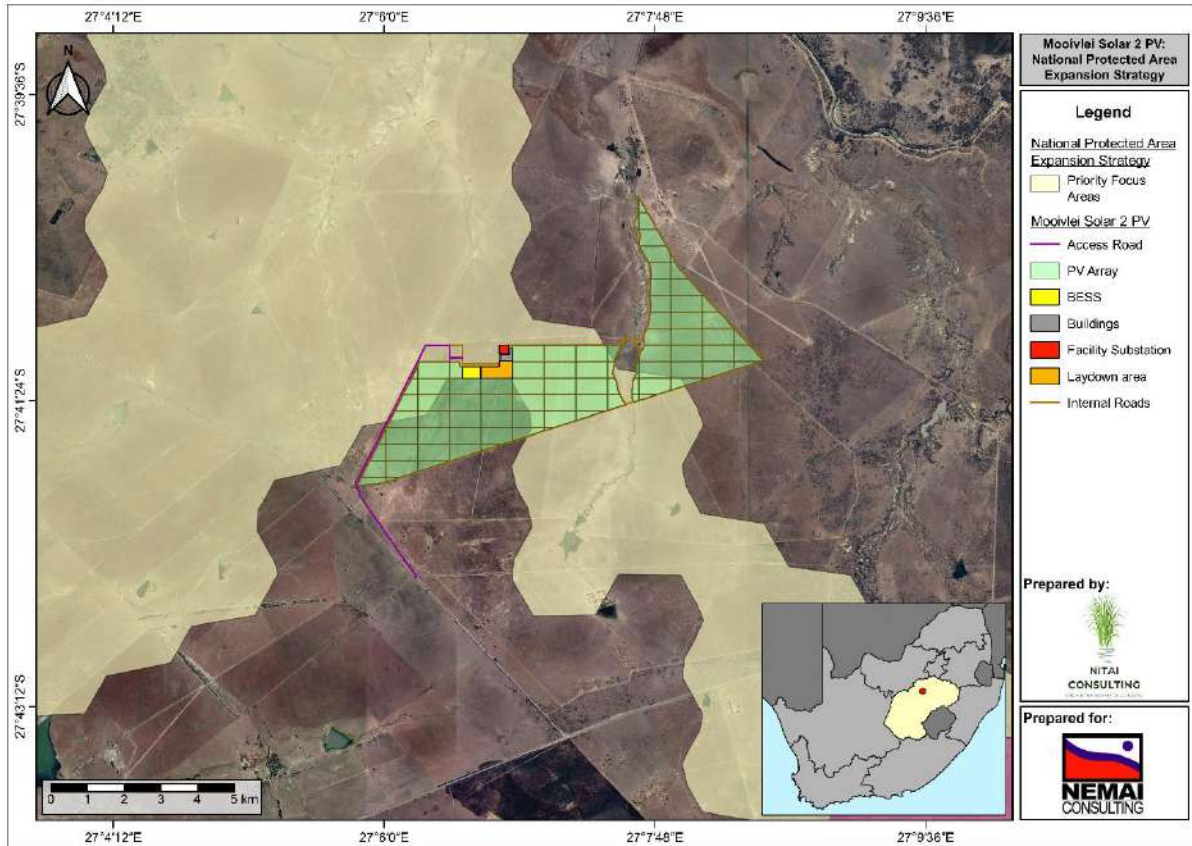
Figure 15 shows the remaining extent of Threatened Ecosystems in the region surrounding the study area. Majority of Mooivlei Solar 2 PV is situated within **Least Concern (LC)** land while small sections of the PV site and access road is in **Endangered** and **unclassified land**.



*Figure 15: Map showing the location of the study area (Alternative 1) in relation of the estimated remaining extent of the identified Threatened Ecosystems (SANBI, 2021)*

### 5.2.1.2 National Protected Area Expansion Strategy (NPAES)

The location and extent of the existing National Protected Area Expansion Strategy (NPAES) is shown in Figure 16. The study area is mostly situated in unclassified land and the remaining footprint is within a **Priority Focus Area**.



**Figure 16: Map showing the study area (Alternative 1) in relation to the National Protected Areas Expansion Strategy**

### 5.2.1.3 Watercourses

#### **National Freshwater Ecosystem Priority Areas (NFEPA) rivers**

The watercourses map in Figure 17 highlights the NFEPA rivers, non-perennial rivers and dams associated with the study area. The Vals River is a tributary of the Vaal River and originates in the Eastern Free State near the town Bethlehem and flows westerly from upstream of Kroonstad past Khotsong and Bothaville before draining into the Vaal River (Machete & Shadung, 2019; Thirion & Jafta, 2019). The Vals River is located north east of the study area. In addition, there are several unnamed non-perennial rivers to the north, east and west of the study area and drains into the Vals River to the north. The study area is not situated within any river FEPA catchments (areas that achieve biodiversity targets for river ecosystems and fish species) and these catchments are identified in rivers that are currently in good condition (Ecological category of A or B).



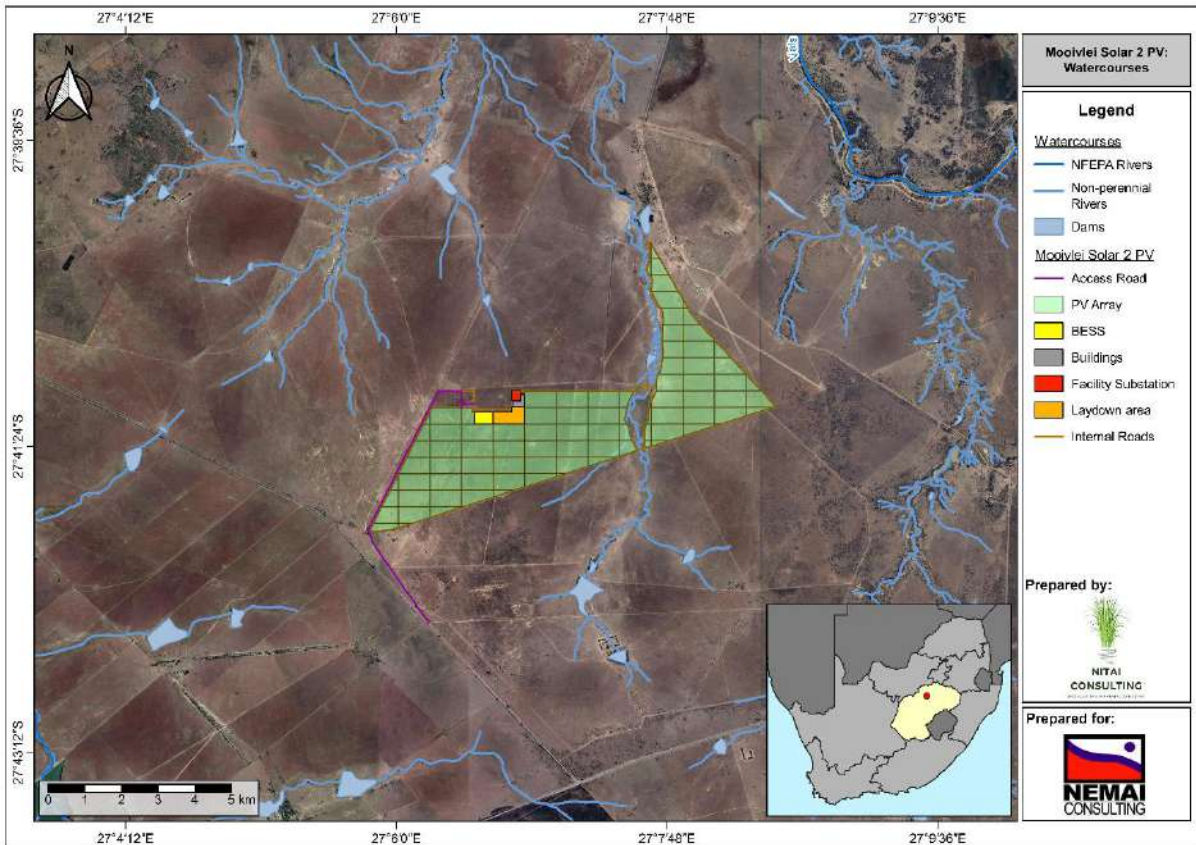


Figure 17: Map showing watercourses (NFEPA rivers, non-perennial rivers and Dams) associated with the study area (Alternative 1)

### **National Biodiversity Assessment (NBA) 2018 National Wetland Map (NWM) 5**

A South African Inventory of Inland Aquatic Ecosystems (SAIIAE) was established in 2018 during the National Biodiversity Assessment (Van Deventer *et al.*, 2018). This inventory highlights a collection of data layers pertaining to ecosystem types and pressures for rivers and inland wetland types. This includes the different wetland HGM units (CVB, UCVB, S, Dep, F and FL) as well its protection level (Well protected, Moderately protected, Poorly protected and Not protected) and threat status (Critical, Endangered, Vulnerable and Least Concern).

Within the footprint of the study area, there are no HGM units according to the NBA 2018 NWM 5 spatial data found (Figure 18). Several large S are located further north east of the study area while a small Dep and UCVB is located to the west of the study area. In South Africa, rivers and inland wetlands have the highest percentage of being critically endangered; 42% & 61% respectively (Skowno *et al.*, 2019). From the NWM 5 spatial data, majority of wetlands close to the study area are in critical condition while one is of least concern (Figure 19). Skowno *et al.* (2019) has further indicated that inland wetlands have the lowest overall protection in South Africa compared to other ecosystem realms. A total of 60% is classified as not protected while as less as 10% is classified as well protected and moderately protected (Figure 20). This has been attributed to their poor ecological condition (Skowno *et al.*, 2019).

Wetlands are essential ecological infrastructure for water and food security, tourism, recreation and disaster risk reduction (Skowno *et al.*, 2019). Therefore, the need for protection of these watercourses are essential.

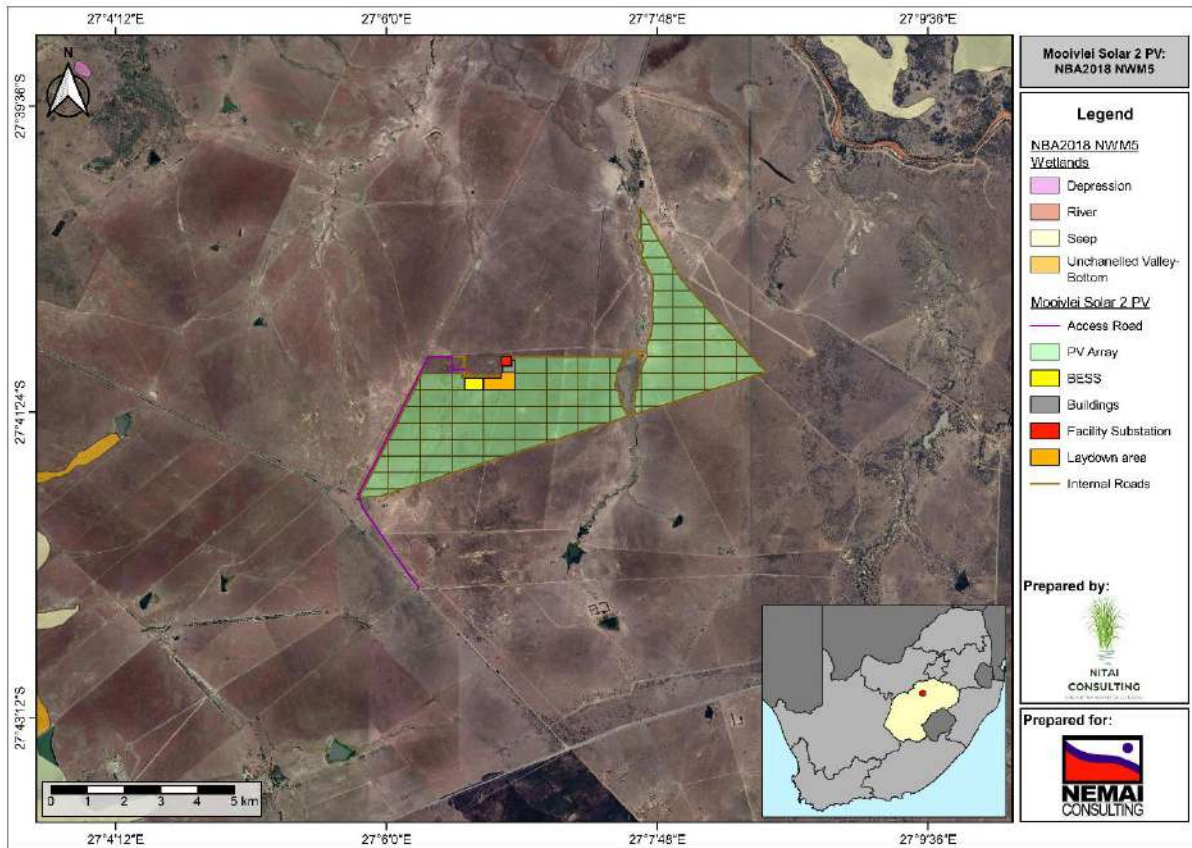


Figure 18: Map indicating the NBA 2018 NWM 5 wetland hydrogeomorphic units associated with the study area (Alternative 1)



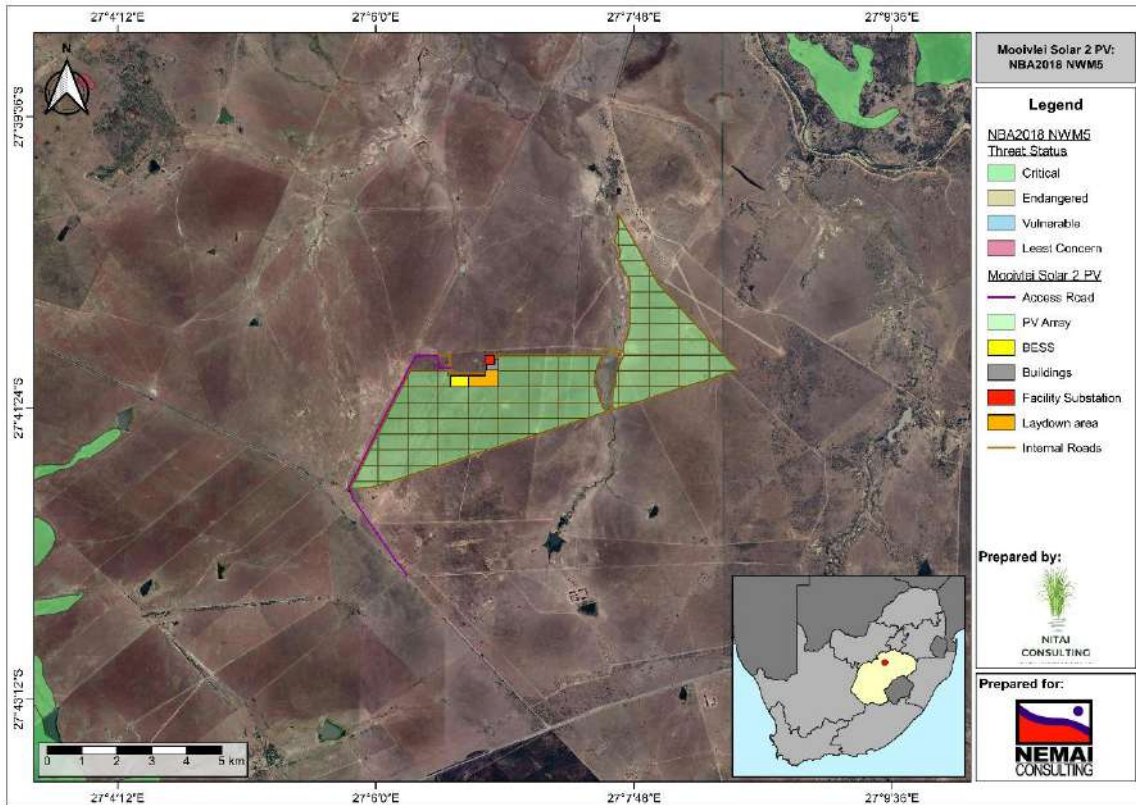


Figure 19: Map indicating the NBA 2018 NWM 5 wetland threat status surrounding the study area (Alternative 1)

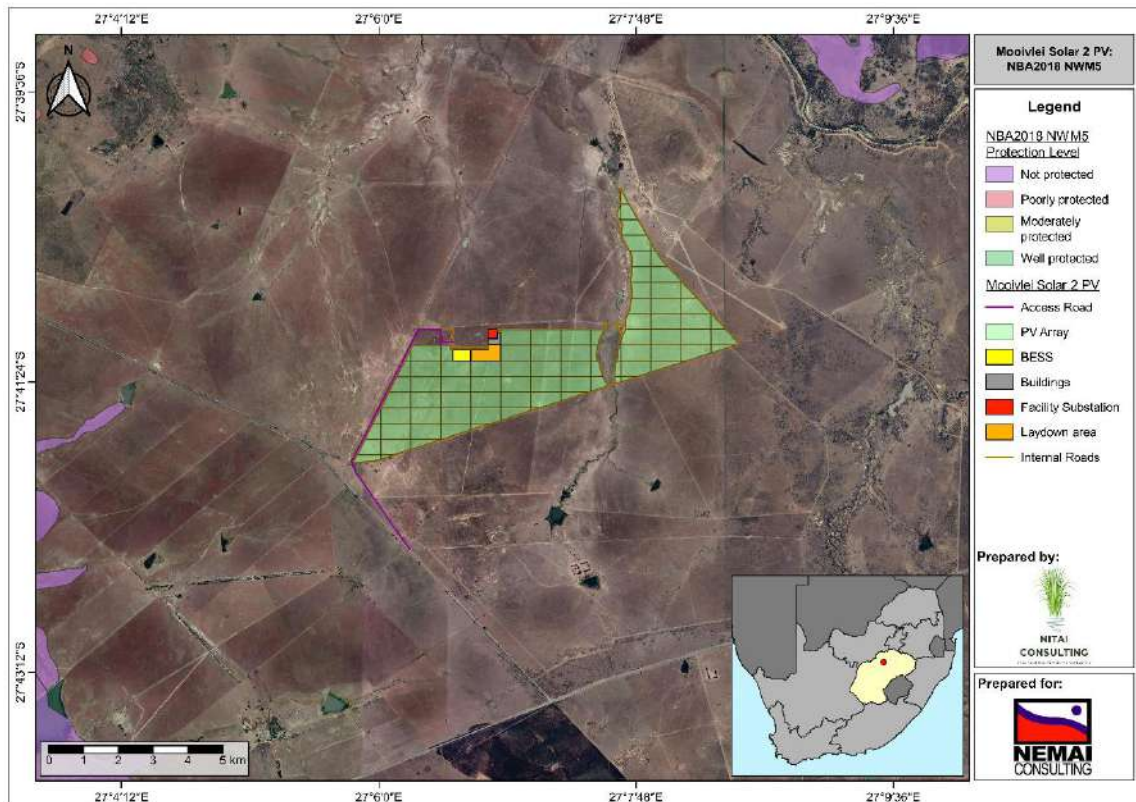


Figure 20: Map indicating the NBA 2018 NWM 5 wetland protection level surrounding the study area (Alternative 1)

#### 5.2.1.4 Strategic Water Source Areas (SWSA's)

Strategic Water Source Areas (SWSA) are either (a) areas that supply an uneven (large quantity) amount of mean annual surface water runoff in relation to their size and are therefore considered to be nationally important or (b) have high groundwater recharge and where the groundwater forms nationally important resource or (c) areas that meet both criteria (a) and (b) (Nel *et al.*, 2013; Le Maitre *et al.*, 2018). Areas that supply these disproportionate amounts of water can be because of climatic conditions such as high rainfall, or physical properties (ability of the soils and underlying weathered material and rocks to store water as groundwater) (Le Maitre *et al.*, 2018). In South Africa, 22 SWSA surface water and 37 SWSA groundwater areas has been identified to be strategically important at national level for water and economic security (Le Maitre *et al.*, 2018).

The study area is situated within the groundwater SWSA of South Africa (Figure 21). The groundwater SWSA covers approximately 9% of the surface land of South Africa and play a key role in sustaining surface water flows during the dry season (Le Maitre *et al.*, 2018).

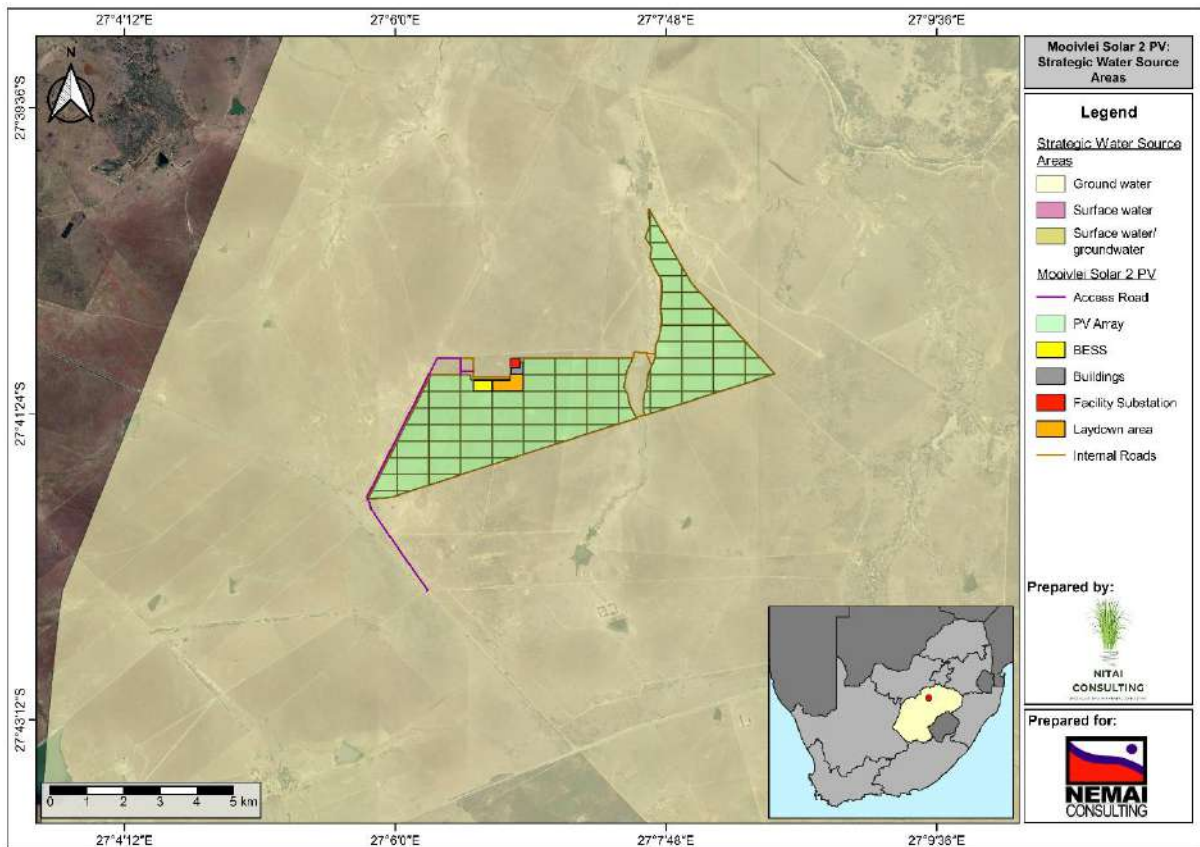


Figure 21: Map indicating the Strategic Water Source Areas in relation to the study area (Alternative 1)

## 5.2.2 Regional context

### 5.2.2.1 Critical Biodiversity Areas (CBA's)

On a regional scale, terrestrial and aquatic biodiversity conservation priorities are highlighted in the Free State (FS) Biodiversity Plan (Collins, 2016). The biodiversity plan identifies areas that are important for the representation and persistence of terrestrial and aquatic species and ecosystems. These areas are referred to as Critical Biodiversity Areas (CBA's) which is the minimum area required to ensure the persistence and representation of biodiversity (Collins, 2016). Critical Biodiversity Areas within the FS are planning units that when not included in the final portfolio will result in targets not being met. As such, these areas are identified based on irreplaceability output of the Conservation Plan (C-Plan) or the frequency of selection analysis of Marxan (Collins, 2016). Furthermore, CBA 1 and CBA 2 areas are areas of high biodiversity that will result in targets not achieved when excluded from the final portfolio (CBA 1) and areas that will not necessarily result in loss of achievable targets from the final portfolio (CBA 2). These areas account for 12 % of the biodiversity plan (Collins, 2016). Importantly, aquatic features have yet to be included in the FS Biodiversity Plan, with the exception of FEPA catchments and wetland clusters (which is included as Ecological Support Areas).

The spatial dataset from Collins (2016) highlights that the study area does fall within both CBA 1 and CBA 2 (Figure 22). A small portion (western side) of the PV site is situated within a CBA 1 and 2. Majority of the PV site is located within an ESA 1 and a small portion of the eastern boundary is within and ESA 2 (Collins, 2016).

### 5.2.2.2 Ecological Support Areas (ESA's)

Ecological Support Areas (ESA's) are areas required to support the persistence of terrestrial and/or aquatic species. In the Free State, the ESA's covers a total of 53% area of the biodiversity plan (Collins, 2016).

From the FS Biodiversity spatial data, majority of the PV site is located within an ESA 1 while some portions of the site is located within an ESA 2 area (Figure 22) (Collins, 2016).



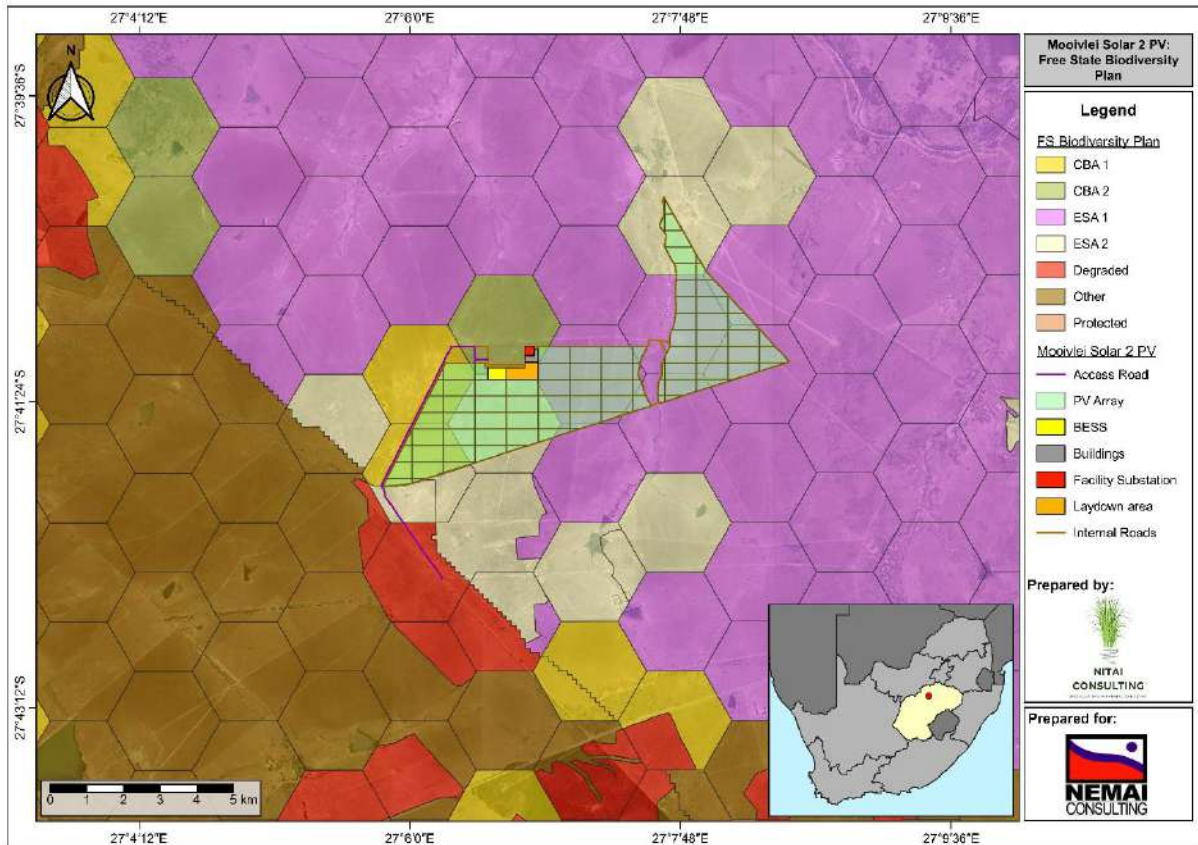


Figure 22: Map indicating the Free State Biodiversity Plan in relation to the study area (Alternative 1)

## 6 FINDINGS OF THE ASSESSMENT

### 6.1 Desktop mapping and identifying resources

All areas of interest or potential of wetlands were identified, and pin drops were placed around the perimeter of the area of interest. This was done using the latest satellite aerial imagery from Google Earth. All pin drops “flagged” on Google Earth were visually inspected during the site visit (Figure 23).

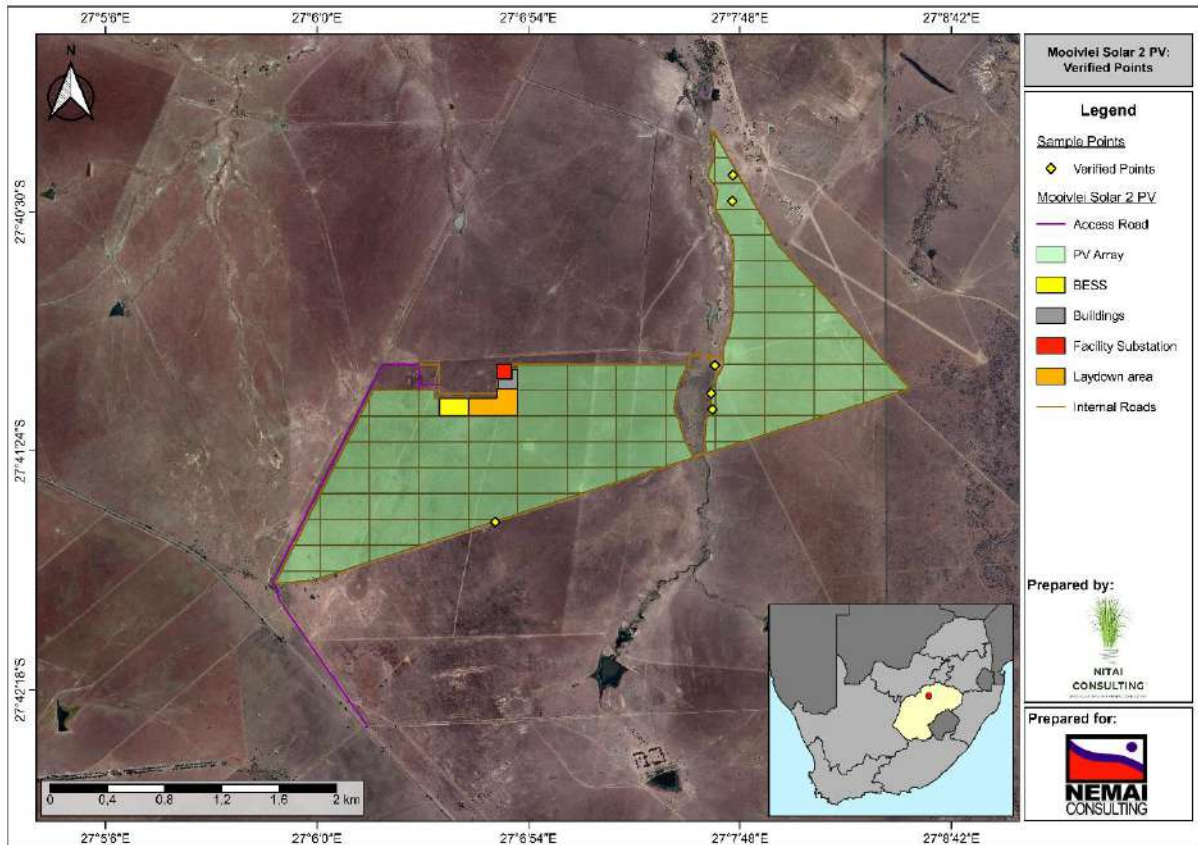


Figure 23: Map indicating the flagged potential wetland areas within the study area (Alternative 1)

## 6.2 Available information (rivers and wetlands)

To date, no previous Freshwater Assessments have been conducted within the study area. One perennial river, Vals River, is located to the north of the proposed PV site while several small unnamed non-perennial rivers are flowing adjacent to the proposed PV site before draining into the Vals River. The DWS (2014) has conducted studies on all river catchments and determined the PES and EIS categories. For the Vals River, DWS (2014) has determined that the river has a PES category of C (Moderately modified) and an EIS of B and C (High and Moderate importance and sensitivity) in the C60G Quaternary Catchment (DWA, 2014). Furthermore, the study has concluded that the Riparian and Wetland zone continuity modifications is moderate, meaning that, the modifications are present at a small number of localities and the impact on habitat quality, diversity, size, and variability are also limited. In addition, the potential flow modifications are regarded as moderate, meaning that, the modifications are present at a small number of localities and the impact on habitat quality, diversity, size, and variability are also limited.

### **6.3 Ecological findings of the Assessment**

During the site visits to the study area in Fall (17 & 18 April 2023), the study area is situated within the 500 m regulated area of several identified watercourses (wetlands and rivers) as well as within watercourses (see Figure 24 below). Due to freshwater sensitivity within the Alternative 1 layout, the proponent has revised the layout (hereafter referred to as Alternative 2). As such, each section of the ecological findings was sub-divided into Alternative 1 and Alternative 2.

#### **Alternative 1**

During site visits to the study area, the study area is situated within the 500 m regulated area of several identified watercourses (wetlands and rivers) (Figure 24). One HGM unit (CVB) was identified within the footprint of the study area. The CVB is located in and near the south eastern portion of the PV site. The study area with the Alternative 1 layout encroaches into a channel of a non-perennial river in the southern portion as well as the CVB in the south eastern portion of the study area (see Figure 24). This non-perennial river flowing adjacent to the study area is draining into the Vals River which is situated further north of the study area. Moreover, The non-perennial originates south of the study area near the R34. Furthermore, a few in-channel dams are located in this non-perennial river.

#### **Alternative 2**

The 2<sup>nd</sup> alternative option takes into account all identified watercourses within the study area. As such, the Mooivlei Solar 2 PV footprint is outside of any watercourse (wetland and rivers) (Figure 25).



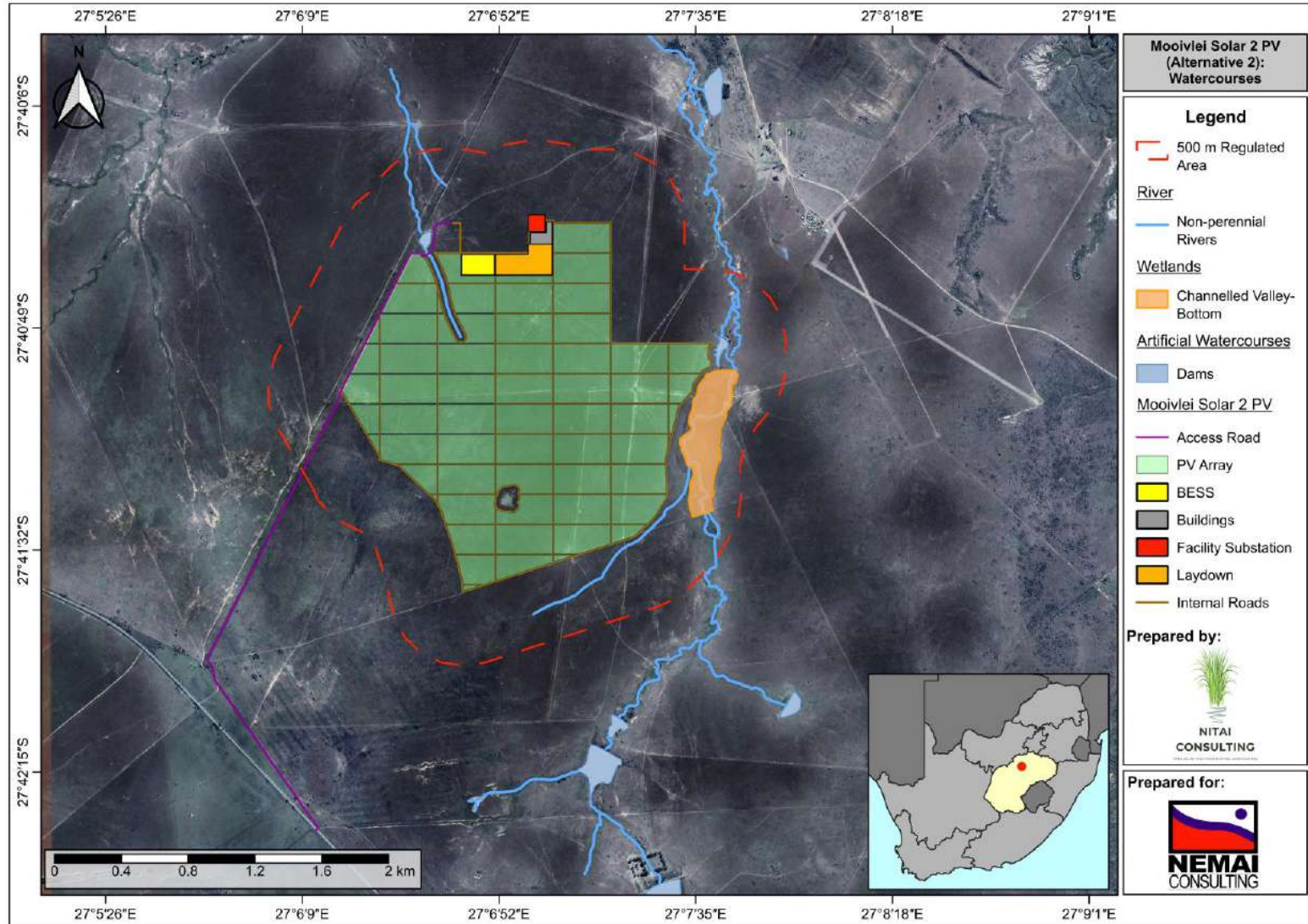


Figure 24: All watercourses associated with Alternative 1 of the Mooivlei Solar 2 PV Facility as well as the 500 m regulated area



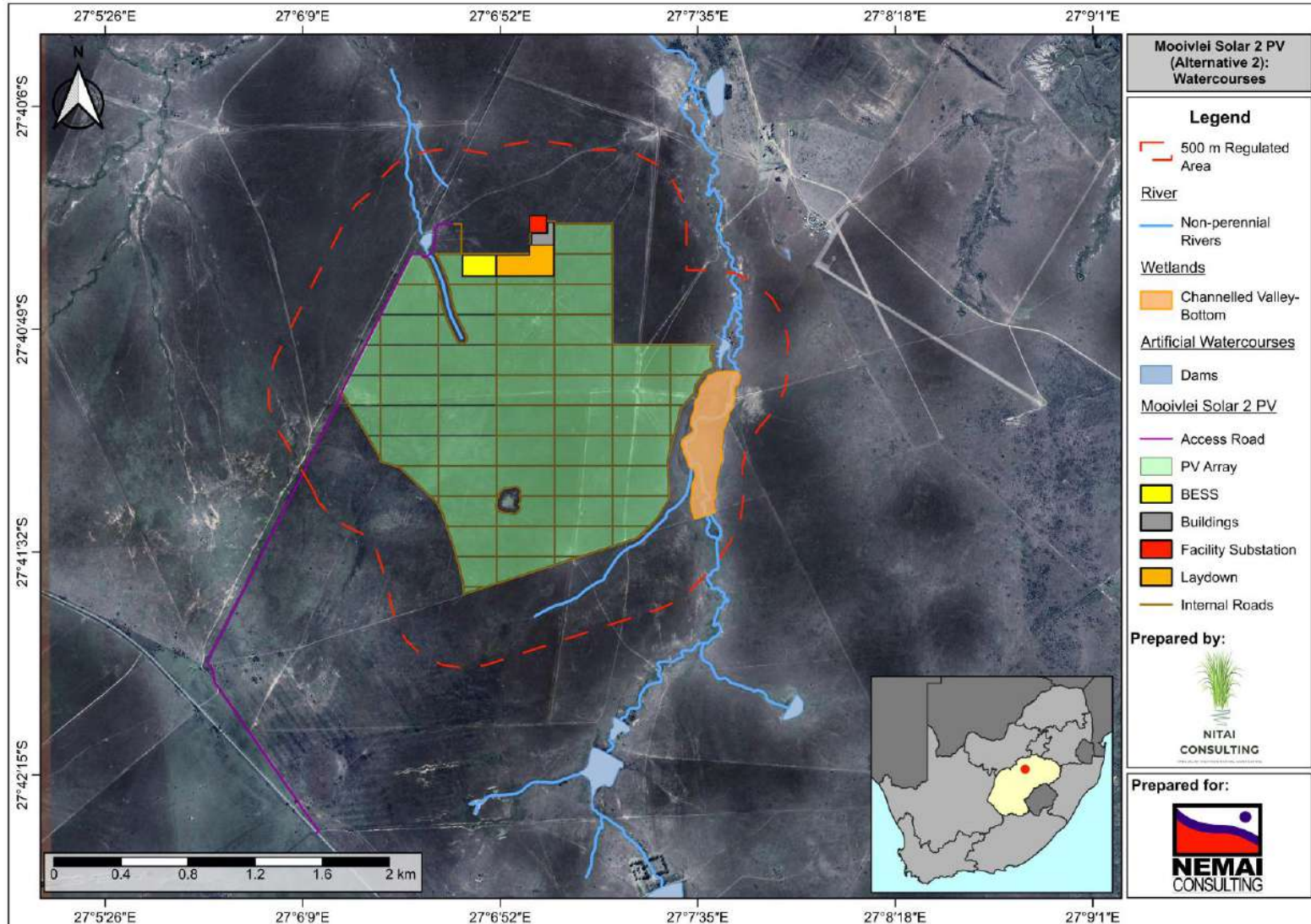


Figure 25: All watercourses associated with Alternative 2 of the Mooivlei Solar 2 PV Facility as well as the 500 m regulated area

### 6.3.1 Wetlands

#### 6.3.1.1 Alternative 1

Several HGM units (Dep and CVB) was identified within and in close proximity to the alternative 1 layout of Mooivlei Solar 2 PV Facility (see Figure 26 and Table 6 below). The Dep is situated north west of the upper portion of the PV footprint near the non-perennial river. In addition, a CVB wetland is situated separates the upper and lower portion of the PV site. Furthermore, the study area encroaches into small sections of this CVB wetland. The remaining footprint of Mooivlei Solar 2 PV is comprised of terrestrial habitat.

#### 6.3.1.2 Alternative 2

Within the alternative 2 layout, the proposed Mooivlei Solar 2 PV Facility has accommodated the presence of the CVB (see Figure 27). The study area is outside the delineated boundary of the wetland.

### 6.3.2 Rivers

#### 6.3.2.1 Alternative 1

One perennial river, Vals River, was found well north of the study area and is flowing westerly away from the study area and drains into Vaal River (Figure 28). In addition, one non-perennial river was also identified that is flowing between the upper and lower portions of the study area (Figure 28 and see Table 7). The southern section of the study area encroaches into a channel of a non-perennial river. Furthermore, no drainage lines were identified within Mooivlei Solar 2 PV (Figure 28). As a result, a freshwater sensitivity map was generated to highlight the Low, Medium and High sensitivities associated with the proposed development. Please refer to **Section 6.4: Sensitivities and Buffer Zones** and Figure 37 for the Sensitivity Map of the Alternative 1 Layout.

#### 6.3.2.2 Alternative 2

The revised layout for Mooivlei Solar 2 PV has taken into account the one channel of a non-perennial river draining into a farm dam in the north west corner as well as the one channel of a non-perennial to the south of the study area (Figure 29). The Sensitivity Map for the Preferred Alternative 2 layout can be found in **Section 6.4: Sensitivities and Buffer Zones** as well as Figure 38.

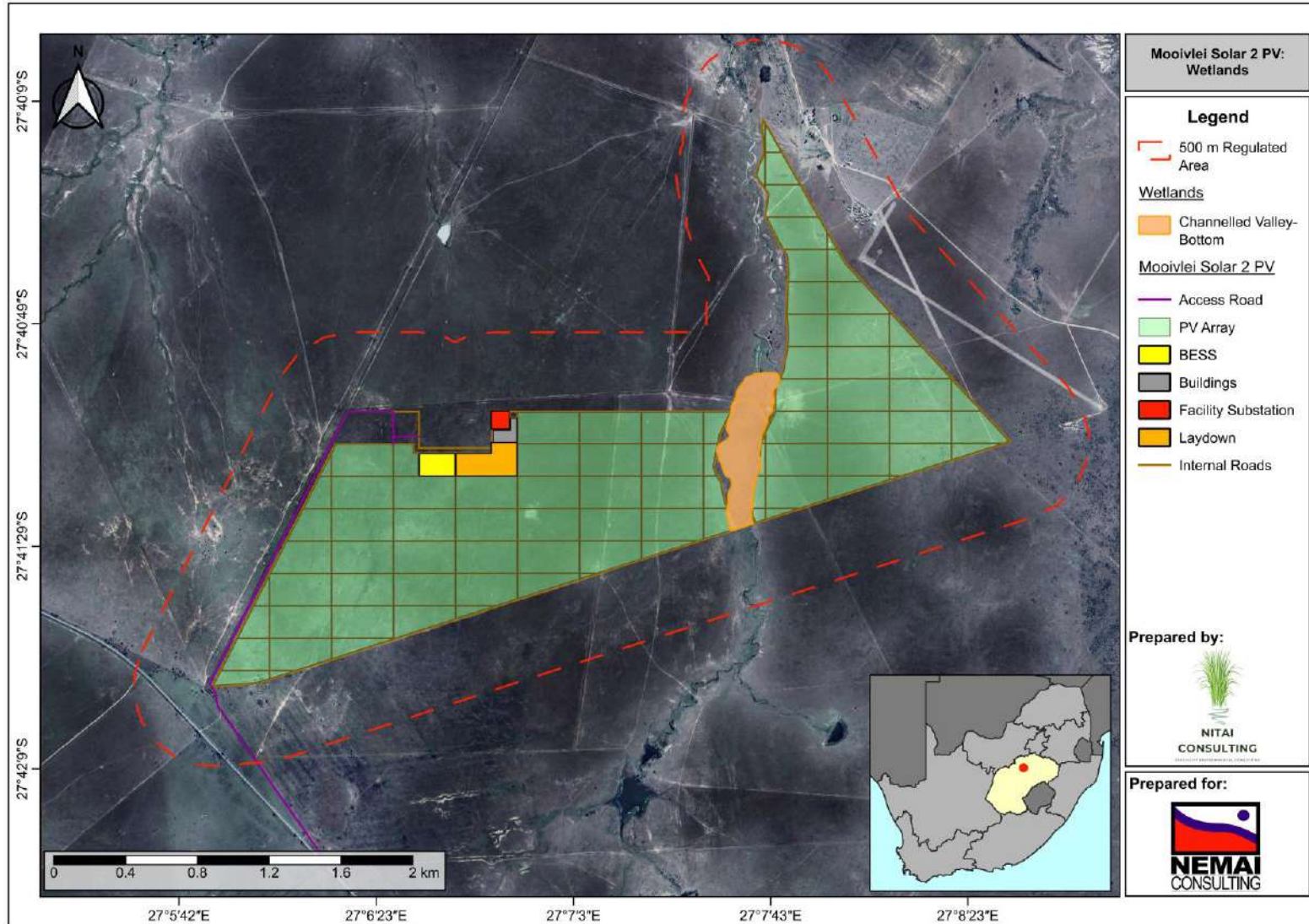


Figure 26: All identified wetlands within the Alternative 1 Layout



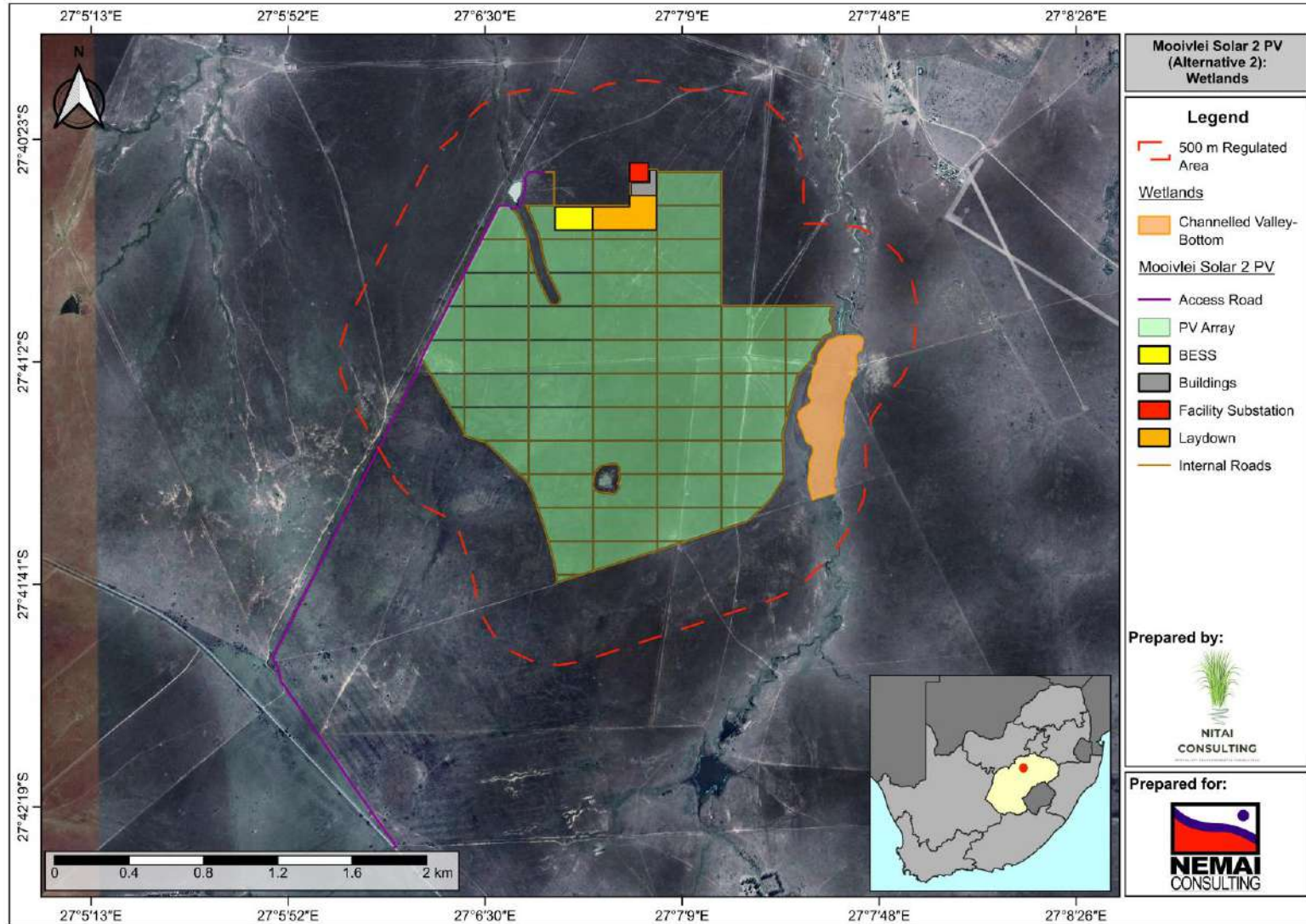





Figure 27: All identified wetlands within the Alternative 2 and Preferred Layout



**Table 6: Wetland Classification as per SANBI Guidelines (Ollis et al., 2013)**

HGM Unit	Wetland Type	Photograph
HGM Unit 1	Depression	
HGM Unit 2	Channelled Valley-Bottom	 

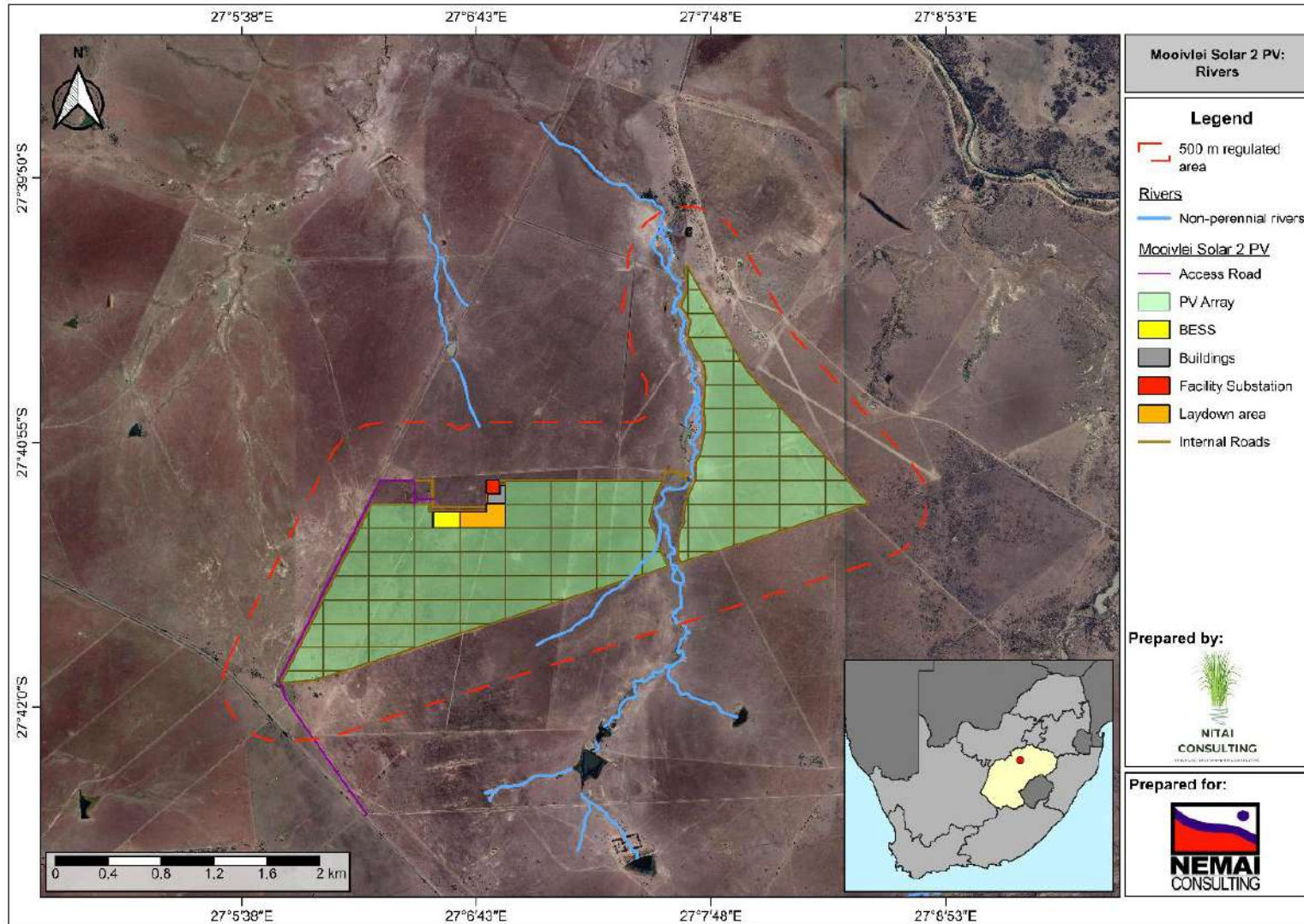


Figure 28: All identified rivers within the Alternative 1 Layout of the study area



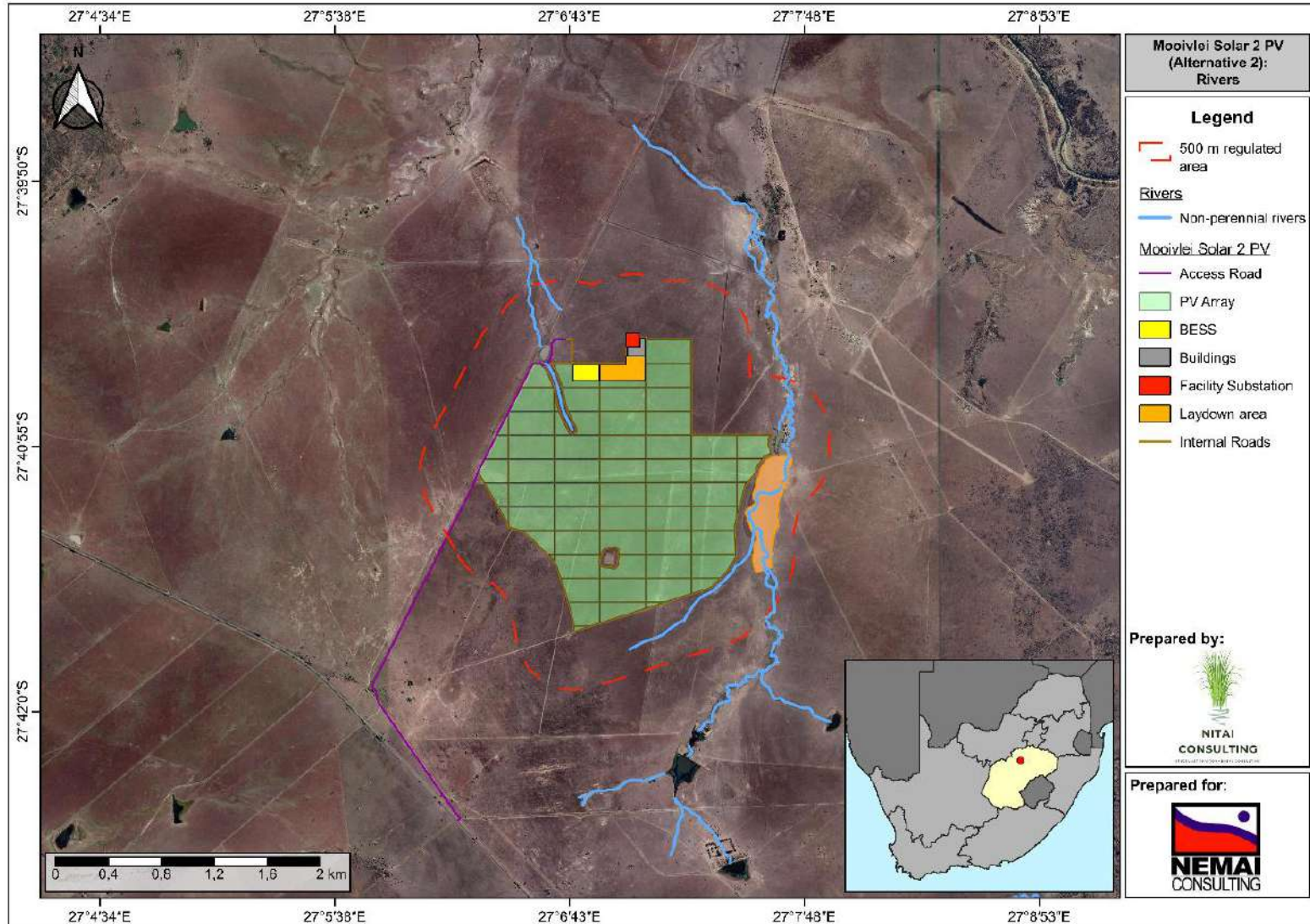




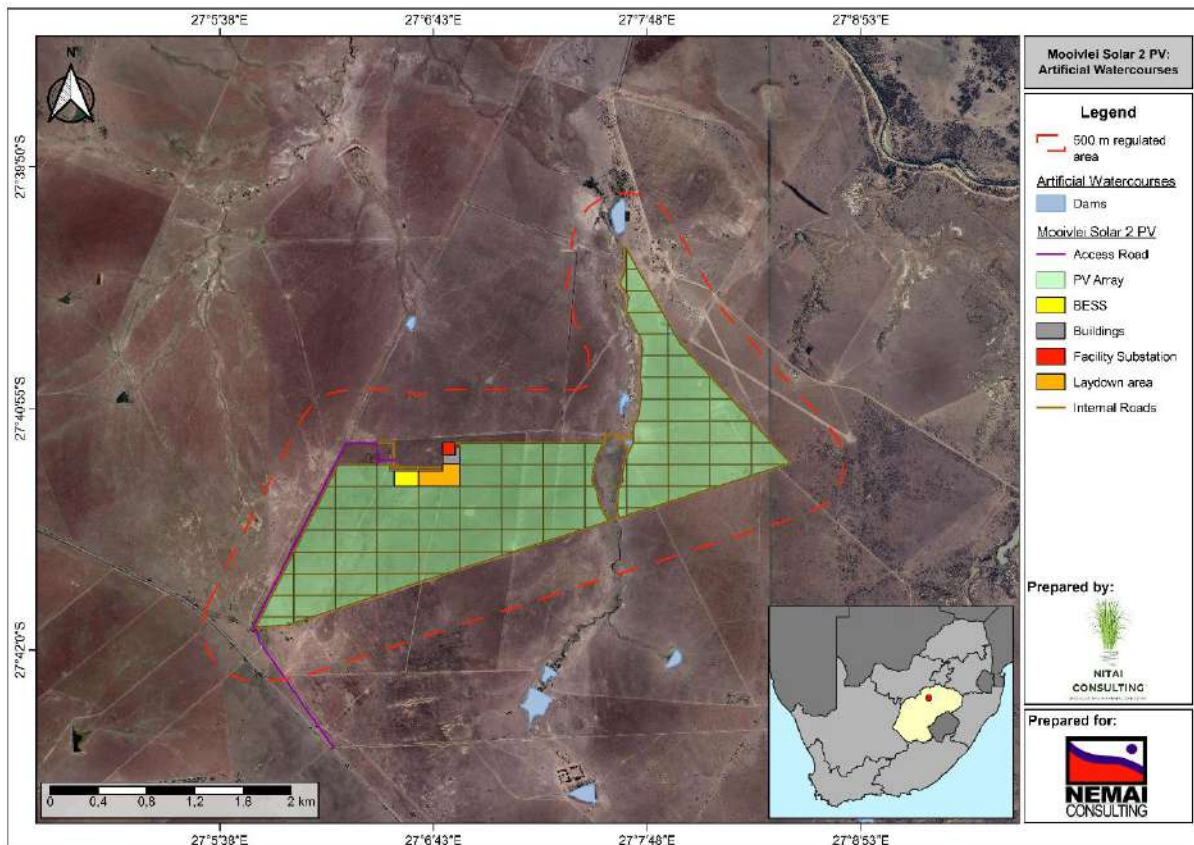
Figure 29: All identified rivers within the Alternative 2 and Preferred Layout of the study area

**Table 7: Rivers flowing adjacent to the study area as well as within 500 m regulated area**

River	Upstream	Downstream
Non-perennial River		

### 6.3.3 Other watercourses

Several dams and reservoirs are situated within the study area (Figure 31). A few of these dams are highlighted in Figure 32 below. Figure 33 below shows the general environment around areas of interest within the study area.

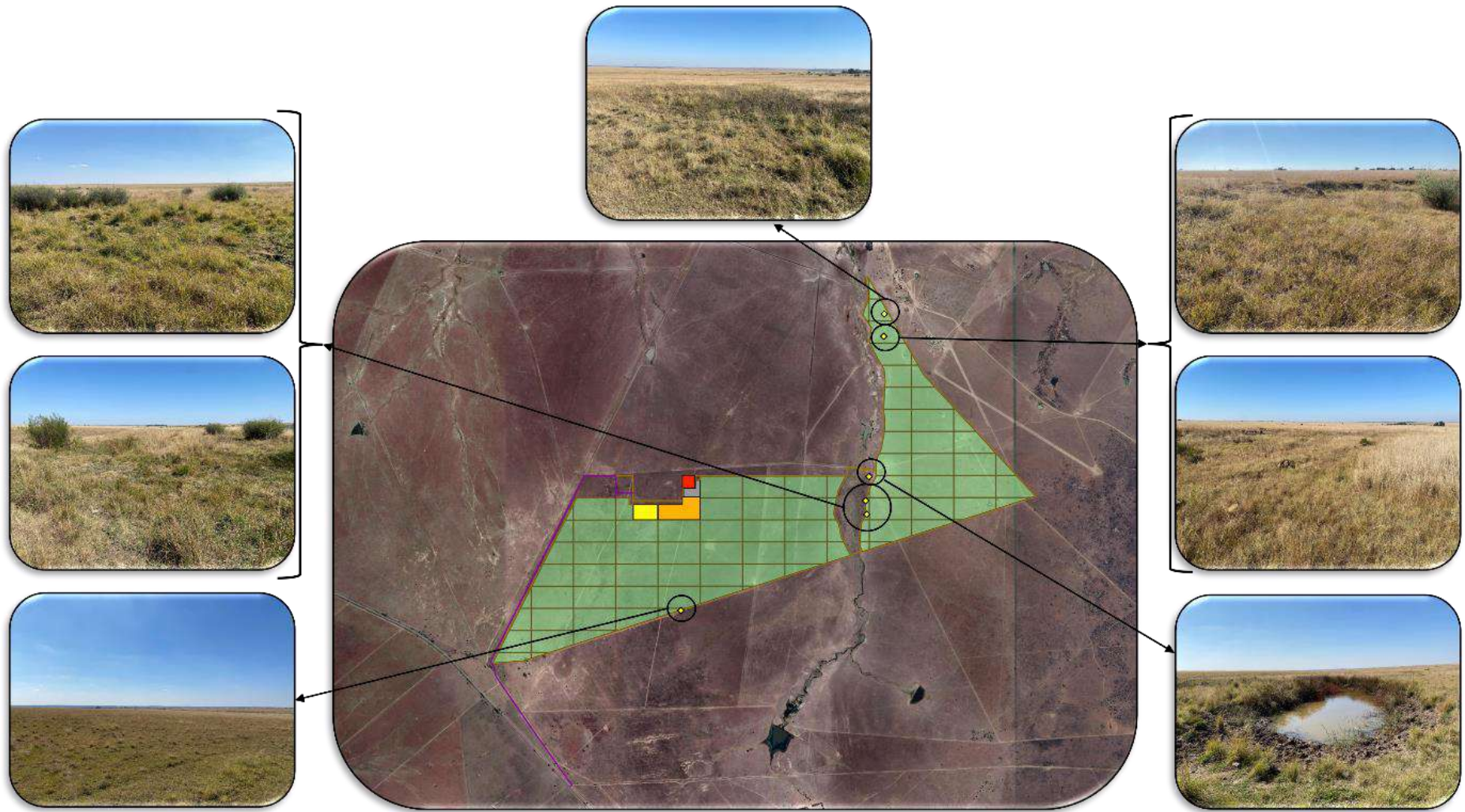


**Figure 30: Map showing the location of the dams in and around the study area**





*Figure 31: Photographs showing some of the dams located within and around the study area*



*Figure 32: Photographs indicating the general environment around areas of interest within the study area*



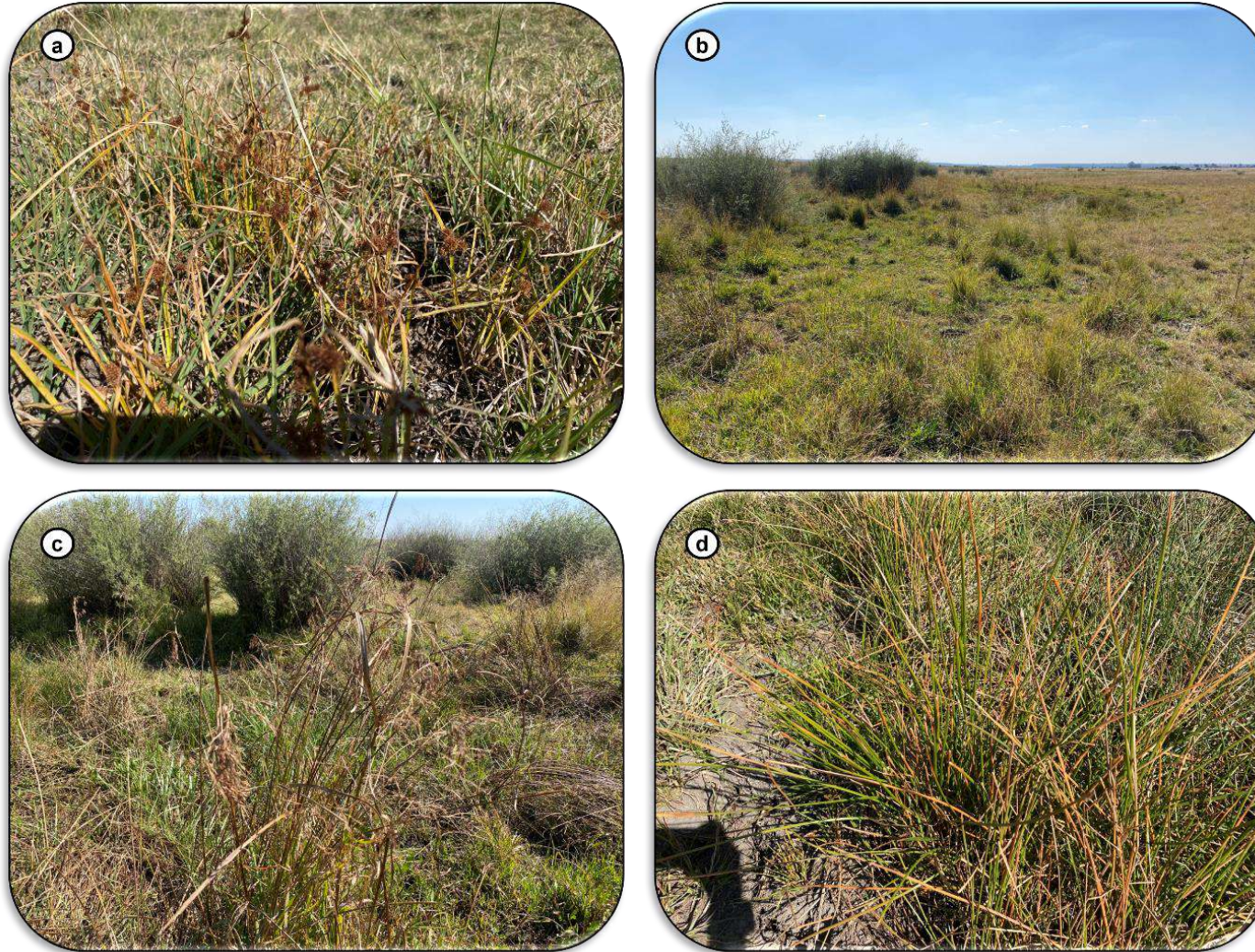
#### **6.3.4 Vegetation characteristics**

During the site visit, vegetation characteristics indicative of wetland habitats was observed within the small Dep and CVB wetlands. Typical vegetation species indicating wetness included *Paspalum dilatatum*, *Juncus effesus*, *Cyperus fastigiatus* and *Cyperus congestus* (Figure 34). Furthermore, majority of the study area was comprised of terrestrial vegetation.

#### **6.3.5 Soil characteristics**

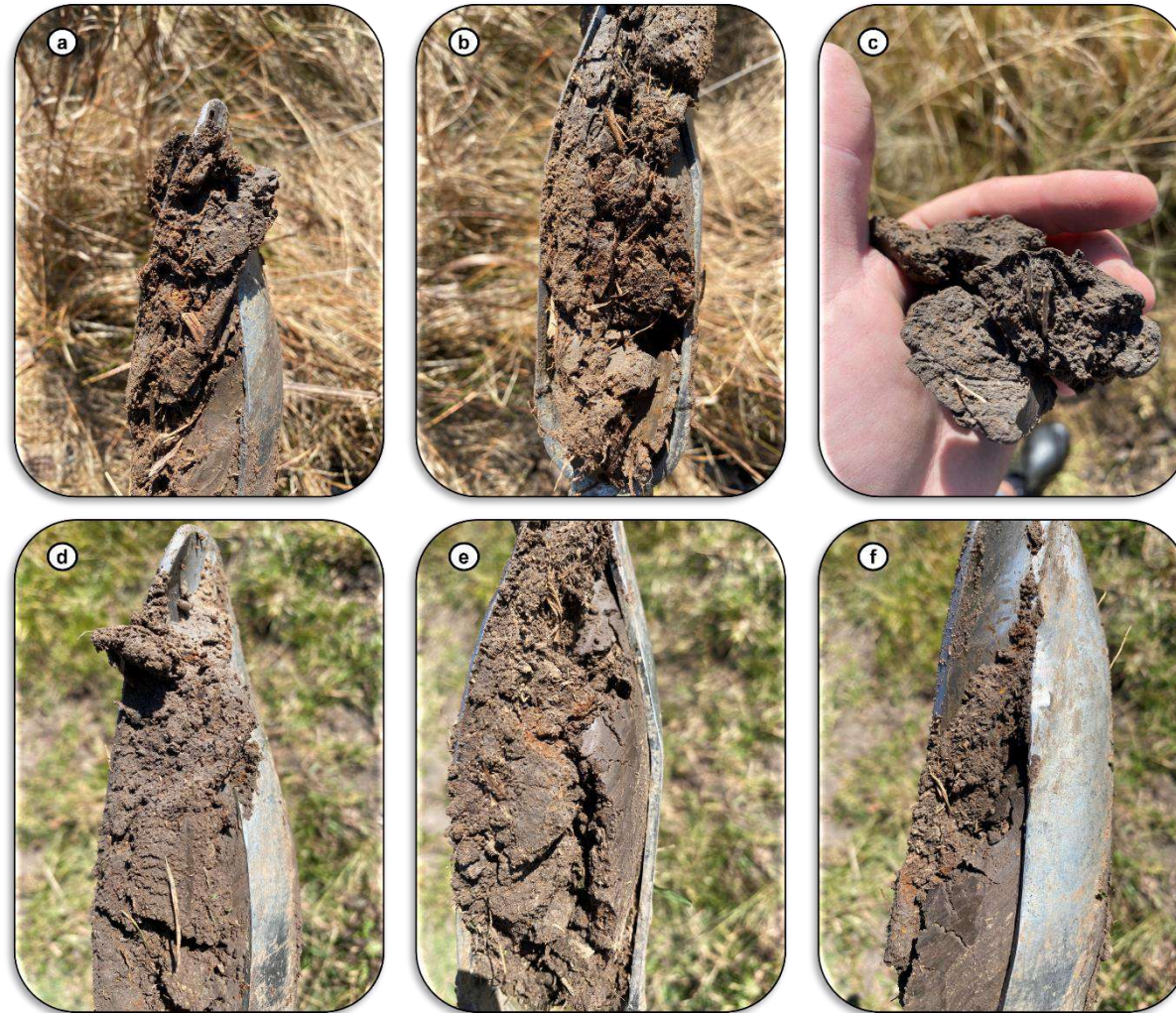
Soil samples collected within wetland areas did show the presence of red-yellow mottling within the 50 cm layer (Figure 35). Collected soils samples across the study area were identified to be Valsrivier, Bonheim and Arcadia near the non-perennial river and within the CVB and Dep wetlands (refer to section 5.1.3 and Figure 11). These soil types are typical of Dc and Ea land types. The structured subsoil horizon within the Dc land types may display a certain degree of redox morphology and within this land type there are distinct water accumulation and later flows that can occur below these structured horizons. Therefore, the redox morphology can be utilized to identify wetlands and is consistent with the criteria from DWS (2005), except for the depth criteria (van der Waals *et al.*, 2019).

Within the Ea land type, the vertic dominated soils exhibit a high base status while Calcium and Magnesium are also dominant (van der Waals *et al.*, 2019). The soil moisture regime of these two soil types largely varies and is determined by the area of formation (van der Waals *et al.*, 2019). Furthermore, formation in low lying landscapes highlights the occurrence of vertic and melanic horizons, indicating hillslopes and water related weathering product accumulation processes. These soils are most of the time associated with watercourses and localised wetland conditions (van der Waals *et al.*, 2019).



**Figure 33: Vegetation characteristics associated with the study area. Photographs highlight the different species (a) *Cyperus congestus*, (b) *Paspalum dilatatum*, (c) *Cyperus fastigiatus* and (d) *Juncus effesus***





**Figure 34: Soil samples collected showing the presence of white and red-yellow mottling within the 50 cm layer. Photographs (a) and (b) shows the Bonheim soil type observed on site with red mottling, photographs (c) shows the Arcadia soil types while photographs (d), (e), and (f) shows the Valsrivier soil type with red and white mottling**

### 6.3.6 Present Ecological State (PES): Wetlands

The PES (Macfarlane *et al.*, 2020) has been determined for the Dep and CVB verified on site during the site visit. Present Ecological State was calculated for the Dep as C (Moderately modified) (Table 8). The PES for the CVB wetland was determined as C (Moderately Modified). Water quality was not included in the PES calculations as water quality did not form part of the overall assessment.

**Table 8: Present Ecological State scores calculated for the two HGM units**

HGM Unit	Hydrology	Geomorphology	Vegetation	Overall
Depression	C (Moderately Modified) Impact Score: 3.2	C (Moderately Modified) Impact Score: 2.7	C (Moderately Modified) Impact Score: 3.0	C (Moderately Modified) Impact Score: 2.8
Channelled Valley-Bottom	C (Moderately Modified) Impact Score: 2.8	C (Moderately Modified) Impact Score: 2.3	C (Moderately Modified) Impact Score: 2.0	C (Moderately Modified) Impact Score: 2.3

### 6.3.7 Ecological Importance and Sensitivity (EIS)

The EIS (Rountree *et al.*, 2013) has been determined for the Dep and CVB wetlands verified on site during the site visit. Ecological Importance and Sensitivity categories for both the Dep and CVB wetland was determined as Moderate (C) (see Table 9 below). Both wetlands identified is according to the FS Biodiversity Plan situated in an ESA 1 and ESA 2 (refer to Figure 22).

**Table 9: Ecological Importance and Sensitivity of the two HGM units**

HGM Unit	Ecological Importance and Sensitivity
Depression	<p><b>Moderate (1,61)</b></p> <ul style="list-style-type: none"> <li>• Ecological Importance &amp; Sensitivity: 2.2</li> <li>• Hydrological/Functional Importance: 2.1</li> <li>• Direct Human Benefits: 0.5</li> </ul>
Channelled Valley-Bottom	<p><b>Moderate (1,68)</b></p> <ul style="list-style-type: none"> <li>• Ecological Importance &amp; Sensitivity: 2.3</li> <li>• Hydrological/Functional Importance: 2.4</li> <li>• Direct Human Benefits: 0.3</li> </ul>

### 6.3.8 Wetland Ecosystems Services

The wetland ecosystem services (Kotze *et al.*, 2020) for all the wetlands identified during the site visit are shown in Table 10 below (see Table 11 for description of impact category ratings). The Dep wetland is of moderate importance for biodiversity maintenance while low importance for cultivated foods (Table 10). Furthermore, the Dep is located within an ESA that increases its importance in supporting the ecological functioning of critical biodiversity areas and/or in delivering ecosystem services that support socio-economic development, such as water provision, flood mitigation or carbon sequestration.

The CVB wetland is of moderately-high importance for sediment trapping and phosphate assimilation. Furthermore, the CVB is of moderate importance for toxicant assimilation and biodiversity maintenance (Table 10). In addition, the wetland is moderately-low importance for nitrate assimilation and cultivated foods. The CVB is located within an ESA and just as the Dep, the ESA increases the importance for supporting ecological function.

**Table 10: Wetland Ecosystem Services calculated for the two HGM units**

Ecosystem Services		Score			
		Depression Score	Importance	Channelled Valley-Bottom Score	Importance
Regulating and Supporting Services	Flood attenuation	0.0	Very Low	0.0	Very Low
	Stream flow regulation	0.0	Very Low	0.6	Very Low
	Sediment trapping	0.4	Very Low	2.3	Moderately-High
	Erosion control	0.6	Very Low	0.3	Very Low
	Phosphate assimilation	0.0	Very Low	2.3	Moderately-High
	Nitrate assimilation	0.0	Very Low	1.5	Moderately-Low
	Toxicant assimilation	0.0	Very Low	1.8	Moderate
	Carbon storage	0.0	Very Low	0.4	Very Low
	Biodiversity maintenance	2.0	Moderate	1.8	Moderate
Provisioning services	Water for human use	0.0	Very Low	1.2	Low
	Harvestable resources	0.5	Very Low	0.0	Very Low

	Food for livestock	2.0	Moderate	0.0	Very Low
	Cultivated foods	1.4	Moderately Low	1.5	Moderately-Low
Cultural Services	Tourism and Recreation	0.0	Very Low	0.0	Very Low
	Education and Research	0.3	Very Low	0.0	Very Low
	Cultural and Spiritual	0.5	Very Low	0.0	Very Low

**Table 11: Importance Category ratings**

Importance Category		Description
Very Low	0-0.79	The importance of services supplied is very low relative to that supplied by other wetlands.
Low	0.8 – 1.29	The importance of services supplied is low relative to that supplied by other wetlands.
Moderately-Low	1.3 – 1.69	The importance of services supplied is moderately-low relative to that supplied by other wetlands.
Moderate	1.7 – 2.29	The importance of services supplied is moderate relative to that supplied by other wetlands.
Moderately-High	2.3 – 2.69	The importance of services supplied is moderately-high relative to that supplied by other wetlands.
High	2.7 – 3.19	The importance of services supplied is high relative to that supplied by other wetlands.
Very High	3.2 - 4.0	The importance of services supplied is very high relative to that supplied by other wetlands.

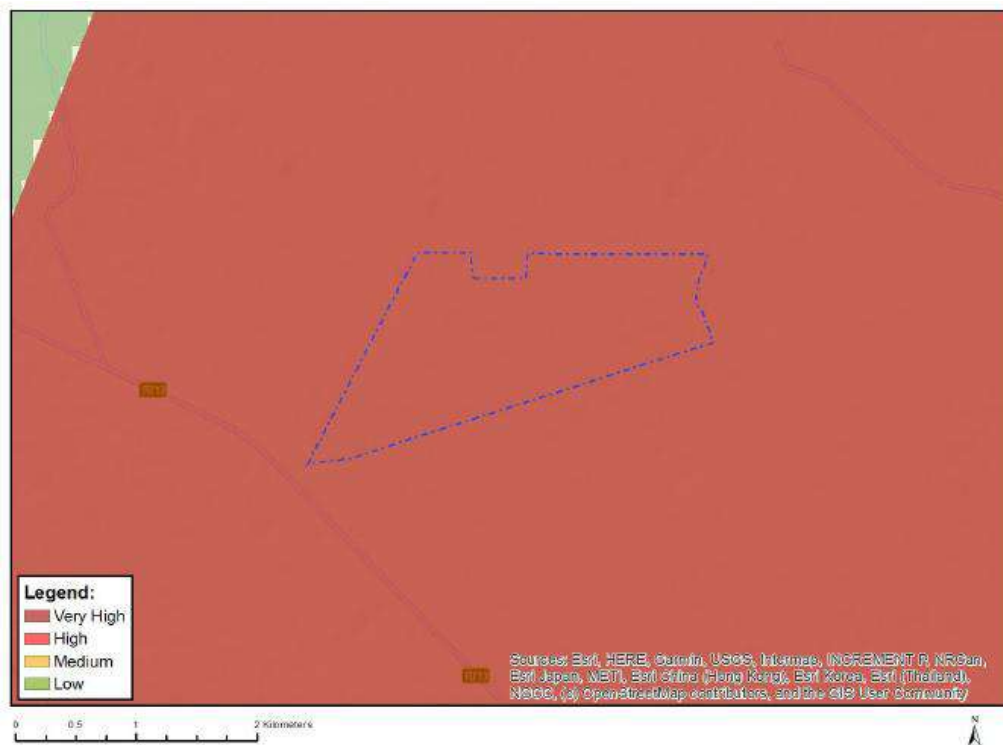


## 6.4 Site Sensitivity Verification and Buffer Zones

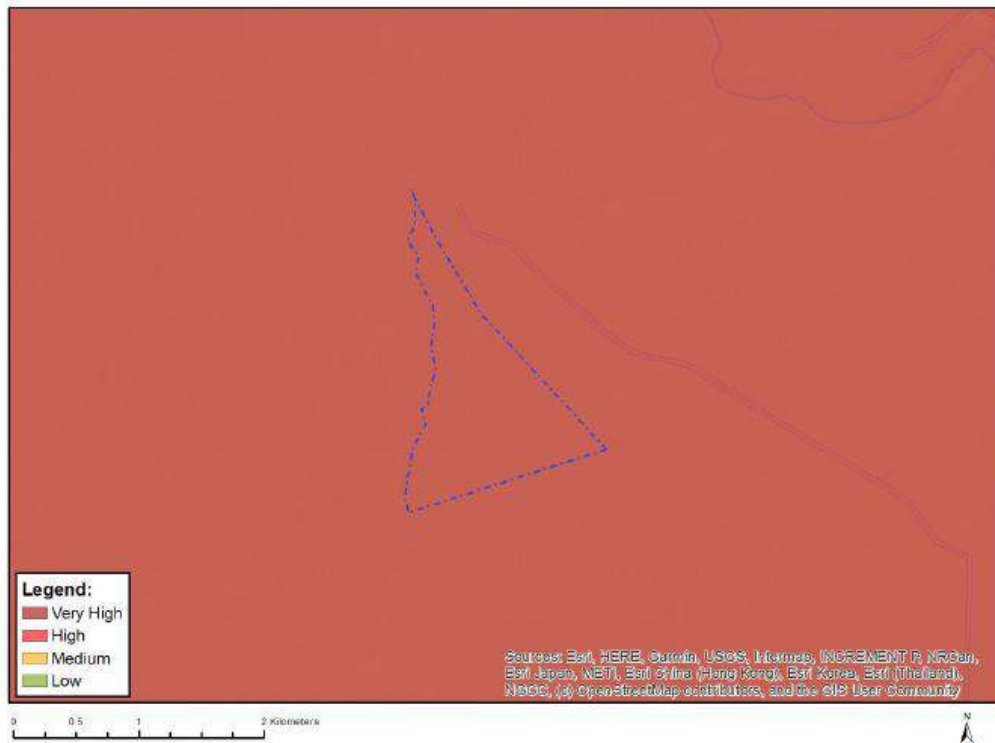
### 6.4.1 Desktop sensitivity assessment (DFFE Screening Tool)

During the Desktop study for the Mooivlei Solar 2 PV Facility an Environmental Screening tool from Department of Forestry, Fisheries & the Environment (DFFE) was queried. The Screening Tool allows for the generation of a Screening Report referred to in Regulation 16(1)(v) of the Environmental Impact Assessment Regulations 2014, as amended, whereby a Screening Report is required to accompany any application for Environmental Authorisation.

The DFFE Screening Tool Report has identified that Aquatic Biodiversity Theme for the study area is of very high sensitivity for both the upper and lower portions of the PV site (Figure 35 and Figure 36). The very high sensitivity is due to PV site being within a groundwater SWSA. Furthermore, due to the Alternative 1 layout encroaching into the freshwater features, the site sensitivity was confirmed as very high.



**Figure 35: Lower portion of the Alternative 1 layout for the Mooivlei Solar 2 PV's Aquatic Biodiversity Sensitivity Theme from the Department of Forestry, Fisheries & the Environment Screening Tool**



*Figure 36: Upper portion of the Alternative 1 layout for the Mooivlei Solar 2 PV's Aquatic Biodiversity Sensitivity Theme from the Department of Forestry, Fisheries & the Environment Screening Tool*

#### 6.4.2 Ground Truthing

Ground truthing the Alternative 1 layout with site visits during Fall (17 & 18 April 2023), the study area could be classified as **Very High** sensitivity due to the PV site encroaching into a few non-perennial rivers and wetlands. In addition, majority of the Alternative 1 layout was classified as **Low** sensitivity whereas the non-perennial rivers, wetlands and its associated buffer zones was classified as **High** and **Medium** sensitivity, respectively (Figure 37).

As a result, the PV site layout has been revised and the Alternative 2 layout (preferred layout) is outside of these non-perennial rivers, wetlands as well as their associated buffer zones (discussed below) (Figure 38). Therefore, the Alternative 2 layout has an overall **Low** sensitivity to freshwater features. Importantly, based on these sensitivity classifications, the **Preferred Alternative for the proposed development is Alternative 2.**

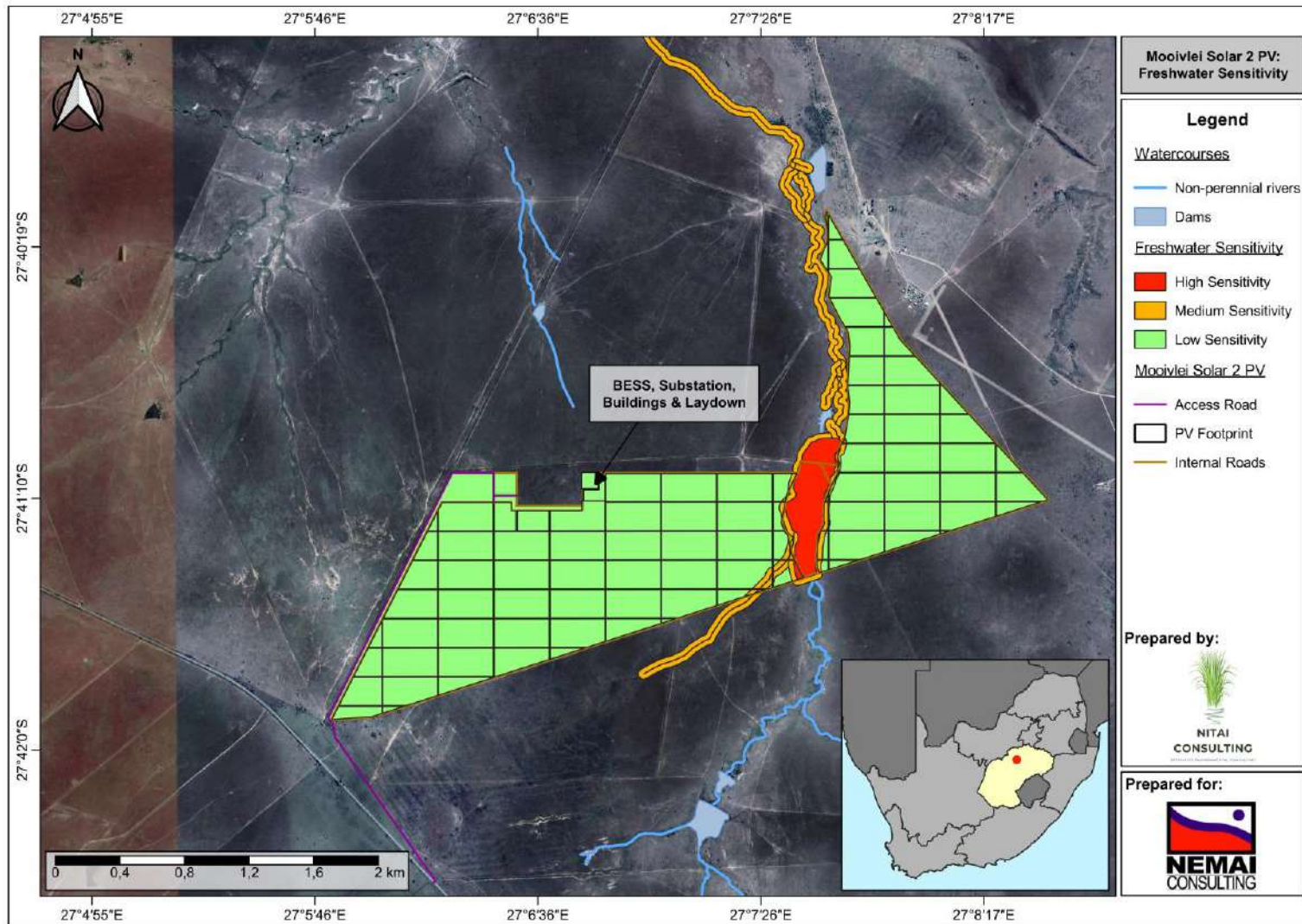


Figure 37: Freshwater Sensitivities associated with the proposed Alternative 1 layout for the Mooivlei Solar 2 PV Facility



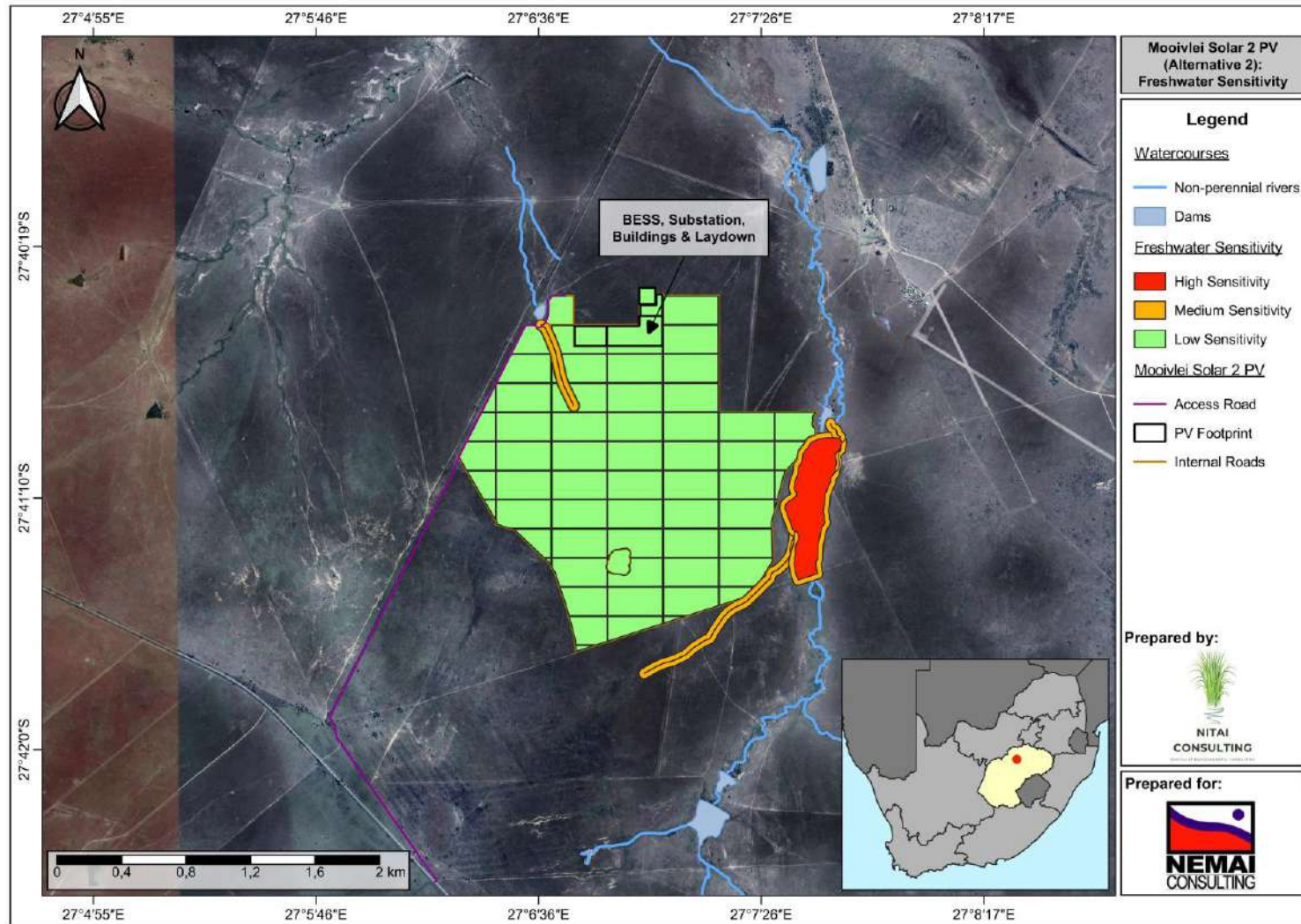


Figure 38: Freshwater Sensitivities associated with the proposed Alternative 2 and Preferred layout for the Mooivlei Solar 2 PV Facility



### **6.4.3 Buffer Zones**

Buffer zones for all watercourses (wetlands, rivers and riparian zone) were determined based on the current condition of these watercourses. The buffer zones determined for the wetland, rivers and riparian zones were based on the Macfarlane and Bredin (2017) guidelines. As such, the minimum buffer zones were determined as 32 m (Figure 39 and Figure 40).

Between the two alternatives for Mooivlei Solar 2 PV Facility, Alternative 1 is encroaching the 32 m buffer zones for the river and CVB wetland. Also, the layout does not only encroach into the buffer zones, but the CVB wetland as well (Figure 39). Alternative 2 has made provision for the 32 m buffer zone around the watercourses and as such does not encroach into the buffer zone as well as the watercourses (Figure 40).

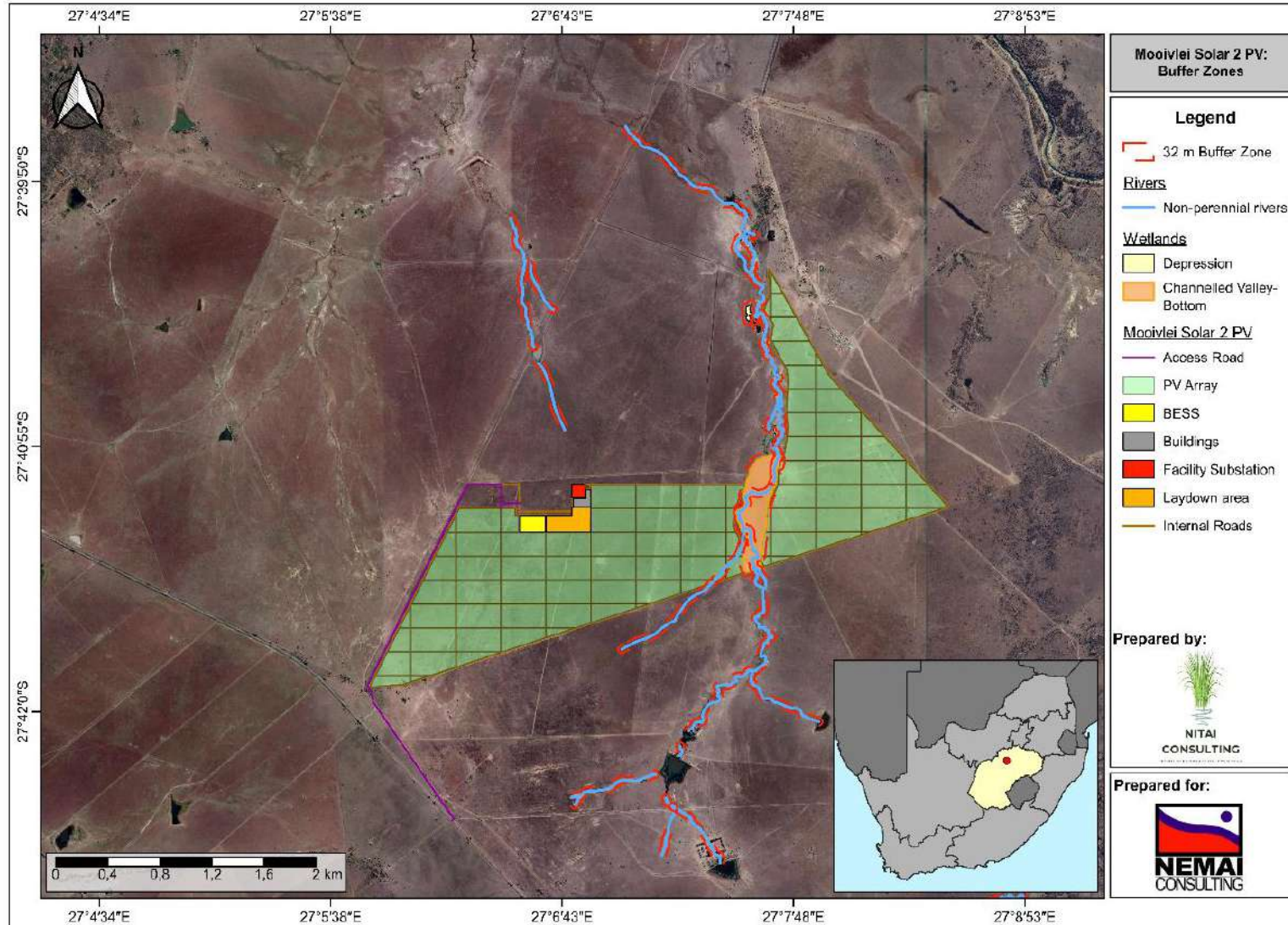


Figure 39: Buffer zones determined for all watercourses associated with the Alternative 1 Layout

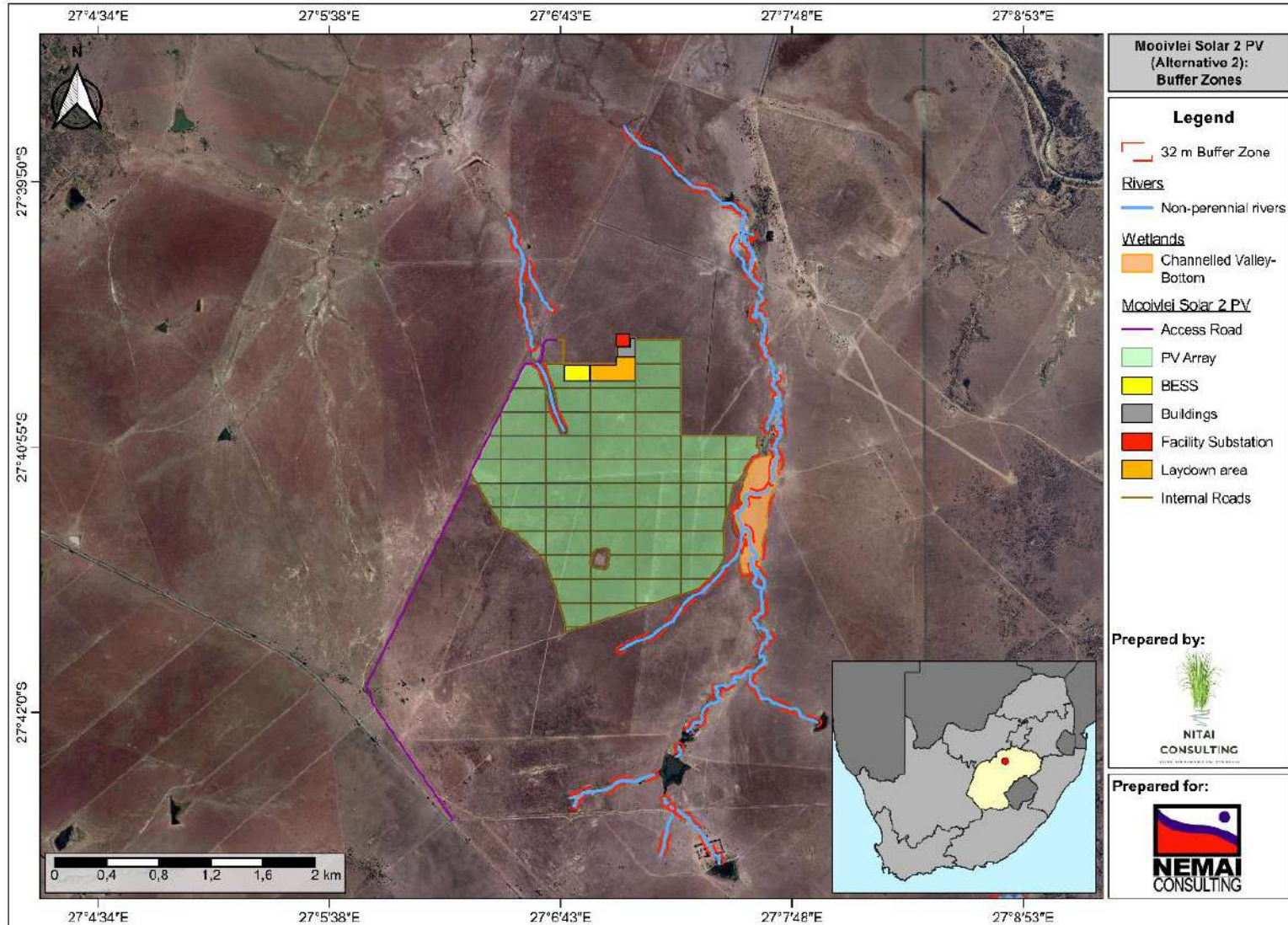


Figure 40: Buffer zones determined for all watercourses associated with the Alternative 2 and Preferred Layout



## 7 RISK-BASED IMPACT ASSESSMENT

### 7.1 Impacts and Mitigation Framework

Since watercourses have been identified in close proximity of the study area that could be potentially significantly affected by the proposed development of the Mooivlei Solar 2 PV Facility, a Risk-based Impact Assessment were conducted.

All impacts are analysed in the section to follow with regard to their nature, probability, duration, extent, magnitude, likelihood and significance.

The following criteria for nature, probability, duration, extent, magnitude and significance were used:

*Table 12: Probability descriptors, definitions and rating scores*

Descriptors	Definitions	Score
<b>Rare/Remote</b>	May occur only in exceptional circumstances.	<b>1</b>
<b>Unlikely</b>	Could occur at some time.	<b>2</b>
<b>Moderate</b>	Should occur at some time.	<b>3</b>
<b>Likely</b>	Will probably occur in most circumstances.	<b>4</b>
<b>Almost certain</b>	Expected to occur in most circumstances.	<b>5</b>

*Table 13: Duration descriptors, definitions and rating scores*

Descriptors	Definitions	Score
<b>Temporary</b>	Impact is only for a short period (0-1 years).	<b>1</b>
<b>Short term</b>	Impact is for a period of 1 – 5 years.	<b>2</b>
<b>Medium</b>	Impact is for a period of 5 – 15 years.	<b>3</b>
<b>Long term</b>	Impact ceases after operational life cycle of the activity either because of natural processes or by human intervention.	<b>4</b>
<b>Permanent</b>	Impact will continue indefinitely.	<b>5</b>



**Table 14: Extent descriptors, definitions and rating scores**

Descriptors	Definitions	Score
<b>Site only</b>	Impact on the extent of the site only.	<b>1</b>
<b>Local</b>	Impact on the immediate surroundings.	<b>2</b>
<b>Regional</b>	Impact on the region but within the province.	<b>3</b>
<b>National</b>	Impact on an interprovincial scale.	<b>4</b>
<b>International</b>	Impact outside South Africa.	<b>5</b>

**Table 15: Magnitude descriptors, definitions and rating scores**

Descriptors	Definitions	Score
<b>Negligible</b>	Ecosystem pattern, process and functioning are not affected, although there is a small negative impact on quality of the ecosystem.	<b>1</b>
<b>Minor</b>	A minor impact on the environment and processes will occur.	<b>2</b>
<b>Low</b>	Natural and socio-economic functions and processes are not affected or minimally affected.	<b>4</b>
<b>Moderate</b>	Valued, important, sensitive or vulnerable systems or communities are negatively affected, but ecosystem pattern, process and functions can continue albeit in a slightly modified way.	<b>6</b>
<b>High</b>	Natural or socio-economic functions or processes could be substantially affected altered to the extent that they could temporarily cease.	<b>8</b>
<b>Very High</b>	Natural or socio-economic functions or processes could be substantially affected altered to the extent that they could permanently cease.	<b>10</b>

The significance of impacts will be calculated through the combination of the above-mentioned criteria using the following formula:

**Significance = (Extent + Duration + Magnitude) x Probability**

Descriptors	Definitions	Score
<b>Low</b>	Perceived impact will not have a noticeable negative impact on the environment. Unlikely to require management intervention.	<b>0 – 19</b>
<b>Low to Moderate</b>	Perceived impact is acceptable, and application of recommended mitigation measures recommended.	<b>20 – 39</b>
<b>Moderate</b>	Perceived impact is likely to have negative impact on the environment, and is likely to influence decision to approve the activity. Implementing recommended mitigation measures are required as a routine monitoring to ensure effectiveness of recommended mitigation measures.	<b>40 – 59</b>
<b>Moderate to High</b>	Perceived impact will have significant impact on the environment and will likely influence the decision-making process. Strict implementation of provided mitigation measures is required. Strict monitoring and high levels of compliance and enforcement in respect of the impact are required.	<b>60 – 79</b>
<b>High</b>	Perceived impact on the environment will be significantly high and likely to be irreversible and therefore will result in a highly likely fatal flaw for the project. Any alternatives for the proposed activity should be considered as the impact will influence the decision-making process.	<b>80 – 100</b>

### 7.1.1 NEMA (2014) Impact Assessment

Table 16 to Table 19 below indicate the impact scores for the potential watercourse impacts surrounding the construction and operational phases of Mooivlei Solar 2 PV Facility. Furthermore, the tables below indicates the impact scores for both alternative options.

**Table 16: Impacts to hydrological function**

<b>Nature:</b> Changes to flood regimes of the watercourse through, for example, flood suppression, unseasonal flooding or the loss of flood attenuation capacity.				
<b>ACTIVITY:</b> Sources include the compaction of soil, vegetation removal, redirecting surface water, changes to the surface water characteristics or through construction of roads.				
	Alternative 1		Alternative 2	
	Without mitigation	With mitigation	Without mitigation	With mitigation
<b>Construction Phase</b>				
<b>Probability</b>	Moderate (3)	Unlikely (2)	Unlikely (2)	Unlikely (2)
<b>Duration</b>	Short term (2)	Short term (2)	Short term (2)	Short term (2)
<b>Extent</b>	Regional (3)	Local (2)	Regional (3)	Local (2)
<b>Magnitude</b>	Low (4)	Low (4)	Low (4)	Minor (2)

<b>Significance</b>	<b>27 (Low to Moderate)</b>	<b>16 (Low)</b>	<b>18 (Low)</b>	<b>12 (Low)</b>
<b>Status (positive or negative)</b>	Negative	Negative	Negative	Negative
<b>Operational Phase</b>				
<b>Probability</b>	Moderate (3)	Unlikely (2)	Minor (1)	Rare (1)
<b>Duration</b>	Medium term (3)	Medium term (3)	Short term (2)	Short term (2)
<b>Extent</b>	Local (2)	Local (2)	Local (2)	Local (2)
<b>Magnitude</b>	Low (4)	Low (4)	Minor (2)	Minor (2)
<b>Significance</b>	<b>27 (Low to Moderate)</b>	<b>18 (Low)</b>	<b>12 (Low)</b>	<b>6 (Low)</b>
<b>Status (positive or negative)</b>	Negative	Negative	Negative	Positive
<b>Reversibility</b>	Low	Low	Low	Low
<b>Irreplaceable loss of resources?</b>	High	Low	Low	Low
<b>Can impacts be mitigated?</b>	Yes		Yes	
<b>Mitigation:</b>				
<ul style="list-style-type: none"> <li>• The entire footprint should avoid the delineated boundaries of watercourses as well as its buffer zones;</li> <li>• The area is still likely prone to erosion around these areas should poor stormwater management be implemented. As such, a comprehensive stormwater management plan is required for the project;</li> <li>• Effective stormwater and erosion management plans should be in place during both the construction and operational phases. This should also be monitored as part of the EMPr;</li> <li>• Appropriate stormwater structures should be in place to control run-off and minimize erosion;</li> <li>• All stormwater runoff from the panels should enter the systems through diffuse channels fitted with flow attention/energy dissipation structures;</li> <li>• Stormwater runoff and runoff from the cleaning of panels would be increased and therefore increases the erosion potential in the surrounding areas;</li> <li>• Panels should be fitted with stormwater gutters to control the runoff in an ecologically sensitive manner to prevent erosion;</li> <li>• With regards to the powerline and road construction, the recommended buffer zones must be strictly adhered to during the construction phase with the exception when activities and structures required to traverse the watercourse. Pylons should be constructed outside the delineated watercourses;</li> <li>• All areas where vegetation was cleared should be re-vegetated in order to limit the erosion potential;</li> <li>• Sedimentation and erosion protection measures (such as sand bags, silt traps and fences) should be installed prior to construction;</li> <li>• Roads crossing low-lying areas/potentially wet areas require permeable paving in order to lower the risk of habitat damage and possible erosion;</li> <li>• Inspect all pylons, road network and influences areas 1 month following the conclusion of the construction activities as well as after the first rainfall event. Routing monitoring should take place for the duration of the project. Should erosion develop, then eroded areas should be immediately addresses through appropriate measures;</li> <li>• All roads traversing delineated low-lying areas should be kept to a minimum to ensure hydrological connectivity;</li> </ul>				

<ul style="list-style-type: none"> <li>• Construction of watercourse crossings (if needed) must take place from existing disturbed areas;</li> <li>• Prevent uncontrolled access of vehicles through the watercourse which can impact the hydrology and alluvial soil structure; and,</li> <li>• All no-go areas should be clearly demarcated prior to commencement of construction activities.</li> </ul>
<p><b>Cumulative impacts:</b> Low to moderate and could possibly include edge effects to remaining natural vegetation as the footprint activities may result in vegetation clearing. This could lead to increase in sedimentation as well as introduction of alien and invasive species.</p>
<p><b>Residual Risks:</b> Expected to be low given that all structures are situated outside the delineated sensitive areas and that stormwater is managed effectively.</p>

**Table 17: Impacts to sediment**

<p><b>Nature:</b> Change in sedimentation patterns, changes in sediment in watercourses and sub-catchment due to the removal of soil.</p>				
<p><b>ACTIVITY:</b> Construction activities and maintenance of solar plant would result in earthworks as well as causing soil and vegetation disturbances. Loss of topsoil, sedimentation in rivers that would cause an increase in turbidity. Other potential impacts include; earthworks, clearing of vegetation would result in bare soil that could be washed into the river, erosion, disturbance of slopes through road works next to watercourses.</p>				
	Alternative 1		Alternative 2	
	Without mitigation	With mitigation	Without mitigation	With mitigation
<b>Construction Phase</b>				
<b>Probability</b>	Likely (4)	Moderate (3)	Unlikely (2)	Unlikely (2)
<b>Duration</b>	Medium term (3)	Short term (2)	Short term (2)	Short term (2)
<b>Extent</b>	Local (2)	Local (2)	Local (2)	Local (2)
<b>Magnitude</b>	Moderate (6)	Low (4)	Low (4)	Minor (2)
<b>Significance</b>	44 (Moderate)	24 (Low to Moderate)	16 (Low)	12 (Low)
<b>Status (positive or negative)</b>	Negative	Negative	Negative	Negative
<b>Operational Phase</b>				
<b>Probability</b>	Moderate (3)	Unlikely (2)	Unlikely (2)	Rare (1)
<b>Duration</b>	Medium term (3)	Short term (2)	Short term (2)	Short term (2)
<b>Extent</b>	Local (2)	Local (2)	Local (2)	Local (2)
<b>Magnitude</b>	Moderate (6)	Low (4)	Low (4)	Minor (2)
<b>Significance</b>	33 (Low to Moderate)	16 (Low)	16 (Low)	6 (Low)
<b>Status (positive or negative)</b>	Negative	Negative	Negative	Positive
<b>Reversibility</b>	Low	Moderate	Low	High
<b>Irreplaceable loss of resources?</b>	High	Low	Low	Low
<b>Can impacts be mitigated?</b>	Yes		Yes	



**Mitigation:**

- Install sediment traps;
- Remove topsoil and keep topsoil stockpiles free of any weeds to keep topsoil viable for rehabilitation;
- All stockpiles should be safeguarded against rain wash;
- Ensure that stockpiles are covered during windy conditions
- Remove only vegetation in areas essential for construction;
- Excess water flow should be managed efficiently to avoid any impacts on rivers;
- Protect all areas susceptible to erosion through installing erosion berms that can prevent gully formation and siltation of watercourses;
- All soil and topsoil removed should not be stockpiled within any watercourse and should take place outside delineated watercourses. All stockpiles should be protected from erosion and stored on flat surfaces;
- Avoid using chemicals for cleaning of solar panels to lower the risk of polluting soils, and in times of flow will pollute surface runoff from contaminated soils;
- Monitor sediment pollution;
- Construction activities should take place in low flow period (as much as possible). This will lower the risk of erosion, sedimentation and polluting downstream water resources;
- All stationary vehicles should be equipped with drip trays;
- Avoid parking of vehicles close to any watercourses;
- No dumping of waste or any other materials near delineated and buffered areas; and
- All areas affected by construction activities should be rehabilitated upon completion of the construction phase. Areas where vegetation was removed, should be reseeded with indigenous grasses as per recommendations from Terrestrial Report.

**Cumulative impacts:** Low to moderate and could possibly include edge effects to remaining natural vegetation as the footprint activities may result in vegetation clearing. This could lead to increase in sedimentation as well as introduction of alien and invasive species.

**Residual Risks:** Expected to be low given that all structures are situated outside the delineated sensitive areas and that stormwater is managed effectively.

**Table 18: Introduction and spread of alien and invasive species**

<b>Nature:</b> Introduction and spread of alien and invasive species.				
<b>ACTIVITY:</b> The removal and movement of soil and vegetation could result in opportunistic invasions after such disturbances as well as the introduction of seed in building materials and on vehicles. In addition, invasions of alien vegetation species can have an impact on hydrology through reducing the water quantity entering a watercourse and it can outcompete natural vegetation and therefore decrease natural biodiversity.				
	Alternative 1		Alternative 2	
	Without mitigation	With mitigation	Without mitigation	With mitigation
<b>Construction Phase</b>				
<b>Probability</b>	Unlikely (2)	Rare (1)	Unlikely (2)	Rare (2)
<b>Duration</b>	Short term (2)	Short term (2)	Short term (3)	Short term (2)
<b>Extent</b>	Local (2)	Local (2)	Local (2)	Local (2)
<b>Magnitude</b>	Low (4)	Low (4)	Low (4)	Low (4)
<b>Significance</b>	<b>16 (Low)</b>	<b>8 (Low)</b>	<b>16 (Low)</b>	<b>8 (Low)</b>

<b>Status (positive or negative)</b>	Negative	Negative	Negative	Negative
<b>Operational Phase</b>				
<b>Probability</b>	Rare (1)	Rare (1)	Rare (1)	Rare (1)
<b>Duration</b>	Short term (2)	Short term (2)	Short term (2)	Short term (2)
<b>Extent</b>	Local (2)	Site-only (1)	Local (2)	Site-only (1)
<b>Magnitude</b>	Low (4)	Minor (2)	Low (4)	Minor (2)
<b>Significance</b>	<b>8 (Low)</b>	<b>5 (Low)</b>	<b>8 (Low)</b>	<b>5 (Low)</b>
<b>Status (positive or negative)</b>	Negative	Negative	Negative	Negative
<b>Reversibility</b>	Low	Moderate	Moderate	Moderate
<b>Irreplaceable loss of resources?</b>	Low	Low	Low	Low
<b>Can impacts be mitigated?</b>	Yes		Yes	
<p><b>Mitigation:</b></p> <ul style="list-style-type: none"> <li>• Monitor for early detection, to find species when they first appear on site. This should be as per the frequency specified in the management plan and should be conducted by an experienced person. Early detection should provide a list of species and locations where they have been detected. Summer (vegetation maximum growth period) is usually the most appropriate time, but monitoring can be adaptable, depending on local conditions – this must be specified in the management plan;</li> <li>• Monitor for the effect of management actions on target species, which provides information on the effectiveness of management actions. Such monitoring depends on the management actions taking place. It should take place after each management action; and,</li> <li>• Monitor for the effect of management actions on non-target species and habitats.</li> </ul>				
<p><b>Cumulative impacts:</b> Limited alien and Invasive plant species were observed on site, cumulative impacts can be Low to Moderate. As such, continuous monitoring should be implemented during the different phases of development and rehabilitation as well as a period after rehabilitation is completed.</p>				
<p><b>Residual Risks:</b> Expected to be limited given that an Alien and Invasive Plant Management Plan forms part of the operational processes of the PV facility.</p>				

**Table 19: Activities causing pollution**

<b>Nature:</b> Surface water, groundwater and sediment pollution.				
<b>ACTIVITY:</b> Accidental spillages of wet concrete, chemical hazardous substances, oil and diesel spillages may result in surface water, groundwater and sediment pollution.				
	<b>Alternative 1</b>		<b>Alternative 2</b>	
	<b>Without mitigation</b>	<b>With mitigation</b>	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Construction Phase</b>				
<b>Probability</b>	Likely (4)	Unlikely (2)	Unlikely (2)	Unlikely (2)
<b>Duration</b>	Medium term (3)	Medium term (3)	Medium term (3)	Short term (2)
<b>Extent</b>	Local (2)	Local (2)	Local (2)	Local (2)
<b>Magnitude</b>	Moderate (6)	Moderate (6)	Low (4)	Low (4)
<b>Significance</b>	<b>44 (Moderate)</b>	<b>22 (Low to Moderate)</b>	<b>18 (Low)</b>	<b>16 (Low)</b>
<b>Status (positive or negative)</b>	Negative	Negative	Negative	Negative
<b>Operational Phase</b>				
<b>Probability</b>	Likely (4)	Unlikely (2)	Unlikely (2)	Unlikely (2)
<b>Duration</b>	Short term (2)	Short term (2)	Short term (2)	Short term (2)
<b>Extent</b>	Local (2)	Local (2)	Local (2)	Local (2)
<b>Magnitude</b>	Moderate (4)	Low (4)	Low (4)	Minor (2)
<b>Significance</b>	<b>40 (Moderate)</b>	<b>16 (Low)</b>	<b>16 (Low)</b>	<b>12 (Low)</b>
<b>Status (positive or negative)</b>	Negative	Negative	Negative	Negative
<b>Reversibility</b>	Low	Moderate	Moderate	Moderate
<b>Irreplaceable loss of resources?</b>	High	Low	Moderate	Low
<b>Can impacts be mitigated?</b>	Yes		Yes	
<b>Mitigation:</b>				
<ul style="list-style-type: none"> <li>• The development footprint should remain outside the delineated rivers, riparian and buffer zones;</li> <li>• Concrete mixing should be done outside the buffer zones and should be done on an impermeable surface;</li> <li>• All stationary vehicles should be equipped with drip trays;</li> <li>• No servicing of vehicles or construction equipment should take place near delineated or buffer areas and should be done on an impermeable surface area;</li> <li>• No washing of construction equipment is allowed in any watercourse;</li> <li>• All hazardous substances should be safely stored on an impermeable surface within the construction site camp;</li> <li>• No ablution facilities should be located within 50 m of watercourses and should be outside the 1:100 year flood line;</li> <li>• Construction camp, storage of construction equipment and materials, and chemicals should be located outside the 1: 100 year flood line;</li> </ul>				

- No dumping of waste near or within delineated watercourses and should be adequately stored and removed from site by waste facility;
- All waste and refuse should be removed from site and disposed in adequate storage containers before being disposed at a registered landfill site;
- All accidental spillages should be rehabilitated immediately and contaminated soil should be adequately disposed off;
- No vehicle or construction machinery are allowed within the watercourse; and,
- Only use clean water in the washing of the solar panels.

**Cumulative impacts:** Impacted water quality will not only affect local water quality but regional water quality as well. This is considered as a significant cumulative impact.

**Residual Risks:** Since pollution can be controlled and to a large extent be prevented, the impact of spillages will have a significant residual impact on local watercourses and as such should be considered a significant residual risk.



## 8 CONCLUSION AND RECOMMENDATIONS

The proposed Mooivlei Solar 2 PV facility is situated in the Moqhaka Local Municipality, near Kroonstad, Free State Province, South Africa. During site visits to the study area, several watercourses were identified such as rivers (non-perennial), four wetlands (three Depressions and one Channelled Valley-Bottom), and a few dams. From the Alternative 1 layout, the PV site encroaches into one of the channels of a non-perennial river while also encroaching into a small section of the Channelled Valley-Bottom. In addition, the PV site also encroaches into the 32 m buffer zone of the large non-perennial river on several occasions. These findings were verified based on wetland soil (red-yellow mottling) characteristics and vegetation species.

The area, according to spatial data, has been mostly characterised as Bonheim, Arcadia, and Valsrivier soils. Soil augered samples indicated that the Depression was Arcadia soils whereas areas around the river and the Channelled Valley-Bottom were comprised of Valsrivier soils and indicated in some areas strong clay content and soil wetness indicators (mottling). Vegetation species observed on site were indicative of wetness, specifically near the river and the wetlands.

Due to these freshwater sensitivities and the 32 m buffer zone around these features, the proponent has revised the layout for Mooivlei Solar 2 PV facility. Based on this revised layout, Alternative 2 has accommodated the presence of freshwater features and its subsequent 32 m buffer zone. Therefore, it is of the opinion that the proposed works will have a low impact on all associated freshwater features given that above-mentioned mitigation measures are followed and best practise pollution control. Importantly, based on the current condition of the surrounding habitat of the proposed Mooivlei Solar 2 PV facility and the mitigations provided above, the surrounding areas can be successfully rehabilitated back to its current condition.

The DFFE Screening Tool has identified the area as a **Very High** sensitivity from an Aquatic Biodiversity Theme perspective. This was confirmed (if Alternative 1 layout is used) by the specialist. Importantly, if the Alternative 2 (Preferred layout) layout is used, the site sensitivity for the proposed Mooivlei Solar 2 PV facility is **Low**. **As such, the specialist recommends that the development of the PV facility with the use of Alternative 2 as layout may proceed with low impacts on the freshwater features.**

## 9 REFERENCES

- Collins, N.B. 2016. Free State Province Biodiversity Plan: Technical Report v1.0. Free State Department of Economic, Small Business Development, Tourism and Environmental Affairs. Internal Report.
- Department of Water Affairs and Forestry (DWAf). 2004a. *Upper Vaal Water Management Area: Internal Strategic Perspective*. Prepared by PDNA, WRP Consulting Engineers (Pty) Ltd, WMB and Kwezi-V3 on behalf of the Directorate: National Water Resource Planning. DWAf Report No. P WMA 08/000/00/0304.
- Department of Water Affairs and Forestry (DWAf). 2004b. *Middle Vaal Water Management Area: Internal Strategic Perspective*. Prepared by PDNA, WRP Consulting Engineers (Pty) Ltd, WMB and Kwezi-V3 on behalf of the Directorate: National Water Resource Planning. DWAf Report No. P WMA 09/000/00/0304.
- Department of Water Affairs and Forestry (DWAf). 2002. *Middle Vaal Management Area: Water Resource Situation Assessment – Main Report – Volume 1 of 3*. Prepared by Stewart Scott Consulting Engineers on behalf of the Directorate: National Water Resources Planning. DWAf Report No. P09000/00/0101.
- Department of Water Affairs and Forestry (DWAf). 2005. A practical field procedure for identification and delineation of wetlands and riparian areas.
- Department of Water Affairs and Forestry (DWAf). 2007. Manual for the assessment of a Wetland Index of Habitat Integrity for South African floodplain and channelled valley bottom wetland types by M. Rountree (ed); C.P. Todd, C.J. Kleynhans, A.L. Batchelor, M.D. Louw, D. Kotze, D. Walters, S. Schroeder, P. Illgner, M. Uys & G.C. Marneweck. Report No. N/0000/00/WEI/0407. Resource Quality Services, Department of Water Affairs and Forestry, Pretoria, South Africa.
- Department of Water Affairs and Forestry (DWAf). 2008. Updated Manual for the Identification and Delineation of Wetlands and Riparian Areas, prepared by M. Rountree, A.L. Batchelor, J. MacKenzie & D. Hoare. Stream Flow Reduction Activities, Department of Water Affairs and Forestry, Pretoria, South Africa.
- Department of Water Affairs (DWA), South Africa, 2013. Directorate Water Resource Classification. Classification of significant water resources in the Crocodile (West), Marico, Mokolo and Matlabas Catchment: Management Classes Report. Report No. RDM/WMA1, 3/00/CON/CLA/0612.
- Department of Water and Sanitation (DWS). 2014. A Desktop Assessment of the Present Ecological State, Ecological Importance and Ecological Sensitivity per Sub Quaternary Reaches for Secondary Catchments in South Africa. Compiled by RQIS-RDM: <https://www.dwa.gov.za/iwqs/rhp/eco/peseismodel.aspx> accessed on 27 January 2023.

- Department of Water and Sanitation (DWS). 2016. Limpopo Water Management Area North Reconciliation Strategy: Draft Reconciliation Strategy. Prepared by AECOM SA (Pty) Ltd in association with Hydrosol Consulting, Jones & Wagener and VSA Rebotile Metsi Consulting on behalf of DWS Directorate: National Water Resources Planning. Report No. P WMA 01/000/00/02914/11A.
- Le Maitre, D., Seyler, H., Holland, M., Smith-Adao, L., Maherry, A., Nel, J. & Witthüser, K. 2018. Identification, delineation and importance of the Strategic Water Source Areas of South Africa, Lesotho and Swaziland for surface water and groundwater. Report No. TT 743/1/18, Water Research Commission, Pretoria.
- Kleynhans, C.J., Thirion, C. & Moolman, J. 2005. A Level I River Ecoregion classification System for South Africa, Lesotho and Swaziland. Report No. N/0000/00/REQ0104. Resource Quality Services, Department of Water Affairs and Forestry, Pretoria, South Africa.
- Kleynhans C.J., MacKenzie J. and Louw M.D. (2007). Module F: Riparian Vegetation Response Assessment Index in River Classification: Manual for EcoStatus Determination (version 2). Joint Water Research Commission and Department of Water Affairs and Forrestry report. WRC Report No. TT 333/08
- Kotze D C, (1999): A system for supporting wetland management decisions. Ph.D. thesis. School of Applied Environmental Sciences, University of Natal, Pietermaritzburg.
- Machete, M. & Shadung, J.M. 2019. Detection of selected agricultural pesticides in river and tap water in Letsitele, Lomati and Vals-Renoster catchments, South Africa. *Water SA*, 45(4).
- Macfarlane, D.M. & Bredin, I. 2017. Buffer Zone Guidelines for Rivers, Wetlands and Estuaries. Part 1: Technical Manual. WRC Report No. TT 715-1-17.
- Macfarlane, D.M., Ollis, D.J. & Kotze, D.C. 2020. WET-Health (Version 2.0). A refined suite of tools for assessing the present ecological state of wetland Ecosystems: Technical Guide. WRC Report No. TT 820/20.
- Mallick, J., Khan, R.A., Ahmed, M., Alqadhi, S.D., Alsubih, M., Falqi, I. & Hasan, M.A. 2019. Modeling Groundwater Potential Zone in a Semi-Arid Region of Aseer Using Fuzzy-AHP and Geoinformation Techniques. *Water*, 11(2656), 1 - 29.
- Mucina, I. & Rutherford, M.C. 2006. The vegetation of South Africa, Lesotho and Swaziland. South African National Biodiversity Institute, Pretoria.
- Mucina, I. & Rutherford, M.C. 2018. The vegetation of South Africa, Lesotho and Swaziland. South African National Biodiversity Institute, Pretoria.
- Naicker, U., Henning, D. & Davis, J. 2023. Proposed 240 MW Onderstepoort Solar 1 Photovoltaic Project North West of Rustenburg, North West Province: Draft Scoping Report. Prepared by Nemai Consulting (PTY) Ltd.

- Nel, J.L., Colvin, C., Le Maitre, D., Smith, J. & Haines, I. 2013. South Africa's Strategic Water Source Areas (SWSA's). Report for WWF-South Africa. March 2013. Report No. CSIT/NRE/ECOS/ER/2013/0031/A. CSIR, Stellenbosch, South Africa.
- Nel, J.L., Murray, K.M., Maherry, A.M., Petersen, C.P., Roux, D.J., Driver, A., Hill, L., van Deventer, H., Funke, N., Swartz, E.R., Smith-Adao, L.B., Mbona, N., Downsborough, L. & Nienaber, S. 2011. Technical Report for the National Freshwater Ecosystem Priority Areas project. WRC Report No. K5/1801.
- Nel, J., Colvin, C., Le Maitre, D., Smith, J. & Haines, I. 2013. South Africa's Strategic Water Source Areas. CSIR/NRE/ECOS/ER/2013/0031/A.
- Ollis, D.J., Snaddon, C.D., Job, N.M. & Mbona, N. 2013. Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems. *SANBI Biodiversity Series 22*. South African National Biodiversity Institute, Pretoria.
- Rountree, M.W., Malan, H.L. & Weston, B.C. 2013. Manual for the Rapid Ecological Reserve Determination of Inland Wetlands (Version 2.0). WRC Report No. 1788/1/12.
- Thirion, C. & Jafta, N. 2019. River Ecstatus Monitoring Programme State of Rivers Report 2017 - 2018. Report No. N/000/00/REMP/2019.
- van Deventer, H., Smith-Adao, L., Peterson, C., Mbona, N., Showno, A. & Nel, J.L. 2018. Review of available data for a South African Inventory of Inland Aquatic Ecosystems (SAIIAE).
- van Deventer, H., Smith-Adao, L., Peterson, C., Mbona, N., Showno, A. & Nel, J.L. 2019. Review of available data for a South African Inventory of Inland Aquatic Ecosystems (SAIIAE): National Wetland 5 Map.
- van Der Waals, J.H., Grundling, A.T. & Paterson, D.G. 2019. Developing wetland distribution and transfer functions from land type data as a basis for the critical evaluation of wetland delineation guidelines by inclusion of soil water flow dynamics in catchment areas: Volume 3. *WRC Report No: 2461/3/18*.
- van Tol, J.J. & Le Roux, P.A. 2019. Hydopedological grouping of South African soil forms. *South African Journal of Plant and Soil*, 1 - 3.



## APPENDIX 1: SPECIALIST DETAILS, QUALIFICATIONS AND EXPERTISE

### 1 PERSONAL PARTICULARS

<b>Profession:</b>	Aquatic and Wetland Specialist
<b>Date of Birth:</b>	20 December 1993
<b>Name of Firm:</b>	Nitai Consulting
<b>Name of Staff:</b>	Divan van Rooyen
<b>Nationality:</b>	RSA
<b>Membership of Professional Societies</b>	SACNASP (Can. Sci. Nat. 151272), IAIAsa (7063)

### 2 EDUCATION:

- Ph.D. Environmental Science (Aquatic Ecosystem Health), NWU, South Africa, 2022
- M. Sc. Environmental Science (Ecological Remediation and Sustainable Development), NWU, South Africa, 2017
- B.Sc. Hons Environmental Science (Ecological Remediation and Sustainable Development), NWU, South Africa, 2015
- B.Sc. Tourism, Geography and Zoology, NWU, South Africa, 2014

#### Publications:

- van Rooyen, D., Gerber, R., Smit, N.J. & Wepener, V. 2022. An assessment of water and sediment quality of aquatic ecosystems within South Africa's largest floodplain. *African Journal of Aquatic Sciences*, 474 – 488.
- Schaeffner, B.C. van Rooyen, D., Gerber, R., Scholz, T. & Smit, N.J. 2020. *Wenyonia gracilis* sp. n. (Cestoda: Caryophyllidea) from *Synodontis zambezensis* (Siluriformes: Mochokidae): the first native caryophyllidean tapeworm from southern Africa. *Folia Parasitologica*, 67: 035.

### 3 EMPLOYMENT RECORD:

- 2022 – Present Aquatic and Wetland Specialist, Nitai Consulting

Conduct Wetland Delineations and Impact Assessments;

Conduct Aquatic Ecological Assessments;

SASS5 Assessments;

Aquatic and Wetland Monitoring Programs; and,

GIS Mapping

- March 2022 – November 2022 Environmental Consultant and Aquatic Specialist, Enviroworks  
Environmental Control Officer;  
Water Use Licensing;  
Environmental Auditing;  
Report Writing.
- January 2022 – February 2022 Environmental Intern, ABS-Africa (PTY) Ltd  
Environmental Auditing;  
Groundwater quality monitoring;  
Data interpretation and evaluation; and  
Report writing
- 2017 – 2021 Research and Field Assistant, North West University (NWU-Water Research Group)  
Assisting UNISA and NWU Zoology students with module practical's;  
Supervisor to 3<sup>rd</sup> year Zoology students on a Water Quality Project;  
Fish specialist for a fish translocation study at Lethabo Power Station (ESKOM);  
Junior Aquatic Specialist for aquatic biomonitoring at Khumba Iron Ore Mining (Joint Amanzi Aquatics and NWU-WRG);  
Junior Aquatic Specialist for biomonitoring at a WWTW (Ecosphere & NWU-WRG); and  
Assisted students with aquatic biomonitoring assessments (FRAI, MIRAI, FROC, Fish identification and SASS under the supervision of Dr. Wynand Malherbe).

## 4 SELECTED CONSULTANCIES

### 4.1 **Fish Translocation study (NWU – WRG), Lethabo Power Station (ESKOM)**

2016 - 2021 – Fish Specialist, Fish Translocation at ESKOM, South Africa, Sampling of fish species in ESKOM Cooling Towers and translocating them to the NWU.

### 4.2 **Aquatic Biomonitoring at Khumba Iron Ore Mining (Joint with Amanzi Aquatics and NWU – WRG)**

2019, Junior Aquatic Specialist, Aquatic Biomonitoring at Khumba Iron Ore Mining (Joint Amanzi Aquatics and NWU – WRG), South Africa, Undertake aquatic biomonitoring in nearby rivers surrounding Khumba Iron Ore to assess fish community structures.

### 4.3 **Aquatic Biomonitoring at a WWTW near Greylingstad (Joint with Ecosphere and NWU – WRG)**

2022, Junior Aquatic Specialist, Aquatic biomonitoring (SASS5, water and sediment quality and fish community structure), South Africa, Undertake aquatic biomonitoring in nearby rivers surrounding Khumba Iron Ore to assess fish community structures.

### 4.4 **Kroonstad Solar PV Facilities**

2022, Aquatic and Wetland Specialist, Development of three Solar PV facilities near Kroonstad, Free State Province, South Africa, Assess and map all wetlands associated with the three solar PV facilities as well as perform aquatic biomonitoring of the Vals River.

### 4.5 **Kroonstad South Solar PV Facilities**

2022, Aquatic and Wetland Specialist, Development of five Solar PV facilities near Kroonstad, Free State Province, South Africa, Assess and map all wetlands associated with the five solar PV facilities as well as perform aquatic biomonitoring of the Blomspruit.

### 4.6 **Proposed Nketoana Regional Bulk Water Scheme Project**

2022, Aquatic and Wetland Specialist, Nketoana Local Municipality is experiencing severe water shortages in its towns Reitz/Petsana/ Petrus Steyn/ Mamafubedu/ Arlington/ Leratswana and Lindley. Solutions to the water shortages are the proposed Nketoana Regional Bulk Water Scheme Pipeline, South Africa, Perform aquatic biomonitoring and assessing all wetlands within a 500m radius of the bulk water scheme project.

#### **4.7 Rustenburg Solar PV Facilities**

2022, Aquatic and Wetland Specialist, Development of three Solar PV facilities near Rustenburg, North West Province, South Africa, Assess and map all wetlands associated with the three solar PV facilities as well as perform aquatic biomonitoring of the Elands River.

#### **4.8 Grootvlei Solar PV Facility**

2022, Aquatic and Wetland Specialist, Development of three Solar PV facilities near Carletonville, North West Province, South Africa, Assess and map all wetlands associated with the one solar PV facility.

#### **4.9 400kV Transmission and 132kV distribution power lines for the Apollo-Lepini-Mesong Project**

2023, Aquatic and Wetland Specialist, Proposed development of a 400kV transmission and 132kV power lines for the Apollo-Lepini-Mesong Project, Gauteng Province, South Africa, Undertake and Aquatic and Wetland Impact Assessment along the proposed routes for the 400kV and 132kV power lines.

#### **4.10 CCUS 3D Seismic Survey & Drilling**

2023, Wetland Specialist. Proposed 3D Seismic Survey within the Leandra area, Mpumalanga Province, South Africa, Assess and map all wetlands within the footprint of the survey area.

#### **4.11 CCUS 3D Seismic Survey & Drilling**

2023, Wetland Specialist, Proposed CCUS Injection within the Leandra area, Mpumalanga Province, South Africa, Assess and map all wetlands within the footprint of the survey area.

#### **4.12 Paulputs 400 kV Strengthening (Transmission Line Loop in Loop Out) Project**

2022, Aquatic and Wetland Specialist, Proposed Paulputs 400kv Strengthening Project (Transmission Line Loop In Loop Out From Aries – Kokerboom Transmission Line), South Africa, Assess and map all wetlands associated with the power line as well as aquatic biomonitoring.



#### **4.13 Seelo Solar PV Facilities**

2022, Aquatic and Wetland Specialist, Development of three Solar PV facilities near Carletonville, North West Province, South Africa, Assess and map all wetlands associated with the three solar PV facilities as well as perform aquatic biomonitoring of the Mooirivierloop.

#### **4.14 Arnot-Kendal power line re-stringing**

2023, Wetland Specialist, Proposed Eskom Arnot-Kendal power line re-stringing, Mpumalanga Province, South Africa, Conduct a Risk Matrix for an General Authorisation.

## **5 LANGUAGES:**

English - excellent speaking, reading, and writing

Afrikaans – excellent speaking, reading and writing

## APPENDIX 2: REVIEWERS DETAILS, QUALIFICATIONS AND EXPERTISE (ELZET HUMAN)

### 1. PERSONAL PARTICULARS

<b>Profession:</b>	Biodiversity Specialist
<b>Date of Birth:</b>	13 March 1987
<b>Name of Firm:</b>	Nitai Consulting
<b>Name of Staff:</b>	Elzet Human
<b>Nationality:</b>	RSA
<b>Membership of Professional Societies</b>	SACNASP (Pr. Sci. Nat. 147031)

### 2. EDUCATION:

- M-Tech Nature Conservation, (Plant DNA Barcoding and phylogenetics), TUT, South Africa, 2021
- B-Tech Nature Conservation, (Resource Management, Vegetation ecology and rehabilitation) TUT, South Africa, 2011
- N. Dip Nature Conservation, TUT, South Africa, 2008

### 3. EMPLOYMENT RECORD:

- 2022 – Present Biodiversity Specialist, Nitai Consulting  
Conduct Biodiversity Impact Assessments.  
Conduct Plant Ecological Assessments.  
Conduct Animal Ecological Assessments  
Biodiversity monitoring programs; and,  
GIS Mapping
- 2013 – 2022 Lecturer: Nature Management, Centurion academy  
Lectured various subjects for undergraduate students in Nature Management:

Botany and Vegetation Ecology, Zoology, Animal Health, Conservation Development, Ecology, Game Ranch Management, Biostatistics, Research Methodology, Genetics, Soil Science

- 2009 – 2013 HOD Rangers Department, Zebula Gold Estate and Spa  
Ecological Monitoring, Reserve Maintenance, Animal Husbandry, Neonatal care of Endangered carnivore species, Zoological display, and permit compliance
- 2008 – Conservation Student, Ann van Dyk Cheetah Research Centre  
Neonatal Care of Carnivore species,  
Veterinary assistance work – vaccine, diets, Endo scoping, pregnancy tests, health monitoring, quarantine care of species, emergency c-sections, bleeding procedures on vultures  
Enclosure Maintenance  
Tracking wild cheetahs  
Rewilding cheetahs  
Anatolian Shepard project assistance

## 4. SELECTED CONSULTANCIES

### 4.1 **Ecological assessment for Victorious Game farm, Visgat, Ellisras, Limpopo**

2018, Ecologist, Ecological condition assessment and game carrying capacity for game farm. Habitat evaluation and rehabilitation program for problem areas

### 4.2 **Elephant impact study on Mabula Game Reserve, Bela-Bela, Limpopo,**

2019, Ecologist, Ecological impact study on Private Nature reserve to see extent of elephant utilisation and impact. Woody species analysis – structure classification and net primary production. Elephant movement patterns and carrying capacity. Identification of vulnerable habitats and management program.

### 4.3 **Faan Meintjies Municipal Nature Reserve, Matlosana, North West**

2018-2022, Ecologist, Habitat assessments, game carrying capacities, ecological condition assessments, game counts and game recommendations, ecological rehabilitation

programs, white rhino monitoring, anti-poaching programs, Environmental Education programs.

#### **4.4 Kroonstad Solar PV Facilities**

2022, Biodiversity Specialist. Development of three Solar PV facilities near Kroonstad, Free State Province, South Africa, Assess and map all wetlands associated with the three solar PV facilities as well as perform aquatic biomonitoring of the Vals River.

#### **4.5 Kroonstad South Solar PV Facilities**

2022, Biodiversity Specialist. Development of five Solar PV facilities near Kroonstad, Free State Province, South Africa, Assess and map all wetlands associated with the five solar PV facilities as well as perform aquatic biomonitoring of the Blomspruit.

#### **4.6 Proposed Nketoana Regional Bulk Water Scheme Project**

2023, Biodiversity Specialist. Nketoana Local Municipality is experiencing severe water shortages in its towns Reitz/Petsana/ Petrus Steyn/ Mamafubedu/ Arlington/ Leratswana and Lindley. Solutions to the water shortages are the proposed Nketoana Regional Bulk Water Scheme Pipeline, South Africa, Assess and map all biodiversity, plant and animal features associated within the footprint of the bulk water scheme project.

#### **4.7 Rustenburg Solar PV Facilities**

2023, Biodiversity Specialist. Development of three Solar PV facilities near Rustenburg, North West Province, South Africa, Assess and map all biodiversity, plant and animal features associated with the three solar PV facilities.

#### **4.8 Grootvlei Solar PV Facility**

2023, Biodiversity Specialist. Development of three Solar PV facilities near Carletonville, North West Province, South Africa, Assess and map all biodiversity, plant and animal features associated with the one solar PV facility.

#### **4.9 400kV Transmission and 132kV distribution power lines for the Apollo-Lepini-Mesong Project**

2023, Biodiversity Specialist. Proposed development of a 400kV transmission and 132kV power lines for the Apollo-Lepini-Mesong Project, Gauteng Province, South Africa, undertake assessments and map all biodiversity, plant, and animal features along the proposed routes for the 400kV and 132kV power lines.



#### **4.10 CCUS 3D Seismic Survey & Drilling**

2023, Biodiversity Specialist. Proposed 3D Seismic Survey within the Leandra area, Mpumalanga Province, South Africa Assess and map all biodiversity, plant and animal features within the footprint of the survey area.

#### **4.11 Paulputs 400 kV Strengthening (Transmission Line Loop in Loop Out) Project**

2023, Biodiversity Specialist. Proposed Paulputs 400kv Strengthening Project (Transmission Line Loop In Loop Out From Aries – Kokerboom Transmission Line), South Africa, Assess and map all biodiversity, plant and animal features within the power line footprint as well as perform biodiversity monitoring.

#### **4.12 Seelo Solar PV Facilities**

2023, Biodiversity Specialist. Development of three Solar PV facilities near Carletonville, North West Province, South Africa, Assess and map all biodiversity, plant, and animal features within the three solar PV facilities as well as perform biodiversity monitoring.

## **5 LANGUAGES:**

English - excellent speaking, reading, and writing

Afrikaans – excellent speaking, reading and writing

## APPENDIX 2: REVIEWERS DETAILS, QUALIFICATIONS AND EXPERTISE (ANTOINETTE BOOTSMA)

### 1. PROFESSIONAL AFFILIATIONS

- Professional Natural Scientist (SACNASP) # 400222-09 Botany and Ecology
- South African Wetland Society # NA6RY2FP
- Grassland Society of South Africa

### 2. QUALIFICATIONS

- **M.SC** (Environmental Science), University of South Africa, 2017. *Awarded with distinction.* Project Title: Natural mechanisms of erosion prevention and stabilization in a Marakele peatland; implications for conservation management.

### 3. PUBLICATIONS

- A.A. Boostma, S. Elshehawi, A.P. Grootjans, P.L Grundling, S. Khosa, M. Butler, L. Brown, P. Schot. 2019. Anthropogenic disturbances of natural ecohydrological processes in the Matlabas mountain mire, South Africa. South African Journal of Science Volume 115| Number 5/6, May/June 2019, P1 to 8.

### 4. EMPLOYMENT HISTORY

- Director at Limosella Consulting (Pty) Ltd - 2009 – ongoing
- Senior Wetland Specialist at Strategic Environmental Focus – 2007 to 2009
- Technical Assistant at the Conservation Ecology Research Unit, University of Pretoria, Richards Bay field station, 2005 to 2007.

## 5. SUMMARY OF KEY SKILLS

- Management of projects in terms of specialist input, including quotations, planning, technical review, submission of reports and invoicing;
- Fine scale wetland delineations and functional assessments;
- Strategic wetland assessments and open space management and planning;
- General Rehabilitation, Monitoring and Mitigation assessments;
- Wetland offset strategies;
- Hydropedological investigations; and
- Implementation of wetland assessment tools including the DWS (2016) Risk Assessment, Present Ecological Status (PES) Macfarlane et al, (2020), Ecological Importance and Sensitivity (EIS) (DWAF, 1999), Recommended Ecological Category (REC) Rountree et al (2013), Riparian Vegetation Response Assessment Index (VEGRAI) (Kleynhans et al, 2007) and QHI (Quick Habitat Integrity).

## 6. SHORT SUMMARY OF EXPERIENCE

- Numerous external peer reviews as part of mentorship programs for companies including Galago Environmental Consultants, Lidwala Consulting Engineers, Bokamoso Environmental Consultants, Gibb, 2009 – ongoing;
- Wetland specialist input into the Kloof Mine wetland sediment interim management, remediation and rehabilitation plan, 2022;
- Wetland Assessments for the upgrade of 7 culverts and bridges in Vereeniging, Gauteng, July 2021
- Input into the Environmental Management Plan for repair to 90 bridges in the City of Johannesburg, 2020;
- Wetland specialist input into the City of Tshwane Open Space Framework, 2019;
- Wetland specialist input into the North West Environmental Outlook, 2018;
- Wetland specialist input into the Gauteng Environmental Outlook, 2017;
- Wetland specialist input into the Open Space Management Framework for Kyalami and Ruimsig, City of Johannesburg, 2016;
- Kangra Maquasa East and Maquasa West and Nooitgesien Mine, Mpumalanga Province: Rehabilitation and Monitoring Assessment. June 2018; and
- Mbuyelo Coal Welstand Reserve Amendment: Wetland assessment. June 2017.

## APPENDIX 3: SIGNED DECLARATION INDEPENDENCE

I, **Divan van Rooyen**, declare that –

- 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 form 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.



---

**Dr. Divan van Rooyen (Can. Sci. Nat. 151272)**

**Aquatic and Wetland Specialist**

**11/05/2023**

**Date**



I, **Elzet Human**, declare that –

- 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 form 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.



---

**Elzet Human (Pri. Sci. Nat. 147031)**

**Terrestrial Ecologist**

**12/05/2023**

**Date**

I, **Antoinette Bootsma**, declare that –

- 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 form 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.



---

**28/05/2023**

**Antoinette Bootsma (Pri. Sci. Nat. 400222-09)**

**Date**

**Wetland Specialist**

## **APPENDIX E2: Terrestrial Biodiversity Study**

---



Proposed Solar project for Mooivlei Solar 2, Kroonstad Cluster, Freestate Province, RSA

**TERRESTRIAL BIODIVERSITY SPECIALIST ASSESSMENT**

**09 May 2023**

Submitted to : Nemaï Consulting



Prepared by:

**Helena Elizabeth Human (Pr. Sci. Nat 147031)**

Nitai Consulting (PTY) Ltd.

147 Bram Fischer Drive

Ferndale

2194





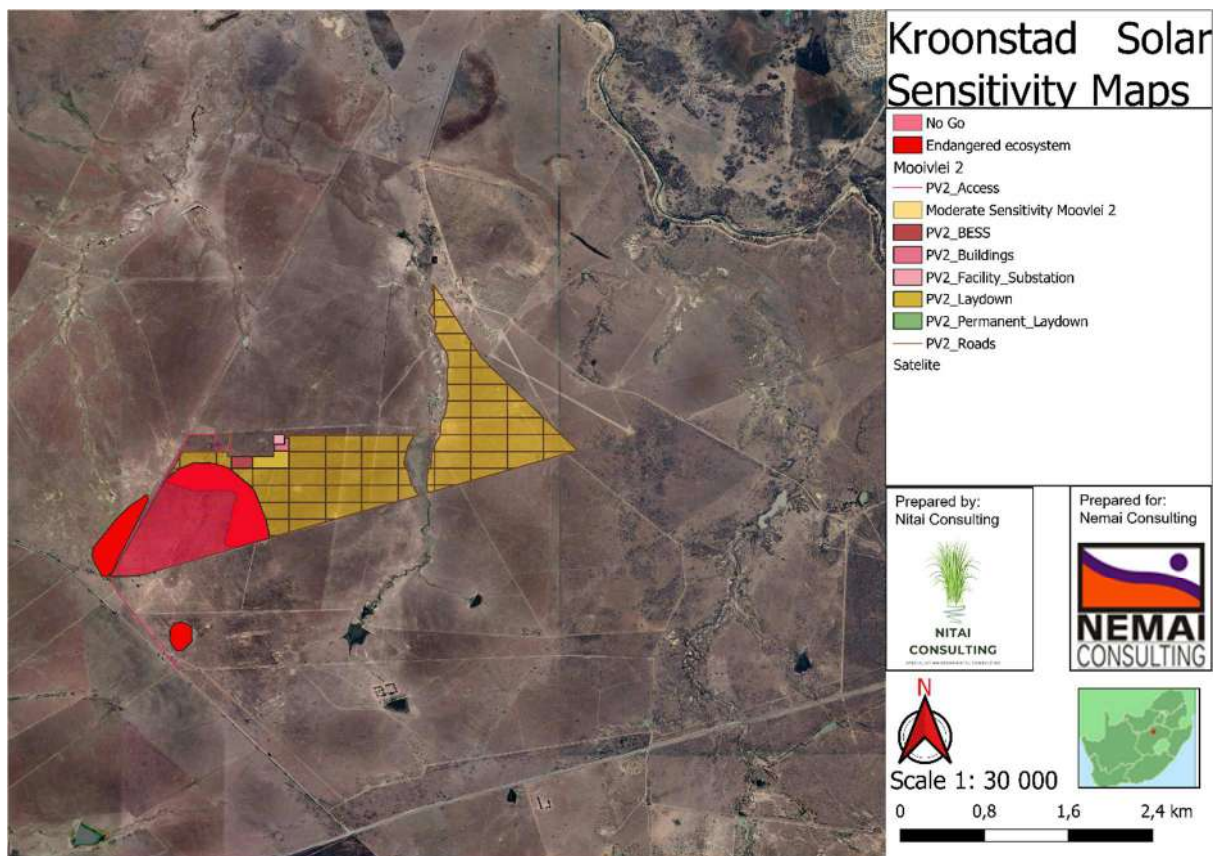
# Executive Summary

Nitai Consulting (Pty) Ltd. was appointed by Nemai Consulting (Pty) Ltd. to undertake a terrestrial biodiversity assessment for the proposed Mooivlei Solar 2 (Pty) Ltd project, near Kroonstad in the Free State Province, South Africa.

According to the National Web Based Environmental Screening Tool (the “Screening Tool”), the terrestrial biodiversity sensitivity theme is very high as the project area falls within a Critical Biodiversity area including Ecological Support Areas and forms part of the protected Areas expansion Strategy.

Several biodiversity features were identified in terms of corridor linkages that could host various faunal and floral species.

The biodiversity importance for all the habitat units were identified and these are rated as moderate sensitivity. The ecological impacts were calculated and with mitigation measures in place the impact of the project footprint ranges from moderate to low.



As a result of the very high sensitivity according to the DFFE Screening Tool, an assessment was conducted in order to identify and mitigate possible loss of biodiversity and corridor linkages, ecological structure and functioning as well as curbing habitat fragmentation during the construction

and operational phases. Possible impacts to the loss of biodiversity areas associated with the proposed project is destruction of floral communities and spread of alien invasive species. In addition, loss of wetland habitat could result due to construction activities while the possibility for erosion is increased if proper mitigation measures are not followed. The impact on the receiving environment is perceived to be high to moderate and can be further lowered if mitigation measures described in this report are followed.

# Table of Contents

<b>1</b>	<b>INTRODUCTION</b>	<b>9</b>
1.1	Background	9
1.2	Project information	9
1.3	Technical Details of the PV Plants	10
1.4	Location	11
<b>2</b>	<b>SCOPE OF WORK</b>	<b>12</b>
2.1	Terms of Reference	12
<b>3</b>	<b>LEGISLATION</b>	<b>23</b>
3.1	Convention on Biological diversity (CBD)	23
3.2	National Environmental Management Act, Act No. 107 of 1998 (NEMA)	23
3.3	National Environmental Management: Biodiversity Act, Act No. 10 of 2004 (NEM:BA)	24
3.4	National Forests Act, Act no. 84 of 1998	27
3.5	National Water Act, Act 36 of 1998	27
3.6	Conservation of Agricultural Resources, Act No. 43 of 1983 as amended in 2001	28
3.7	National Veld and Forest Fire Act, Act No. 101 of 1998	28
3.8	Free State Nature Conservation Ordinance, No 8 of 1969	28
<b>4</b>	<b>METHODS</b>	<b>29</b>
4.1	Desktop Assessment	29
4.1.1	Ecologically Important Landscape features	29
4.1.2	Desktop Flora Assessment	30
4.1.3	Desktop Faunal Assessment	32
4.2	Biodiversity Field Assessment	32
4.2.1	Flora Survey	32
4.2.2	Fauna Survey	32
4.3	Terrestrial Site Ecological Importance	33
<b>5</b>	<b>ASSUMPTIONS AND LIMITATIONS</b>	<b>37</b>
<b>6</b>	<b>RESULTS AND DISCUSSION</b>	<b>38</b>
6.1	Desktop Assessment	38
6.1.1	Ecologically Important landscape features	38
6.1.1.1	Ecosystem Threat Status	38

6.1.1.2	Protected Areas	43
6.1.1.3	Renewable Energy Development Zones (REDZ)	45
6.1.1.4	Critical Biodiversity Areas end Ecological Support Areas	45
6.1.1.5	National Protected Areas expansion Strategy	47
6.1.1.6	Renewable Energy projects	49
6.1.2	Flora Assessment	51
6.1.2.1	Vegetation Type	51
6.1.2.2	Expected Flora Species	57
6.1.3	Faunal Assessment	57
6.1.3.1	Amphibians	57
6.1.3.2	Reptiles	58
6.1.3.3	Mammals	58
6.2	Field Assessment	61
6.2.1	Flora Assessment	61
6.2.1.1	Indigenous Flora	61
6.2.1.2	Invasive Alien Plants	65
6.2.2	Faunal Assessment	66
6.2.2.1	Amphibians and reptiles	66
6.2.2.2	Mammals	67
<b>7</b>	<b>HABITAT AND SITE ECOLOGICAL IMPORTANCE</b>	<b>67</b>
7.1	Habitat Assessment	67
7.1.1	Endangered Vaal-Vet Sandy Grassland	69
7.1.2	Disturbed Central Free State Grasslands	70
7.1.3	Aquatic Habitats/ Wetlands	71
7.1.4	Alien species	73
7.1.5	Transformed areas.	73
7.2	Site sensitivity Verification	74
7.2.1	Biodiversity Importance	78
7.2.2	Site ecological Importance	79
7.2.3	Guidelines for interpreting SEI in the context of the proposed development activities	79
<b>8</b>	<b>IMPACT ASSESSMENT</b>	<b>81</b>
8.1	Biodiversity Impact Assessment	81
8.1.1	Current Impacts to Biodiversity	81
8.1.2	Terrestrial Impact assessment	82



8.1.3	Alternatives Considered _____	82
8.1.4	Loss of Irreplaceable Resources _____	82
8.1.5	Anticipated Impacts _____	82
8.1.6	Unplanned Events _____	85
8.1.7	Identification of Additional Potential Impacts _____	86
8.1.7.1	Assessment of Impact Significance _____	86
8.1.7.2	Construction Phase _____	86
8.1.7.3	Operational Phase _____	86
8.1.7.4	Cumulative Impacts _____	95
8.2	Mitigation Measures	96
8.2.1	Vegetation and habitats _____	96
8.2.2	Fauna _____	98
8.2.3	Alien Species _____	99
8.2.4	Dust _____	100
8.2.5	Waste Management _____	100
8.2.6	Environmental Awareness Training _____	100
8.2.7	Erosion _____	100
8.3	Summary of Monitoring recommendations	101
<b>9</b>	<b>CONCLUSION AND IMPACT STATEMENT _____</b>	<b>102</b>
9.1	Conclusion	102
9.2	Impact Statement	103
<b>10</b>	<b>REFERENCES _____</b>	<b>103</b>
<b>11</b>	<b>APPENDIX 1: SPECIALIST CV _____</b>	<b>105</b>
<b>12</b>	<b>APPENDIX 2: DECLARATION OF INDEPENDENCE _____</b>	<b>109</b>
<b>13</b>	<b>APPENDIX 3: PLANT SPECIES LIST _____</b>	<b>110</b>
<b>14</b>	<b>APPENDIX 4: ANIMAL SPECIES LIST _____</b>	<b>114</b>
<b>15</b>	<b>APPENDIX C – SENSITIVE SPECIES 15 ASSESSMENT _____</b>	<b>122</b>

## List of Tables

Table 1:Conservation importance (CI) criteria.....	34
Table 2:Functional integrity (FI) criteria.....	35
Table 3:Determining the BI.....	35
Table 4: Resilience criteria.....	36
Table 5: Determining the SEI. ....	36
Table 6: Guidelines for interpreting SEI in the context of the proposed development activities. ....	37
Table 7: Summary of relevance of the proposed project to ecologically important landscape.....	38
Table 8: Determining ecosystem status (Driver et al., 2005).....	39
Table 9: Conservation status of different vegetation types occurring in the study area (SANBI, 2021) .....	54
Table 10: Conservation status of different vegetation types occurring in the study area (SANBI, 2021) .....	<b>Error! Bookmark not defined.</b>
Table 11: Threatened flora species that may occur within the project area. <b>Error! Bookmark not defined.</b>	
Table 12: Threatened mammal species that are expected to occur within the project area. * Moderate likelihood of occurrence. ....	58
Table 13: Trees, shrub and herbaceous plant species recorded in the project area.....	61
Table 14: Summary of herpetofauna species recorded within the project area. <b>Error! Bookmark not defined.</b>	
Table 15: Summary of mammal species recorded within the project area.....	67
Table 16: Terrestrial Biodiversity theme screening tool results.....	<b>Error! Bookmark not defined.</b>
Table 17: BI Summary of habitat types delineated within field assessment area of project. ....	78
Table 18: SEI Summary of habitat types delineated within field assessment area of project. ....	79
Table 19: Anticipated impacts for the proposed activities on terrestrial biodiversity. ....	82
Table 20: Summary of unplanned events for terrestrial biodiversity.....	85
Table 21: Assessment of significance of potential impacts on the terrestrial fauna and flora associated with the construction phase. ....	87
Table 26: Cumulative impacts of Solar Pv Projects around study .....	95

## List of Figures

Figure 1: Project Locality.....	11
Figure 2: Map illustrating extent of area used to obtain the expected flora species list from the.....	31
Figure 3: Study site with Least Concern ecosystem.....	40
Figure 4:Study site with Endemic classification .....	42
Figure 5: Map illustrating the project area in relation to the nearest protected areas. ....	44
Figure 6: Map illustrating the locations of CBAs in the project area. ....	46
Figure 7: The project area in relation to the National Protected Area Expansion Strategy. ....	48

Figure 8: Map illustrating the vegetation type associated with the project area. .... 52

Figure 9: Photograph illustrating the reptile species recorded within the assessment. .... **Error!**  
**Bookmark not defined.**

Figure 10: Habitat units found on site ..... 68

Figure 11: General view of the dominant features..... 69

Figure 12: General view of natural Savanna habitat ..... **Error! Bookmark not defined.**

Figure 13: View of Open Savanna habitat..... **Error! Bookmark not defined.**

Figure 14: General view of Mountain Bushveld..... **Error! Bookmark not defined.**

Figure 15: General view of wetland habitats..... 72

Figure 16: General view of old land habitats ..... **Error! Bookmark not defined.**

Figure 17: General view of areas with alien species..... 73

Figure 18: General view of degraded areas ..... **Error! Bookmark not defined.**

Figure 19: Terrestrial biodiversity sensitivity..... 75

Figure 20: Iant Theme Sensitivity, National Web based Environmental Screening Tool..... 76

Figure 21: Animal species theme sensitivity..... 77

Figure 22: Sensitivity of the project area. .... 80

## List of Abbreviations

CBA	Critical Biodiversity Area
CR	Critical
DFFE	Department of Forestry, Fisheries & the Environment
DWS	Department of Water and Sanitation
EIS	Ecological Importance and Sensitivity
EMPr	Environmental Management Programme
EN	Endangered
ESA	Ecological Support Area
GDARD	Gauteng Department of Agriculture and Rural Development
GIS	Geographic Information System
GN	Government Notice
ha	Hectares
km	Kilometer (1 000m)
LC	Least Concern
MAP	Mean Annual Precipitation
m	Meters
NEMA	National Environmental Management Act (No. 107 of 1998)
NFEPA	National Freshwater Priority Areas
NWA	National Water Act
SANBI	South African National Biodiversity Institute
VU	Vulnerable



## 1 INTRODUCTION

### 1.1 Background

Electricity generation sources need to be diversified to ensure security of supply and reduction in the carbon footprint created by the current heavy reliance of South Africa (SA) on coal to produce electricity. Mooivlei Solar 2 (Pty) Ltd (the “Applicant”) has proposed the development of the Mooivlei 240MW Solar Photovoltaic (PV) Project near Kroonstad, in the Free State Province (the “Project”). The electricity generated by the Project will be injected into the Eskom National Grid system via the 275kV powerlines loop in loop out (LILO) between the proposed Eskom substation/switching station and the existing 275 kV powerlines. The Applicant intends to bid for the current and future Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) bid windows and/or other renewable energy markets within SA.

This assessment was conducted in accordance with the amendments to the Environmental Impact Assessment Regulations, 2014 (GNR 326, 7 April 2017) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA). The approach has taken cognisance of the recently published Government Notices (GN) 320 (20 March 2020): “Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorisation” (Reporting Criteria).

The purpose of the specialist studies is to provide relevant input into the basic assessment process and provide a report for the proposed activities associated with the project. This report, after taking into consideration the findings and recommendations provided by the specialist herein, should inform and guide the Environmental Assessment Practitioner (EAP) and regulatory authorities, enabling informed decision making, as to the ecological viability of the proposed project.

### 1.2 Project information

The proposed Solar PV Projects include the following infrastructure:

The proposed Mooivlei Solar 2 facility will cover approximately 312 ha and will include the following infrastructure:

- PV modules and mounting structures
- 1 Inverters and transformers
- 2 Battery Energy Storage System (BESS)
- 3 Site and internal access roads (up to 8 m wide)
- 4 Operation and Maintenance buildings including a gate house and security building, control centre, offices, warehouses and workshops for storage and maintenance.
- 5 Temporary and permanent laydown area

## 6 Facility grid connection infrastructure

The proposed integrated grid connection infrastructure will include the following:

- 33 kV cabling between the project components and the facility substation
- A 132 kV facility substation
- 33 kV or 132 kV cabling or powerline between the facility substation and the Eskom collector switching station.

The proposed Solar PV Projects have a design life of a minimum of 25 years. The extension of the life of the plant will be considered when assessing the plant's economic viability to remain operational after its end of life.

### 1.3 Technical Details of the PV Plants

Capacity of on-site substation	Medium voltage (up to 33 kV) to high voltage (132 kV)  Each facility will require inverter-stations, transformers, switchgear, and internal electrical reticulation (underground cabling).
PV array	Monofacial or Bifacial PV panels, mounted on either fixed-tilt, single-axis tracking, and/or double-axis tracking systems.  Area: Up to 300 ha
Area occupied by both permanent and construction laydown areas	Temporary construction laydown area up to 5 ha.  Permanent laydown area up to 1 ha (to be located within the area demarcated for the temporary construction laydown)
Area occupied by buildings	Approximately 1.5 ha
Length of internal roads	30 km – internal
Width of internal roads	The internal roads will be up to 6 m wide.  The access roads will be up to 8 m wide.
Height of fencing	Up to 3.5m

### 1.4 Location

The Project is located approximately 11km to the west of Kroonstad central business district (CBD) and falls within Ward 7 of the Moqhaka Local Municipality, in the Free State Province. The R713 runs along the southern boundary of the site (Figure 1 and Figure 2). The PV Site will be situated on the farm Mooivlei 284, and an access road crossing Portion 1 of Farm No. 1475 and the Farm Leidzaamheid No. 213.

The project has two layout alternatives. Alternative 1 is the original layout and has sensitive areas where alternative 2 has been adapted to avoid all sensitive areas.

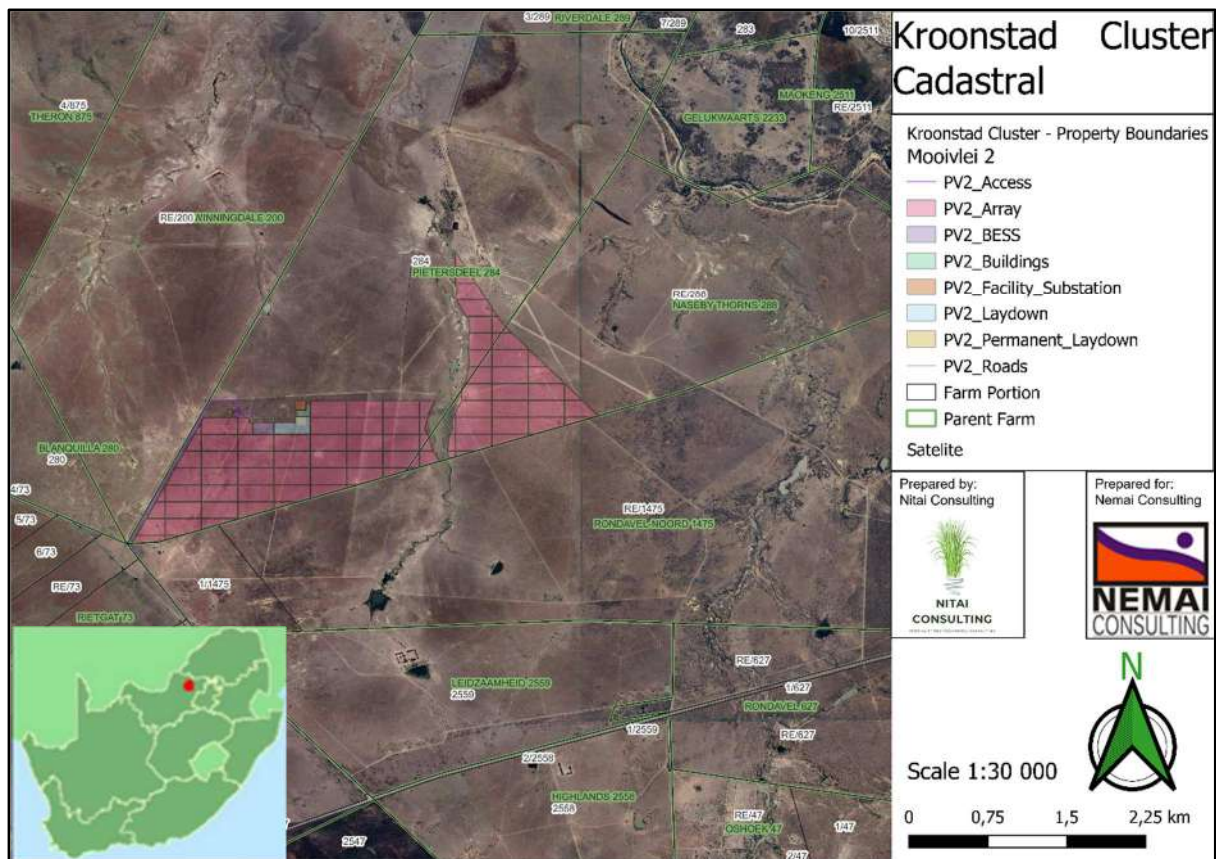


Figure 1: Project Locality

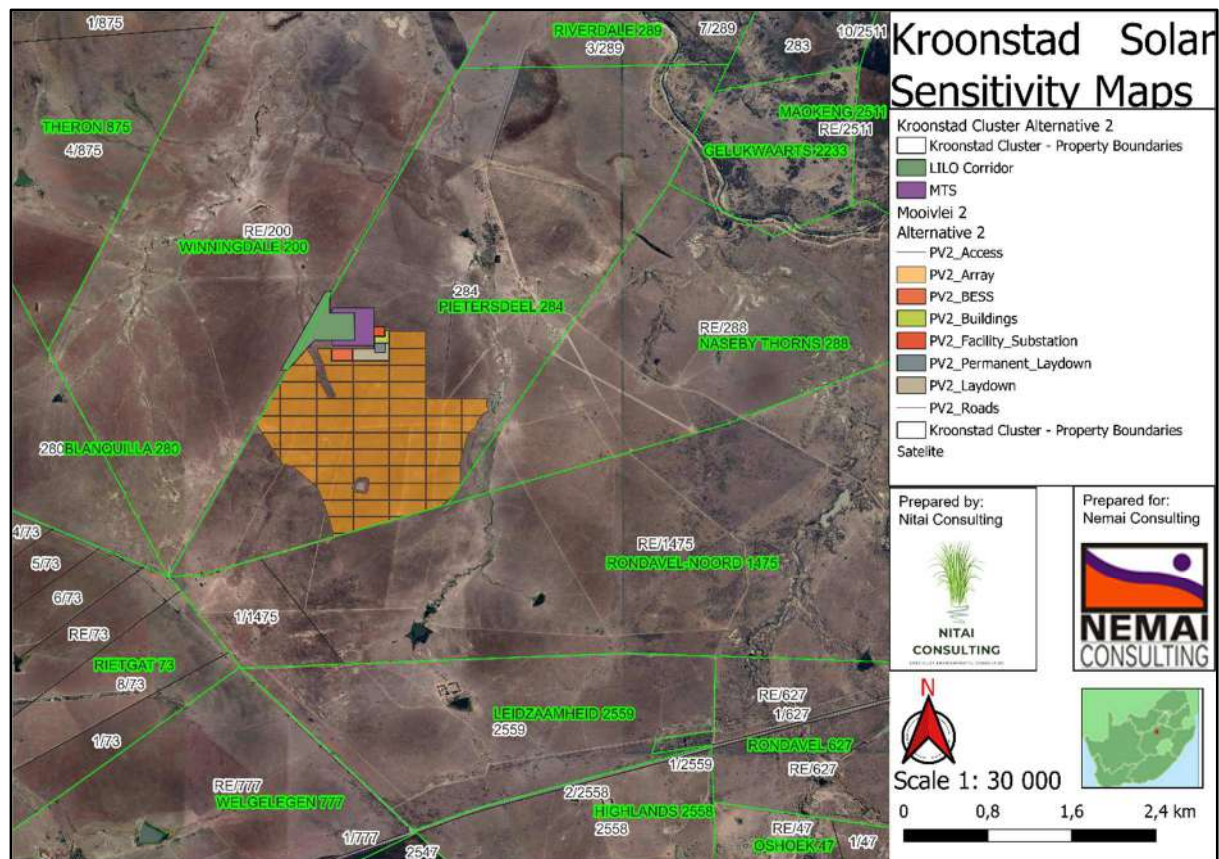


Figure 2: Project alternative 2.

## 2 SCOPE OF WORK

### 2.1 Terms of Reference

The specialist study is required to follow the published Protocols, provided in full below for the assessment of impacts on Terrestrial Biodiversity, Faunal and Floral themes. Note that the Protocols require determination of the level of sensitivity, which then determines the level of assessment required, either a full assessment, or a Compliance Statement.

#### PROTOCOL FOR THE SPECIALIST ASSESSMENT AND MINIMUM REPORT CONTENT REQUIREMENTS FOR ENVIRONMENTAL IMPACTS ON TERRESTRIAL BIODIVERSITY

This site sensitivity assessment follows the requirements of The Environmental Impact Assessment Regulations, as promulgated in terms of Section 24 (5) of the National Environmental Management Act, 1998 (Act No. 107 of 1998), published in GN. No. 320 dated 20 March 2020.

### **General information**

1.1. An applicant intending to undertake an activity identified in the scope of this protocol, on a site identified on the screening tool as being of “very high sensitivity” for terrestrial biodiversity, must submit a Terrestrial Biodiversity Specialist Assessment.

1.2. An applicant intending to undertake an activity identified in the scope of this protocol on a site identified by the screening tool as being “low sensitivity” for terrestrial biodiversity, must submit a Terrestrial Biodiversity Compliance Statement.

1.3. However, where the information gathered from the site sensitivity verification differs from the designation of “very high” terrestrial biodiversity sensitivity on the screening tool and it is found to be of a “low” sensitivity, then a Terrestrial Biodiversity Compliance Statement must be submitted.

1.4. Similarly, where the information gathered from the site sensitivity verification differs from that identified as having a “low” terrestrial biodiversity sensitivity on the screening tool, a Terrestrial Biodiversity Specialist Assessment must be conducted.

1.5. If any part of the proposed development footprint falls within an area of “very high” sensitivity, the assessment and reporting requirements prescribed for the “very high” sensitivity apply to the entire footprint, excluding linear activities for which impacts on terrestrial biodiversity are temporary and the land in the opinion of the terrestrial biodiversity specialist, based on the mitigation and remedial measures, can be returned to the current state within two years of the completion of the construction phase, in which case a compliance statement applies. Development footprint in the context of this protocol means the area on which the proposed development will take place and includes any area that will be disturbed.

### **Terrestrial Biodiversity Specialist Assessment**

2.1. The assessment must be prepared by a specialist registered with the South African Council for Natural Scientific Professionals (SACNASP) with expertise in the field of terrestrial biodiversity.

2.2. The assessment must be undertaken on the preferred site and within the proposed development footprint.

2.3. The assessment must provide a baseline description of the site which includes, as a minimum, the following aspects:

2.3.1. a description of the ecological drivers or processes of the system and how the proposed development will impact these;

2.3.2. ecological functioning and ecological processes (e.g. fire, migration, pollination, etc.) that operate within the preferred site;

2.3.3. the ecological corridors that the proposed development would impede including migration and movement of flora and fauna;



2.3.4. the description of any significant terrestrial landscape features (including rare or important flora-faunal associations, presence of strategic water source areas (SWSAs) or freshwater ecosystem priority area (FEPA) sub catchments;

2.3.5. a description of terrestrial biodiversity and ecosystems on the preferred site, including:

(a) main vegetation types;

(b) threatened ecosystems, including listed ecosystems as well as locally important habitat types identified;

(c) ecological connectivity, habitat fragmentation, ecological processes and fine- scale habitats; and

(d) species, distribution, important habitats (e.g. feeding grounds, nesting sites, etc.) and movement patterns identified;

2.3.6. the assessment must identify any alternative development footprints within the preferred site which would be of a “low” sensitivity as identified by the screening tool and verified through the site sensitivity verification; and

2.3.7. the assessment must be based on the results of a site inspection undertaken on the preferred site and must identify:

2.3.7.1. terrestrial critical biodiversity areas (CBAs), including:

(a) the reasons why an area has been identified as a CBA;

(b) an indication of whether or not the proposed development is consistent with maintaining the CBA in a natural or near natural state or in achieving the goal of rehabilitation;

(c) the impact on species composition and structure of vegetation with an indication of the extent of clearing activities in proportion to the remaining extent of the ecosystem type(s);

(d) the impact on ecosystem threat status;

(e) the impact on explicit subtypes in the vegetation;

(f) the impact on overall species and ecosystem diversity of the site; and

(g) the impact on any changes to threat status of populations of species of conservation concern in the CBA;

2.3.7.2. terrestrial ecological support areas (ESAs), including:

(a) the impact on the ecological processes that operate within or across the site;

(b) the extent the proposed development will impact on the functionality of the ESA; and

(c) loss of ecological connectivity (on site, and in relation to the broader landscape) due to the degradation and severing of ecological corridors or introducing barriers that impede migration and movement of flora and fauna;

2.3.7.3. protected areas as defined by the National Environmental Management: Protected Areas Act, 2004 including-

(a) an opinion on whether the proposed development aligns with the objectives or purpose of the protected area and the zoning as per the protected area management plan;

2.3.7.4. priority areas for protected area expansion, including-

(a) the way in which the proposed development will compromise or contribute to the expansion of the protected area network;

2.3.7.5. SWSAs including:

(a) the impact(s) on the terrestrial habitat of a SWSA; and

(b) the impacts of the proposed development on the SWSA water quality and quantity (e.g. describing potential increased runoff leading to increased sediment load in water courses);

2.3.7.6. FEPA sub catchments, including-

(a) the impacts of the proposed development on habitat condition and species in the FEPA sub catchment;

2.3.7.7 indigenous forests, including:

(a) impact on the ecological integrity of the forest; and

(b) percentage of natural or near natural indigenous forest area lost and a statement on the implications in relation to the remaining areas.

2.4. The findings of the assessment must be written up in a Terrestrial Biodiversity Specialist Assessment Report.

### **Terrestrial Biodiversity Specialist Assessment 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;

3.1.2. a signed statement of independence by the specialist;

3.1.3. a statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;

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;

- 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;
  - 3.1.6. a location of the areas not suitable for development, which are to be avoided during construction and operation (where relevant);
  - 3.1.7. additional environmental impacts expected from the proposed development;
  - 3.1.8. any direct, indirect and cumulative impacts of the proposed development;
  - 3.1.9. the degree to which impacts and risks can be mitigated;
  - 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);
  - 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;
  - 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
  - 3.1.15. any conditions to which this statement is subjected.
- 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

#### **PROTOCOL FOR THE SPECIALIST ASSESSMENT AND MINIMUM REPORT CONTENT REQUIREMENTS FOR ENVIRONMENTAL IMPACTS ON TERRESTRIAL PLANT SPECIES**

This site sensitivity assessment follows the requirements of The Environmental Impact Assessment Regulations, as promulgated in terms of Section 24 (5) of the National Environmental Management Act, 1998 (Act No. 107 of 1998), published in GN. No. 320 dated 20 March 2020.

##### **General information**

1.1 An applicant intending to undertake an activity identified in the scope of this protocol, on a site identified by the screening tool as being of “very high” or “high” sensitivity for terrestrial plant species, must submit a Terrestrial Plant Species Specialist Assessment Report.

1.2 An applicant intending to undertake an activity identified in the scope of this protocol, on a site identified by the screening tool as being of “medium sensitivity” for terrestrial plant species, must submit either a Terrestrial Plant Species Specialist Assessment Report or a Terrestrial Plant Species Compliance Statement, depending on the outcome of a site inspection undertaken in accordance with paragraph 4.

1.3 An applicant intending to undertake an activity identified in the scope of this protocol, on a site identified by the screening tool as being of “low” sensitivity for terrestrial plant species, must submit a Terrestrial Plant Species Compliance Statement.

1.4 Where the information gathered from the site sensitivity verification differs from the screening tool designation of “very high” or “high” for terrestrial plant species sensitivity on the screening tool, and it is found to be of a “low” sensitivity, then a Terrestrial Plant Species Compliance Statement must be submitted.

1.5 Where the information gathered from the site sensitivity verification differs from the screening tool designation of “low” terrestrial plant species sensitivity and it is found to be of a “very high” or “high” terrestrial plant species sensitivity, a Terrestrial Plant Species Specialist Assessment must be conducted.

1.6 If any part of the development falls within an area of confirmed “very high” or “high” sensitivity, the assessment and reporting requirements prescribed for the “very high” or “high” sensitivity, apply to the entire development footprint. Development footprint in the context of this protocol, means the area on which the proposed development will take place and includes the area that will be disturbed or impacted.

1.7 The Terrestrial Plant Species Specialist Assessment and the Terrestrial Plant Species Compliance Statement must be undertaken within the study area.

1.8 Where the nature of the activity is not expected to have an impact on species of conservation concern (SCC) beyond the boundary of the preferred site, the study area means the proposed development footprint within the preferred site.

1.9 Where the nature of the activity is expected to have an impact on SCC beyond boundary of the preferred site, the project areas of influence (PAOI) must be determined by the specialist in accordance with Species Environmental Assessment Guideline, and the study area must include the PAOI, as determined.

### **Terrestrial Plant Species Specialist Assessment**

2.1 The assessment must be undertaken by a specialist registered with the South African Council for Natural Scientific Professions (SACNASP), within a field of practice relevant to the taxonomic groups (“taxa”) for which the assessment is being undertaken.

2.2 The assessment must be undertaken within the study area.

2.3 The assessment must be undertaken in accordance with the Species Environmental Assessment Guideline and must:

2.3.1 Identify the SCC which were found, observed or are likely to occur within the study area;

2.3.2 provide evidence (photographs) of each SCC found or observed within the study area, which must be disseminated by the specialist to a recognized online database facility immediately after the site inspection has been performed (prior to preparing the report contemplated in paragraph 3);

2.3.3 identify the distribution, location, viability and detailed description of population size of the SCC identified within the study area;

2.3.4 identify the nature and the extent of the potential impact of the proposed development to the population of the SCC located within the study area;

2.3.5 determine the importance of the conservation of the population of the SCC identified within the study area, based on information available in national and international databases including the IUCN Red List of Threatened Species, Red List of South African Plants, and/or other relevant databases;

2.3.6 determine the potential impact of the proposed development on the habitat of the SCC located within the study area;

2.3.7 include a review of relevant literature on the population size of the SCC, the conservation interventions as well as any national or provincial species management plans for the SCC. This review must provide information on the need to conserve the SCC and indicate whether the development is compliant with the applicable species management plans and if not, a motivation for the deviation;

2.3.8 identify any dynamic ecological processes occurring within the broader landscape, that might be disrupted by the development and result in negative impact on the identified SCC, for example, fires in fire-prone systems;

2.3.9 identify any potential impact on ecological connectivity within the broader landscape, and resulting impacts on the identified SCC and its long term viability;

2.3.10 determine buffer distances as per the Species Environmental Assessment Guidelines used for the population of each SCC; and

2.3.11 discuss the presence or likelihood of additional SCC including threatened species not identified by the screening tool, Data Deficient or Near Threatened Species, as well as any undescribed species; and

2.3.12 identify any alternative development footprints within the preferred development site which would be of "low" sensitivity" or "medium" sensitivity as identified by the screening tool and verified through the site sensitivity verification.



2.4 The findings of the assessment must be written up in a Terrestrial Plant Species Specialist Assessment Report.

### **Terrestrial Plant Species Specialist Assessment Report**

3.1 This report must include as a minimum the following information:

3.1.1 contact details and relevant experience as well as the SACNASP registration number of the specialist preparing the assessment including a curriculum vitae;

3.1.2 a signed statement of independence by the specialist;

3.1.3 a statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;

3.1.4 a description of the methodology used to undertake the site sensitivity verification and impact assessment and site inspection, including equipment and modelling used where relevant;

3.1.5 a description of the assumptions made and any uncertainties or gaps in knowledge or data;

3.1.6 a description of the mean density of observations/number of samples sites per unit area of site inspection observations;

3.1.7 details of all SCC found or suspected to occur on site, ensuring sensitive species are appropriately reported;

3.1.8 the online database name, hyperlink and record accession numbers for disseminated evidence of SCC found within the study area;

3.1.9 the location of areas not suitable for development and to be avoided during construction where relevant;

3.1.10 a discussion on the cumulative impacts;

3.1.11 impact management actions and impact management outcomes proposed by the specialist for inclusion in the Environmental Management Programme (EMPr);

3.1.12 a reasoned opinion, based on the findings of the specialist assessment, regarding the acceptability or not, of the development related to the specific theme considered, and if the development should receive approval or not, related to the specific theme being considered, and any conditions to which the opinion is subjected if relevant; and

3.1.13 a motivation must be provided if there were any development footprints identified as per paragraph 2.3.12 above that were identified as having “low” or “medium” terrestrial plant species sensitivity and were not considered appropriate.

3.2 A signed copy of the assessment must be appended to the Basic Assessment Report or Environmental Impact Assessment Report.

## **PROTOCOL FOR THE SPECIALIST ASSESSMENT AND MINIMUM REPORT CONTENT REQUIREMENTS FOR ENVIRONMENTAL IMPACTS ON TERRESTRIAL ANIMAL SPECIES**

This site sensitivity assessment follows the requirements of The Environmental Impact Assessment Regulations, as promulgated in terms of Section 24 (5) of the National Environmental Management Act, 1998 (Act No. 107 of 1998), published in GN. No. 320 dated 20 March 2020.

### **General information**

1.1 An applicant intending to undertake an activity identified in the scope of this protocol, on a site identified by the screening tool as being of “very high” or “high” sensitivity for terrestrial animal species, must submit a Terrestrial Animal Species Specialist Assessment Report.

1.2 An applicant intending to undertake an activity identified in the scope of this protocol, on a site identified by the screening tool as being of “medium sensitivity” for terrestrial animal species, must submit either a Terrestrial Animal Species Specialist Assessment Report or a Terrestrial Animal Species Compliance Statement, depending on the outcome of a site inspection undertaken in accordance with paragraph 4.

1.3 An applicant intending to undertake an activity identified in the scope of this protocol, on a site identified by the screening tool as being of “low” sensitivity for terrestrial animal species, must submit a Terrestrial Animal Species Compliance Statement.

1.4 Where the information gathered from the site sensitivity verification differs from the screening tool designation of “very high” or “high” for terrestrial animal species sensitivity on the screening tool, and it is found to be of a “low” sensitivity, then a Terrestrial Animal Species Compliance Statement must be submitted.

1.5 Where the information gathered from the site sensitivity verification differs from the screening tool designation of “low” terrestrial animal species sensitivity and it is found to be of a “very high” or “high” terrestrial animal species sensitivity, a Terrestrial Animal Species Specialist Assessment must be conducted.

1.6 If any part of the development falls within an area of confirmed “very high” or “high” sensitivity, the assessment and reporting requirements prescribed for the “very high” or “high” sensitivity, apply to the entire development footprint. Development footprint in the context of this protocol, means the area on which the proposed development will take place and includes the area that will be disturbed or impacted.

1.7 The Terrestrial Animal Species Specialist Assessment and the Terrestrial Animal Species Compliance Statement must be undertaken within the study area.

1.8 Where the nature of the activity is not expected to have an impact on species of conservation concern (SCC) beyond the boundary of the preferred site, the study area means the proposed development footprint within the preferred site.

1.9 Where the nature of the activity is expected to have an impact on SCC beyond boundary of the preferred site, the project areas of influence (PAOI) must be determined by the specialist in accordance with Species Environmental Assessment Guideline, and the study area must include the PAOI, as determined.

### **Terrestrial Animal Species Specialist Assessment**

2.1 The assessment must be undertaken by a specialist registered with the South African Council for Natural Scientific Professions (SACNASP), within a field of practice relevant to the taxonomic groups (“taxa”) for which the assessment is being undertaken.

2.2 The assessment must be undertaken in accordance with the Species Environmental Assessment Guideline and must:

2.2.1 Identify the SCC which were found, observed or are likely to occur within the study area;

2.2.2 provide evidence (photographs) of each SCC found or observed within the study area, which must be disseminated by the specialist to a recognized online database facility immediately after the site inspection has been performed (prior to preparing the report contemplated in paragraph 3);

2.2.3 identify the distribution, location, viability and detailed description of population size of the SCC identified within the study area;

2.2.4 identify the nature and the extent of the potential impact of the proposed development to the population of the SCC located within the study area;

2.2.5 determine the importance of the conservation of the population of the SCC identified within the study area, based on information available in national and international databases including the IUCN Red List of Threatened Species, South African Red List of Species, and/or other relevant databases;

2.2.6 determine the potential impact of the proposed development on the habitat of the SCC located within the study area;

2.2.7 include a review of relevant literature on the population size of the SCC, the conservation interventions as well as any national or provincial species management plans for the SCC. This review must provide information on the need to conserve the SCC and indicate whether the development is compliant with the applicable species management plans and if not, a motivation for the deviation;

2.2.8 identify any dynamic ecological processes occurring within the broader landscape, that might be disrupted by the development and result in negative impact on the identified SCC, for example, fires in fireprone systems;

2.2.9 identify any potential impact on ecological connectivity in relation to the broader landscape, resulting in impacts on the identified SCC and its long term viability;

2.2.10 determine buffer distances as per the Species Environmental Assessment Guidelines used for the population of each SCC;

2.2.11 discuss the presence or likelihood of additional SCC including threatened species not identified by the screening tool, Data Deficient or Near Threatened Species, as well as any undescribed species, or roosting and breeding or foraging areas used by migratory species where these species show significant congregations, occurring in the vicinity; and

2.2.12 identify any alternative development footprints within the preferred development site which would be of “low” or “medium” sensitivity as identified by the screening tool and verified through the site sensitivity verification.

2.3 The findings of the assessment must be written up in a Terrestrial Animal Species Specialist Assessment Report.

### **Terrestrial Animal Species Specialist Assessment Report**

3.1 This report must include as a minimum the following information:

3.1.1 contact details and relevant experience as well as the SACNASP registration number of the specialist preparing the assessment including a curriculum vitae;

3.1.2 a signed statement of independence by the specialist;

3.1.3 a statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;

3.1.4 a description of the methodology used to undertake the site sensitivity verification and impact assessment and site inspection, including equipment and modelling used where relevant;

3.1.5 a description of the mean density of observations/number of samples sites per unit area of site inspection observations;

3.1.6 a description of the assumptions made and any uncertainties or gaps in knowledge or data;

3.1.7 details of all SCC found or suspected to occur on site, ensuring sensitive species are appropriately reported;

3.1.8 the online database name, hyperlink and record accession numbers for disseminated evidence of SCC found within the study area;

3.1.9 the location of areas not suitable for development and to be avoided during construction where relevant;

3.1.10 a discussion on the cumulative impacts;

3.1.11 impact management actions and impact management outcomes proposed by the specialist for inclusion in the Environmental Management Programme (EMPr);

3.1.12 a reasoned opinion, based on the findings of the specialist assessment, regarding the acceptability or not, of the development related to the specific theme considered, and if the development should receive approval or not, related to the specific theme being considered, and any conditions to which the opinion is subjected if relevant; and

3.1.13 a motivation must be provided if there were any development footprints identified as per paragraph

2.2.12 above that were identified as having “low” or “medium” terrestrial animal species sensitivity and were not considered appropriate.

3.2 A signed copy of the assessment must be appended to the Basic Assessment Report or Environmental Impact Assessment Report.

## 3 LEGISLATION

### 3.1 Convention on Biological diversity (CBD)

South Africa became a signatory to the United Nations Convention on Biological Diversity (CBD) in 1993, which was ratified in 1995. The CBD requires signatory states to implement objectives of the Convention, which are the conservation of biodiversity; the sustainable use of biological resources and the fair and equitable sharing of benefits arising from the use of genetic resources. According to Article 14 (a) of the CBD, each Contracting Party, as far as possible and as appropriate, must introduce appropriate procedures, such as environmental impact assessments of its proposed projects that are likely to have significant adverse effects on biological diversity, to avoid or minimize these effects and, where appropriate, to allow for public participation in such procedures.

### 3.2 National Environmental Management Act, Act No. 107 of 1998 (NEMA)

NEMA is the framework environmental management legislation, enacted as part of the government's mandate to ensure every person's constitutional right to an environment that is not harmful to his or her health or wellbeing. It is administered by the Department of Forestry, Fisheries and the Environment (DFFE) but several functions have been delegated to the provincial environment departments. One of the purposes of NEMA is to provide for co-operative environmental governance by establishing principles for decision-making on matters affecting the environment. The Act further aims to provide for institutions that will promote cooperative governance and procedures for coordinating environmental functions exercised by organs of state and to provide for the administration and enforcement of other environmental management laws. NEMA requires, inter alia, that:

- “development must be socially, environmentally, and economically sustainable”;



- “disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied”; and
- “a risk-averse and cautious approach is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions”.

NEMA states that “the environment is held in public trust for the people, the beneficial use of environmental resources must serve the public interest and the environment must be protected as the people’s common heritage.”

### **3.3 National Environmental Management: Biodiversity Act, Act No. 10 of 2004 (NEM:BA)**

As the principal national act regulating biodiversity protection, NEM:BA, is concerned with the management and conservation of biological diversity, as well as the use of indigenous biological resources in a sustainable manner. In terms of NEM:BA, the developer has a responsibility for:

- The conservation of endangered ecosystems and restriction of activities according to the categorisation of the area (not just by listed activity as specified in the EIA Regulations).
- Promote the application of appropriate environmental management tools in order to ensure integrated environmental management of activities thereby ensuring that all development within the area is in line with ecological sustainable development and protection of biodiversity.
- Limit further loss of biodiversity and conserve endangered ecosystems.

Chapter 4 of the Act relates to threatened or protected ecosystems or species. According to Section 57 of the Act, "Restricted activities involving listed threatened or protected species":

- A person may not carry out a restricted activity involving a specimen of a listed threatened or protected species without a permit issued in terms of Chapter 7.

Such activities include any that are “of a nature that may negatively impact on the survival of a listed threatened or protected species”.

#### Alien and Invasive Species

Chapter 5 of NEMBA relates to species and organisms posing a potential threat to biodiversity. The Act defines alien species and provides lists of invasive species. The Alien and Invasive Species (AIS) Regulations, in terms of Section 97(1) of NEMBA, was published in Government Notice R598 in Government Gazette 37885 in 2014 (NEMBA, 2014). The Alien and Invasive Species (AIS) lists were subsequently published in Government Notice R 864 of 29 July 2016 (NEMBA, 2016).

NEMBA regulates all invasive organisms in South Africa, including a wide range of fauna and flora. Chapter 5 of the Act relates to species and organisms posing a potential threat to biodiversity. The purpose of Chapter 5 is:

- a) to prevent the unauthorized introduction and spread of alien species and invasive species to ecosystems and habitats where they do not naturally occur;
- b) to manage and control alien species and invasive species to prevent or minimize harm to the environment and to biodiversity in particular;
- c) to eradicate alien species and invasive species from ecosystems and habitats where they may harm such ecosystems or habitats;

According to Section 65 of the Act, "Restricted activities involving alien species":

- 1) A person may not carry out a restricted activity involving a specimen of an alien species without a permit issued in terms of Chapter 7. Restricted activities include the following:
  - a) Importing into the Republic, including introducing from the sea, any specimen of a listed invasive species.
  - b) Having in possession or exercising physical control over any specimen of a listed invasive species.
  - c. Growing, breeding or in any other way propagating any specimen of a listed invasive species, or causing it to multiply.
  - c) Conveying, moving or otherwise translocating any specimen of a listed invasive species.
  - d) Selling or otherwise trading in, buying, receiving, giving, donating or accepting as a gift, or in any other way acquiring or disposing of any specimen of a listed invasive species.
  - e) Spreading or allowing the spread of any specimen of a listed invasive species.
  - f) Releasing any specimen of a listed invasive species.
  - h. Additional activities that apply to aquatic species.
- 2) A permit referred to in subsection (1) may be issued only after a prescribed assessment of risks and potential impacts on biodiversity is carried out.

An "**alien species**" is defined in the Act as:

- a. a species that is not an indigenous species; or
- b. an indigenous species translocated or intended to be translocated to a place outside its natural distribution range in nature, but not an indigenous species that has extended its natural distribution range by means of migration or dispersal without human intervention.

According to Section 71 of the Act, "**Restricted activities involving listed invasive species**":

1. A person may not carry out a restricted activity involving a specimen of a listed invasive species without a permit issued in terms of Chapter 7.
2. A permit referred to in subsection (1) may be issued only after a prescribed assessment of risks and potential impacts on biodiversity is carried out.

An "**invasive species**" is defined in the Act as any species whose establishment and spread outside of its natural distribution range:

- a. threaten ecosystems, habitats or other species or have demonstrable potential to threaten ecosystems, habitats or other species; and
- b. may result in economic or environmental harm or harm to human health.

A "**listed invasive species**" is defined in the Act as any invasive species listed in terms of section 70(1). According to Section 73 of the Act, "Duty of care relating to listed invasive species":

- 2) A person who is the owner of land on which a listed invasive species occurs must:
  - a) notify any relevant competent authority, in writing, of the listed invasive species occurring on that land;
  - b) take steps to control and eradicate the listed invasive species and to prevent it from spreading;
  - and c) take all the required steps to prevent or minimize harm to biodiversity.

According to Section 75 of the Act, "Control and eradication of listed invasive species":

1. Control and eradication of a listed invasive species must be carried out by means of methods that are appropriate for the species concerned and the environment in which it occurs.
2. Any action taken to control and eradicate a listed invasive species must be executed with caution and in a manner that may cause the least possible harm to biodiversity and damage to the environment.
3. The methods employed to control and eradicate a listed invasive species must also be directed at the offspring, propagating material and re-growth of such invasive species in order to prevent such species from producing offspring, forming seed, regenerating or re-establishing itself in any manner.

Government Notice No. 47526 of 2022: The revised National List of ecosystems that are threatened and in need of protection.

This notice, published under Section 52(1)(a) of NEMBA, provides for the listing of threatened or protected ecosystems based on national criteria. The list of threatened terrestrial ecosystems supersedes the information regarding terrestrial ecosystem status in the National Spatial Biodiversity Assessment (2004).

**GNR 151: Critically Endangered, Endangered, Vulnerable and Protected Species List**

Published under Section 56(1) of NEMBA.

**GNR 1187: Amendment of Critically Endangered, Endangered, Vulnerable and Protected Species List**

Published under Section 56(1) of NEMBA.

**Government Notice No. 40733 of 2017: Draft National Biodiversity Offset Policy**

Published under NEMA. The aim of the Policy is to ensure that significant residual impacts of developments are remedied as required by NEMA, thereby ensuring sustainable development as

required by section 24 of the Constitution of the Republic of South Africa, 1996. This policy should be taken into consideration with every development application that still has significant residual impact after the Mitigation Sequence has been followed. The mitigation sequence entails the consecutive application of avoiding or preventing loss, then at minimizing or mitigating what cannot be avoided, rehabilitating where possible and, as a last resort, offsetting the residual impact. The Policy specifies that one impact that has come across consistently as unmitigatable is the rapid and consistent transformation of certain ecosystems and vegetation types, leading to the loss of ecosystems and extinction of species. The Policy specifically targets ecosystems where the ability to reach protected area targets is lost or close to being lost. However, the Policy states that “[w]here ecosystems remain largely untransformed, intact and functional, an offset would not be required for developments that lead to transformation, provided they have not been identified as a biodiversity priority”. Biodiversity offsets should be considered to remedy residual negative impacts on biodiversity of ‘medium’ to ‘high’ significance. Residual impacts of ‘very high’ significance are a fatal flaw for development and residual biodiversity impacts of ‘low’ significance would usually not require offsets. The Policy indicates that impacts should preferably be avoided in protected areas, Critical Biodiversity Areas (CBA), verified wetland and river features and areas earmarked for protected area expansion.

### **3.4 National Forests Act, Act no. 84 of 1998**

#### Protected trees

According to this Act, the Minister may declare a tree, group of trees, woodland, or a species of trees as protected. The prohibitions provide that ‘no person may cut, damage, disturb, destroy or remove any protected tree, or collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a licence granted by the Minister’. Forests Prohibits the destruction of indigenous trees in any natural forest without a licence.

### **3.5 National Water Act, Act 36 of 1998**

Any areas that are defined in the National Water Act as a water resource that might be impacted on by certain activities that are contemplated require authorisation (Section 21 of the National Water Act of 1998). A "watercourse" in terms of the National Water Act (Act 36 of 1998) means:

- River or spring;
- A natural channel in which water flows regularly or intermittently;
- A wetland, lake, or dam into which, or from which, water flows; and
- Any collection of water which the Minister may, by notice in the gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

### **3.6 Conservation of Agricultural Resources, Act No. 43 of 1983 as amended in 2001**

Declared Weeds and Invaders in South Africa are categorised according to one of the following categories:

- Category 1 plants: are prohibited and must be controlled.
- Category 2 plants: (commercially used plants) may be grown in demarcated areas providing that there is a permit and that steps are taken to prevent their spread.
- Category 3 plants: (ornamentally used plants) may no longer be planted; existing plants may remain, as long as all reasonable steps are taken to prevent the spreading thereof, except within the flood line of watercourses and wetlands.

### **3.7 National Veld and Forest Fire Act, Act No. 101 of 1998**

Provides requirements for veldfire prevention through firebreaks and required measures for fire-fighting. Chapter 4 of the Act places a duty on landowners to prepare and maintain firebreaks. Chapter 5 of the Act places a duty on all landowners to acquire equipment and have available personnel to fight fires.

### **3.8 Free State Nature Conservation Ordinance, No 8 of 1969**

This Act provides for the management and conservation of the Free State Province's biophysical environment and protected areas within the framework of the National Environmental Management Act, 1998 (Act No 107 of 1998); to provide for the protection of species and ecological- systems that warrant provincial protection; to provide for the sustainable use of indigenous biological resources; and to provide for matters connected therewith.

Amongst other regulations, the following may apply to the current project:

- Various species are protected;
- The owner of land upon which an invasive species is found (plant or animal) must take the necessary steps to eradicate or destroy such species. The Act provides lists of protected species for the Province.

The Act provides lists of protected species for the province. According to the Free State Nature Conservation Ordinance, a permit is required for the removal of any species on this list.



## 4 METHODS

### 4.1 Desktop Assessment

The desktop assessment was principally undertaken using a Geographic Information System (GIS) to access the latest available spatial datasets to develop digital cartographs and species lists. These datasets and their date of publishing are provided below.

#### 4.1.1 Ecologically Important Landscape features

Existing ecologically relevant data layers were incorporated into a GIS to establish how the proposed project might interact with any ecologically important entities. Emphasis was placed around the following spatial datasets:

- Ecosystem Threat Status – indicator of an ecosystem’s wellbeing, based on the level of change in structure, function or composition. Ecosystem types are categorised as Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT) or Least Concern (LC), based on the proportion of the original extent of each ecosystem type that remains in good ecological condition.
- Ecosystem Protection Level – indicator of the extent to which ecosystems are adequately protected or under-protected. Ecosystem types are categorised as Well Protected (WP), Moderately Protected (MP), Poorly Protected (PP), or Not Protected (NP), based on the proportion of the biodiversity target for each ecosystem type that is included within one or more protected areas. NP, PP or MP ecosystem types are collectively referred to as under-protected ecosystems.
- Protected areas:
- South Africa Protected Areas Database (SAPAD) (DEA, 2020) – The (SAPAD) Database contains spatial data for the conservation of South Africa. It includes spatial and attribute information for both formally protected areas and areas that have less formal protection. SAPAD is updated on a continuous basis and forms the basis for the Register of Protected Areas, which is a legislative requirement under the National Environmental Management: Protected Areas Act, Act 57 of 2003.
- National Protected Areas Expansion Strategy (NPAES) (SANBI, 2010) – The NPAES provides spatial information on areas that are suitable for terrestrial ecosystem protection. These focus areas are large, intact and unfragmented and therefore, of high importance for biodiversity, climate resilience and freshwater protection.
- Free State Biodiversity Sector Plan
- The Provincial Department classified CBA areas within the province based on its contribution to reach the conservation targets within the province. The C-Plan uses the following terms to

categorise the various land used types according to their biodiversity and environmental importance:

- Protected Areas (subdivided into Protected areas and Conservation Areas, CBA Irreplaceable)
- Critical Biodiversity Areas (sub-divided into Critical Patches, Irreplaceable sites, Critical Biodiversity Corridor Linkages, Important Terrestrial Habitats, Urban Green Spaces, Informal Conservation areas, protected Area buffers).
- Ecological Support Area (sub-divided into Biodiversity Corridors, Existing or proposed Protected Area Development Corridors, Urban Green Spaces)
- Other Natural Areas
- No Natural Habitat Remaining/ Transformed/ Degraded
- In the spatial datasets a further distinction is made between CBAs that are likely to be in a natural condition or act as corridors (CBA 1) and those that are potentially degraded or represent secondary vegetation or act as buffers and corridors (CBA 2). This distinction is based on best available land cover data. Similarly, a distinction is made between ESAs that are likely to be functional (i.e., in a natural, near-natural or moderately degraded condition; ESA 1), and Ecological Support Areas that are likely severely degraded or have no natural cover remaining and therefore require restoration where feasible (ESA 2).
- It is important to note that the Critical Biodiversity Areas (CBA) map accounts for terrestrial fauna and flora only.
- A CBA is considered a significant and ecologically sensitive area and needs to be kept in a pristine or near-natural state to ensure the continued functioning of ecosystems (SANBI, 2017). A CBA represents the best choice for achieving biodiversity targets. ESAs are not essential for achieving targets, but they play a vital role in the continued functioning of ecosystems and often are essential for proper functioning of adjacent CBAs.
- Important Bird and Biodiversity Areas (IBAs) (BirdLife South Africa, 2015) – IBAs constitute a global network of over 13 500 sites, of which 112 sites are found in South Africa. IBAs are sites of global significance for bird conservation, identified through multi-stakeholder processes using globally standardised, quantitative, and scientifically agreed criteria.

#### **4.1.2 Desktop Flora Assessment**

The desktop vegetation and botanical assessment encompassed an assessment of all the vegetation units and habitat types within the project area. The focus was on an ecological assessment of pre-anthropogenic habitat types as well as the identification of any Red Data and protected species within the known distribution of the project area. The South African National Biodiversity Institute (SANBI) provides an electronic database system, namely the Botanical Database of Southern Africa (BODATSA-POSA, 2019), which was used to access distribution records on Southern African plants and generate an expected species list (Figure 3). This new database replaces the old Plants of Southern Africa database which provided distribution data of flora at the quarter degree square resolution. The Red

List of South African Plants website (SANBI, 2016) was used to provide the most current account of the national conservation status of flora.

Additional information regarding ecosystems, vegetation types, protected flora and Species of Conservation Concern (SCC) was obtained from the following sources:

- The Vegetation of South Africa, Lesotho and Swaziland (Mucina & Rutherford, 2012);
- Red List of South African Plants (Raimondo *et al.*, 2009; SANBI, 2016); and
- List of Protected Tree Species (South African Government, 2014).

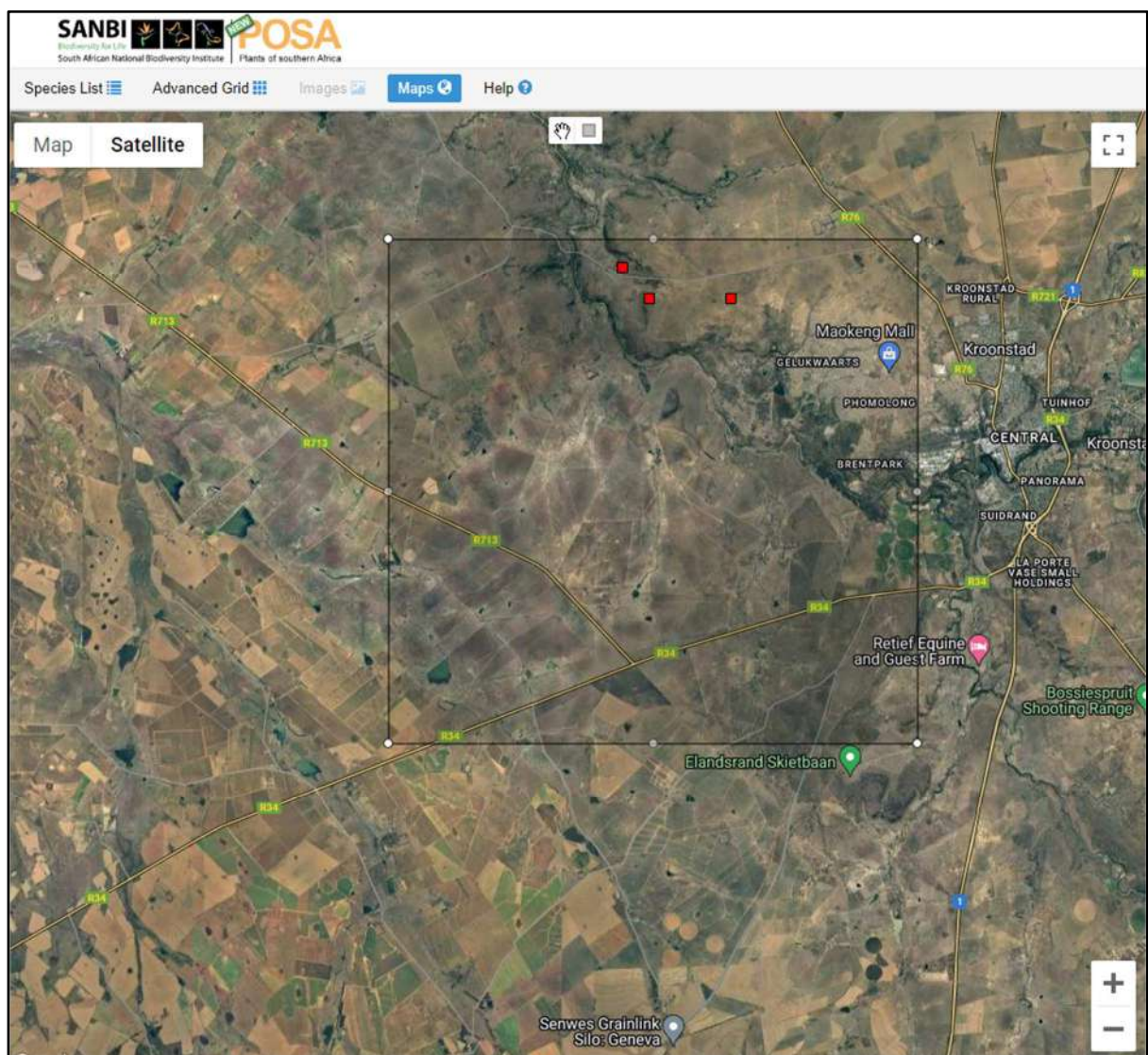


Figure 3: Map illustrating extent of area used to obtain the expected flora species list from the

#### **4.1.3 Desktop Faunal Assessment**

The faunal desktop assessment comprised of the following, compiling an expected:

- Amphibian list, generated from the IUCN spatial dataset (2017)
- Reptile list, generated from the IUCN spatial dataset (2017)
- Mammal list from the IUCN spatial dataset (2017)

#### **4.2 Biodiversity Field Assessment**

A field survey was undertaken in January and April 2023, to determine the presence of Species of Conservation Concern (SCC). Effort was made to cover all the different habitat types, within the limits of time and access.

##### **4.2.1 Flora Survey**

Based on preliminary interpretation of satellite imagery (Google Corporation) and GIS analysis (which included the most recent applicable biodiversity datasets available prior to the fieldwork), the fieldwork and sample sites were located within specific areas (i.e., target sites) perceived as ecologically sensitive. To maximize coverage and navigate to each target location in the field, the fieldwork's main goal was to quickly analyse the vegetation and ecology at each sample site. Sensitive habitats were highlighted, particularly those that overlapped with the proposed project area.

Using satellite photos and current land cover maps, homogenous vegetation units were subjectively determined. Within representative habitat units identified during the scoping fieldwork, timed meanders were used to assess floristic diversity and look for flora SCC. The focus was mostly on sensitive ecosystems that overlapped with the areas of the proposed project. For conducting floristic analysis, the timed random meander method is especially effective in identifying flora SCC and maximizing floristic coverage. A rapid indicator of flora diversity is provided by the method's efficiency in terms of time and money as well as its suitability for producing lists of plant species.

The timed meander search was performed based on the original technique described by Goff et al. (1982). Suitable habitat for SCC were identified according to Raimondo et al. (2009) and targeted as part of the timed meanders.

At each sample site notes were made regarding current impacts (e.g., livestock grazing, erosion etc.), subjective recording of dominant vegetation species and any sensitive features (e.g., wetlands, outcrops etc.). In addition, opportunistic observations were made while navigating through the project area.

##### **4.2.2 Fauna Survey**

The faunal assessment within this report pertains to herpetofauna (amphibians and reptiles) and mammals. The faunal field survey comprised of the following techniques:

- Visual and auditory searches - This typically comprised of meandering and using binoculars to view species from a distance without them being disturbed; and listening to species calls;
- Active hand-searches - are used for species that shelter in or under micro-habitats (typically rocks, exfoliating rock outcrops, fallen trees, leaf litter, bark etc.); and
- Utilization of local knowledge. Relevant field guides and texts consulted for identification purposes included the following:
  - Field Guide to Snakes and other Reptiles of Southern Africa (Branch, 1998);
  - A Complete Guide to the Snakes of Southern Africa (Marais, 2004);
  - Atlas and Red List of the Reptiles of South Africa, Lesotho and Swaziland (Bates et al, 2014);
  - A Complete Guide to the Frogs of Southern Africa (du Preez and Carruthers, 2009);
  - Smithers' Mammals of Southern Africa (Apps, 2000);
  - A Field Guide to the Tracks and Signs of Southern and East African Wildlife (Stuart and Stuart, 2000).

#### **4.3 Terrestrial Site Ecological Importance**

The different habitat types within the project area were delineated and identified based on observations during the field assessment, and available satellite imagery. These habitat types were assigned Ecological Importance (EI) categories based on their ecological integrity, conservation value, the presence of species of conservation concern and their ecosystem processes.

Site Ecological importance (SEI) is a function of the biodiversity importance (BI) of the receptor (e.g., species of conservation concern, the vegetation/fauna community or habitat type present on the site) and its resilience to impacts (receptor resilience [RR]) as follows:

$$SEI = BI + RR$$

BI in turn is a function of conservation importance (CI) and the functional integrity (FI) of the receptor as follows:

$$BI = CI + FI$$

Conservation importance (CI) is evaluated in accordance with recognised established internationally acceptable principles and criteria for the determination of biodiversity-related value, including the IUCN Red List of Species, Red List of Ecosystems and Key Biodiversity Areas (KBA; IUCN, 2016; Table 2).



*Table 1: Conservation importance (CI) criteria*

Conservation importance	Fulfilling criteria
Very high	Confirmed or highly likely occurrence of CR, EN, VU or Extremely Rare <sup>23</sup> or Critically Rare <sup>24</sup> species that have a global EOO of < 10 km <sup>2</sup> . Any area of natural habitat <sup>25</sup> of a CR ecosystem type or large area (> 0.1% of the total ecosystem type extent <sup>26</sup> ) of natural habitat of EN ecosystem type. Globally significant populations of congregatory species (> 10% of global population).
High	Confirmed or highly likely occurrence of CR, EN, VU species that have a global EOO of > 10 km <sup>2</sup> . IUCN threatened species (CR, EN, VU) must be listed under any criterion other than A. If listed as threatened only under Criterion A, include if there are less than 10 locations or < 10 000 mature individuals remaining. Small area (> 0.01% but < 0.1% of the total ecosystem type extent) of natural habitat of EN ecosystem type or large area (> 0.1%) of natural habitat of VU ecosystem type. Presence of Rare species. Globally significant populations of congregatory species (> 1% but < 10% of global population).
Medium	Confirmed or highly likely occurrence of populations of NT species, threatened species (CR, EN, VU) listed under Criterion A only and which have more than 10 locations or more than 10 000 mature individuals. Any area of natural habitat of threatened ecosystem type with status of VU. Presence of range-restricted species. > 50% of receptor contains natural habitat with potential to support SCC.
Low	No confirmed or highly likely populations of SCC. No confirmed or highly likely populations of range-restricted species. < 50% of receptor contains natural habitat with limited potential to support SCC.
Very low	No confirmed and highly unlikely populations of SCC. No confirmed and highly unlikely populations of range-restricted species. No natural habitat remaining.

<sup>23</sup> For butterflies, as per Armstrong *et al.* (2013).

<sup>24</sup> For plants, as per Raimondo *et al.* (2009).

<sup>25</sup> This excludes areas of transformed habitat within a defined ecosystem even if these are partially restored, e.g. Highveld grasslands that have been converted to maize fields and then abandoned so that some form of functional grassland is restored; this is not natural habitat as it does not and will not in the future have species composition representative of the original natural habitat.

<sup>26</sup> This can be calculated from the threatened ecosystem of South Africa shapefile available from the SANBI (current available version 2011: <http://bgis.sanbi.org/Projects/Detail/49>).

<sup>27</sup> Persistent ecological disruptors must not include components that landowners are legally obliged to address or that should be addressed as norm for best practice. Wilful neglect of these legal obligations or the presence of invasive alien species that can practically be controlled through management actions should not negatively influence the FI score to a major extent.

Functional integrity (FI) of the receptor (e.g. the vegetation/fauna community or habitat type) is defined here as the receptors' current ability to maintain the structure and functions that define it, compared to its known or predicted state under ideal conditions (Table 3).

**Table 2:Functional integrity (FI) criteria.**

Functional integrity	Fulfilling criteria
Very high	Very large (> 100 ha) intact area for any conservation status of ecosystem type or > 5 ha for CR ecosystem types. High habitat connectivity serving as functional ecological corridors, limited road network between intact habitat patches. No or minimal current negative ecological impacts with no signs of major past disturbance (e.g. ploughing).
High	Large (> 20 ha but < 100 ha) intact area for any conservation status of ecosystem type or > 10 ha for EN ecosystem types. Good habitat connectivity with potentially functional ecological corridors and a regularly used road network between intact habitat patches. Only minor current negative ecological impacts (e.g. few livestock utilising area) with no signs of major past disturbance (e.g. ploughing) and good rehabilitation potential.
Medium	Medium (> 5 ha but < 20 ha) semi-intact area for any conservation status of ecosystem type or > 20 ha for VU ecosystem types. Only narrow corridors of good habitat connectivity or larger areas of poor habitat connectivity and a busy used road network between intact habitat patches. Mostly minor current negative ecological impacts with some major impacts (e.g. established population of alien and invasive flora) and a few signs of minor past disturbance. Moderate rehabilitation potential.
Low	Small (> 1 ha but < 5 ha) area. Almost no habitat connectivity but migrations still possible across some modified or degraded natural habitat and a very busy used road network surrounds the area. Low rehabilitation potential. Several minor and major current negative ecological impacts.
Very low	Very small (< 1 ha) area. No habitat connectivity except for flying species or flora with wind-dispersed seeds. Several major current negative ecological impacts.

Recalling that biodiversity importance (BI) is a function of conservation importance (CI) and the functional integrity (FI) of a receptor, BI can be derived from a simple matrix of CI and FI as follows:

**Table 3:Determining the BI**

Biodiversity importance		Conservation importance				
		Very high	High	Medium	Low	Very low
Functional integrity	Very high	Very high	Very high	High	Medium	Low
	High	Very high	High	Medium	Medium	Low
	Medium	High	Medium	Medium	Low	Very low
	Low	Medium	Medium	Low	Low	Very low
	Very low	Medium	Low	Very low	Very low	Very low

Receptor resilience (RR) is defined here as: ‘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.’ See Table 4.

**Table 4: Resilience criteria**

Resilience	Fulfilling criteria
Very high	Habitat that can recover rapidly (~ less than 5 years) to restore > 75% <sup>28</sup> of the original species composition and functionality of the receptor functionality, or species that have a very high likelihood of remaining at a site even when a disturbance or impact is occurring, or species that have a very high likelihood of returning to a site once the disturbance or impact has been removed.
High	Habitat that can recover relatively quickly (~ 5–10 years) to restore > 75% of the original species composition and functionality of the receptor functionality, or species that have a high likelihood of remaining at a site even when a disturbance or impact is occurring, or species that have a high likelihood of returning to a site once the disturbance or impact has been removed.
Medium	Will recover slowly (~ more than 10 years) to restore > 75% of the original species composition and functionality of the receptor functionality, or species that have a moderate likelihood of remaining at a site even when a disturbance or impact is occurring, or species that have a moderate likelihood of returning to a site once the disturbance or impact has been removed.
Low	Habitat that is unlikely to be able to recover fully after a relatively long period: > 15 years required to restore ~ less than 50% of the original species composition and functionality of the receptor functionality, or species that have a low likelihood of remaining at a site even when a disturbance or impact is occurring, or species that have a low likelihood of returning to a site once the disturbance or impact has been removed.
Very low	Habitat that is unable to recover from major impacts, or species that are unlikely to remain at a site even when a disturbance or impact is occurring, or species that are unlikely to return to a site once the disturbance or impact has been removed.

Finally, after the successful evaluation of both BI and RR as described above, it is possible to evaluate SEI from the final matrix as follows (Table 5) and interpreted accordingly (Table 6):

**Table 5: Determining the SEI.**

Site ecological importance		Biodiversity importance				
		Very high	High	Medium	Low	Very low
Receptor resilience	Very low	Very high	Very high	High	Medium	Low
	Low	Very high	Very high	High	Medium	Very low
	Medium	Very high	High	Medium	Low	Very low
	High	High	Medium	Low	Very low	Very low
	Very high	Medium	Low	Very low	Very low	Very low

*Table 6: Guidelines for interpreting SEI in the context of the proposed development activities.*

Site ecological importance	Interpretation in relation to proposed development activities
Very high	Avoidance mitigation – no destructive development activities should be considered. Offset mitigation not acceptable/not possible (i.e. last remaining populations of species, last remaining good condition patches of ecosystems/ unique species assemblages). Destructive impacts for species/ecosystems where persistence target remains.
High	Avoidance mitigation wherever possible. Minimisation mitigation – changes to project infrastructure design to limit the amount of habitat impacted; limited development activities of low impact acceptable. Offset mitigation may be required for high impact activities.
Medium	Minimisation and restoration mitigation – development activities of medium impact acceptable followed by appropriate restoration activities.
Low	Minimisation and restoration mitigation – development activities of medium to high impact acceptable followed by appropriate restoration activities.
Very low	Minimisation mitigation – development activities of medium to high impact acceptable and restoration activities may not be required.

## 5 ASSUMPTIONS AND LIMITATIONS

The following assumptions and limitations are applicable for this assessment:

- The assessment area was based on the area provided by the client and any alterations to the route and/or missing GIS information pertaining to the assessment area would have affected the area surveyed;
- The area was only surveyed during a single season and therefore, this assessment does not consider temporal trends;
- Only a single season survey will be conducted for the respective studies, this would constitute a wet season survey with its limitations;
- Some winter flowering plants could have been missed due to the wet season survey timing
- It must be noted that during the survey, only a fraction of the expected geophytes was visible due to their variable emergence patterns.
- Whilst every effort is made to cover as much of the project area as possible, representative sampling is completed and by its nature, it is possible that some plant and animal species that are present across the project area were not recorded during the field investigations.



## 6 RESULTS AND DISCUSSION

### 6.1 Desktop Assessment

#### 6.1.1 Ecologically Important landscape features

The GIS analysis pertaining to the relevance of the proposed project to ecologically important landscape features are summarised in Table 7.

*Table 7: Summary of relevance of the proposed project to ecologically important landscape*

Desktop Information Considered	Relevance	Section
<b>Ecosystem Threat Status</b>	Relevant	6.1.1.1
<b>Protected Areas</b>	Relevant	6.1.1.2
<b>Renewable Energy Development Zones</b>	Not relevant	6.1.1.3
<b>Powerline Corridor</b>	Not Relevant	6.1.1.3
<b>Critical Biodiversity Areas</b>	Relevant	6.1.1.4
<b>National Protected Areas Expansion Strategy</b>	Relevant	6.1.1.5
<b>Important Bird and Biodiversity Areas</b>	Not Relevant	–

##### 6.1.1.1 Ecosystem Threat Status

Based on a scientific approach used at national level by SANBI (Driver et al., 2005), vegetation types can be categorised according to their conservation status which is, in turn, assessed according to the degree of transformation relative to the expected extent of each vegetation type (Table 8). The status of a habitat or vegetation type is based on how much of its original area remains intact relative to various thresholds. The original extent of a vegetation type is as presented in the most recent national vegetation map (SANBI, 2012) and is the extent of the vegetation type in the absence of any historical human impact. On a national scale the thresholds are as depicted in Table 3 below, as determined by best available scientific approaches (Driver et al., 2005). The level at which an ecosystem becomes Critically Endangered differs from one ecosystem to another and varies from 16% to 36% (Driver et al., 2005).



*Table 8: Determining ecosystem status (Driver et al., 2005).*

Habitat remaining (%)	80 -100	Least Threatened	LT/ LC
	60 - 80	Vulnerable	VU
	Biodiversity target - 60	Endangered	EN
	0 – Biodiversity Target	Critically Endangered	CR

DFFE has published the revised national list of ecosystems that are threatened and in need of protection. The revised list has been published in Government Gazette 47526 (Notice No.689) on 18 November 2022 in terms of the National Environmental Management: Biodiversity Act (NEMBA). By listing the ecosystems that are threatened or in need of protection, anyone wanting to undertake any activity will require environmental authorisation to do so. The list of ecosystems is used to support decision-making and to inform bioregional planning. The revised national list of ecosystems that are threatened or in need of protection was developed between 2016 and 2020 and incorporates the best available information on terrestrial ecosystem extent and condition, pressures, and drivers of change (DFFE, 2022).

A total of 120 of the 456 terrestrial ecosystem types assessed are categorised as threatened. Together these threatened ecosystem types make up approximately 10% of the remaining natural habitat in the country. Of the 120 terrestrial ecosystems 55 are critically endangered, 51 endangered and 14 have been found to be vulnerable (DFFE, 2022).

The site forms part of an endemic habitat system (Figure 6, Figure 7) but the main development is on an area of least concern in terms of conservation status, (Figure 4, Figure 5)(SANBI & DFFE, 2021).

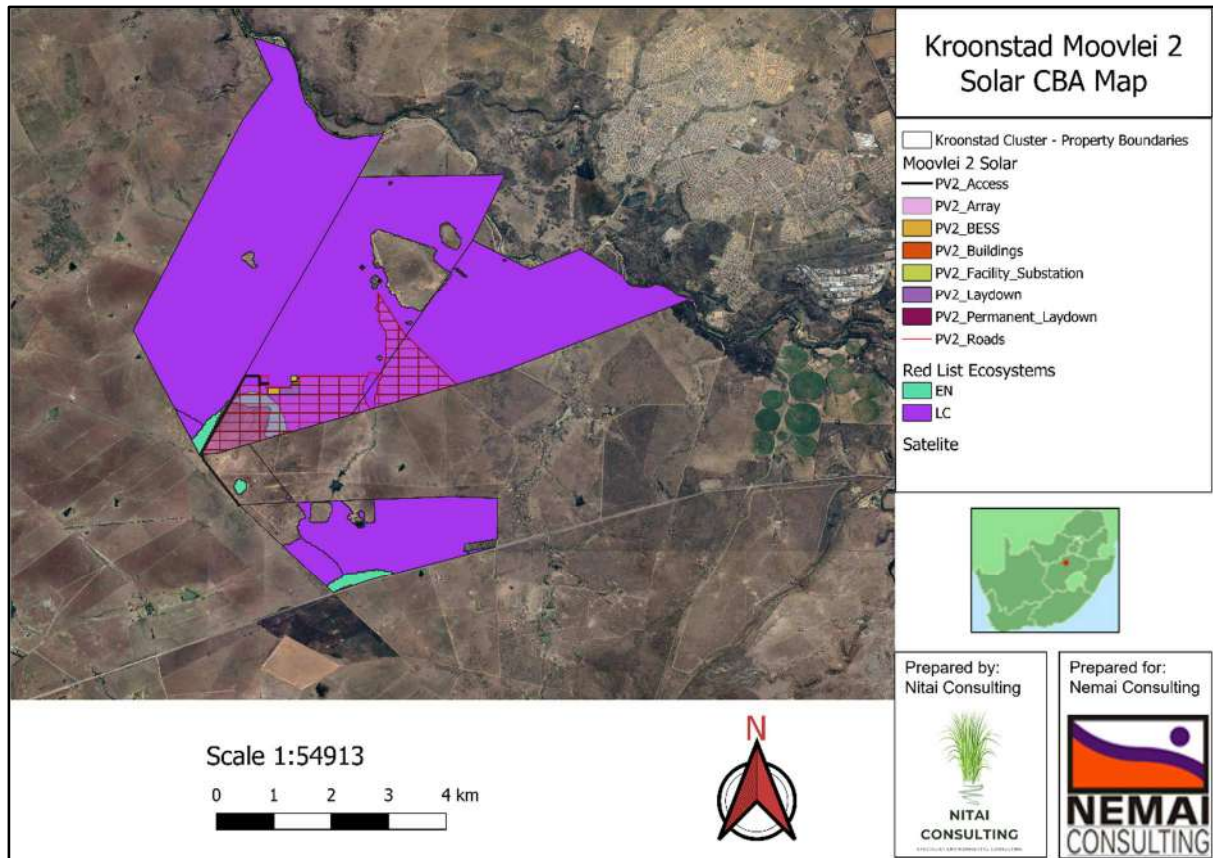


Figure 4: Study site with Endangered and Least Concern ecosystem

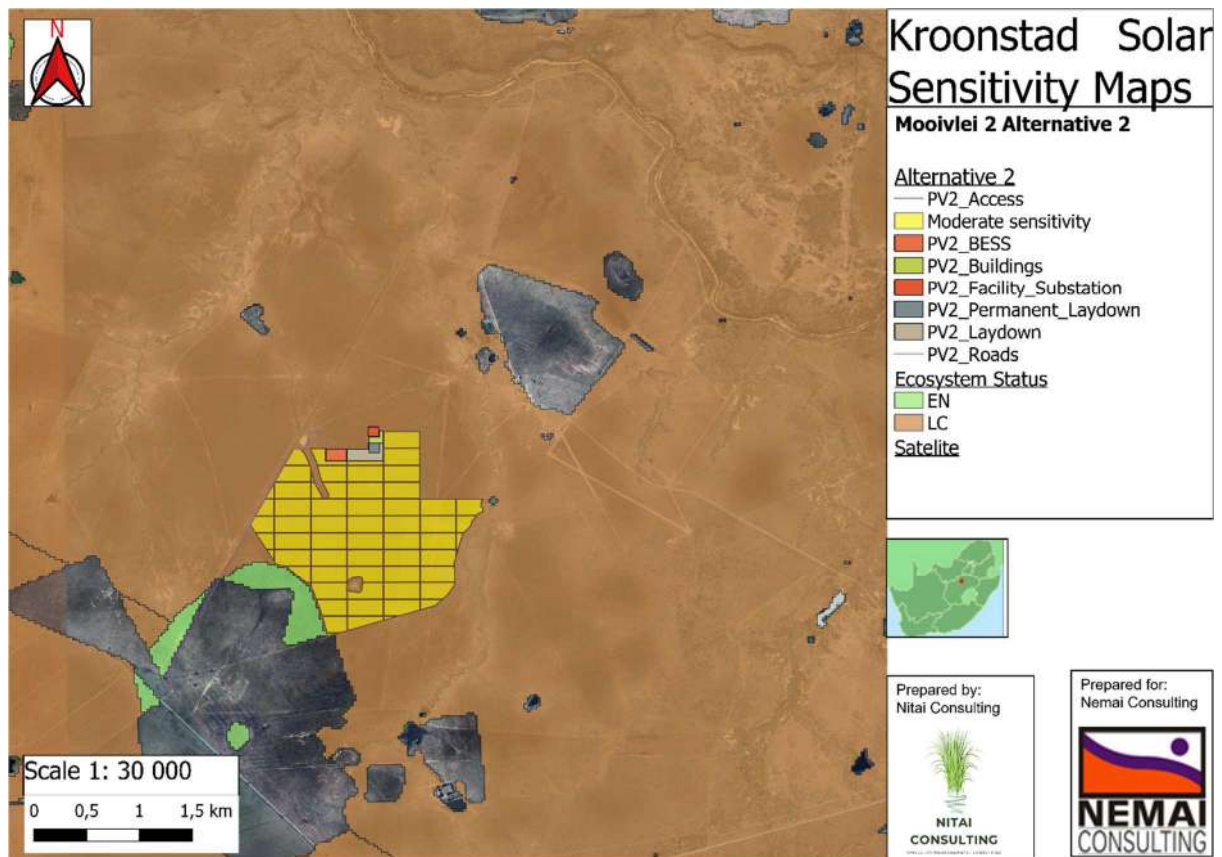


Figure 5: Study site with Endangered and Least Concern ecosystem

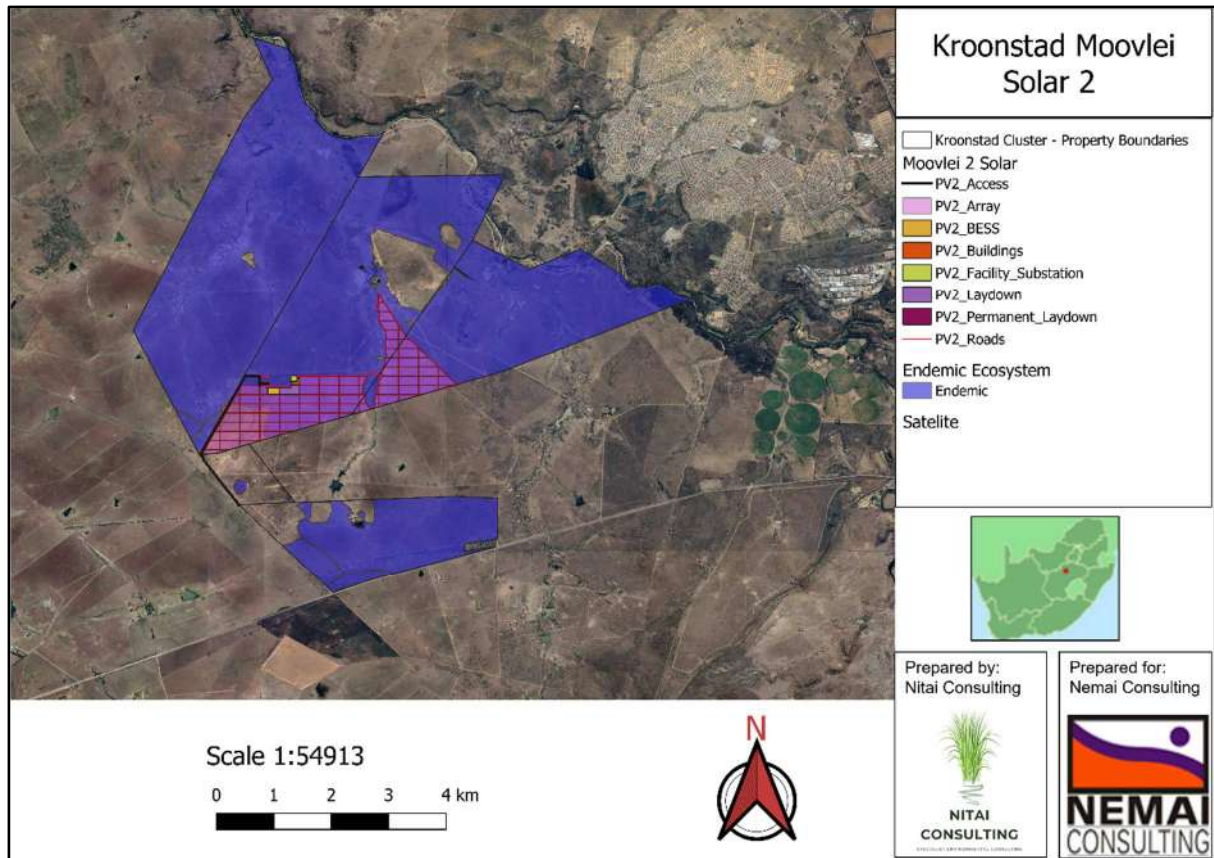


Figure 6: Study site with Endemic classification



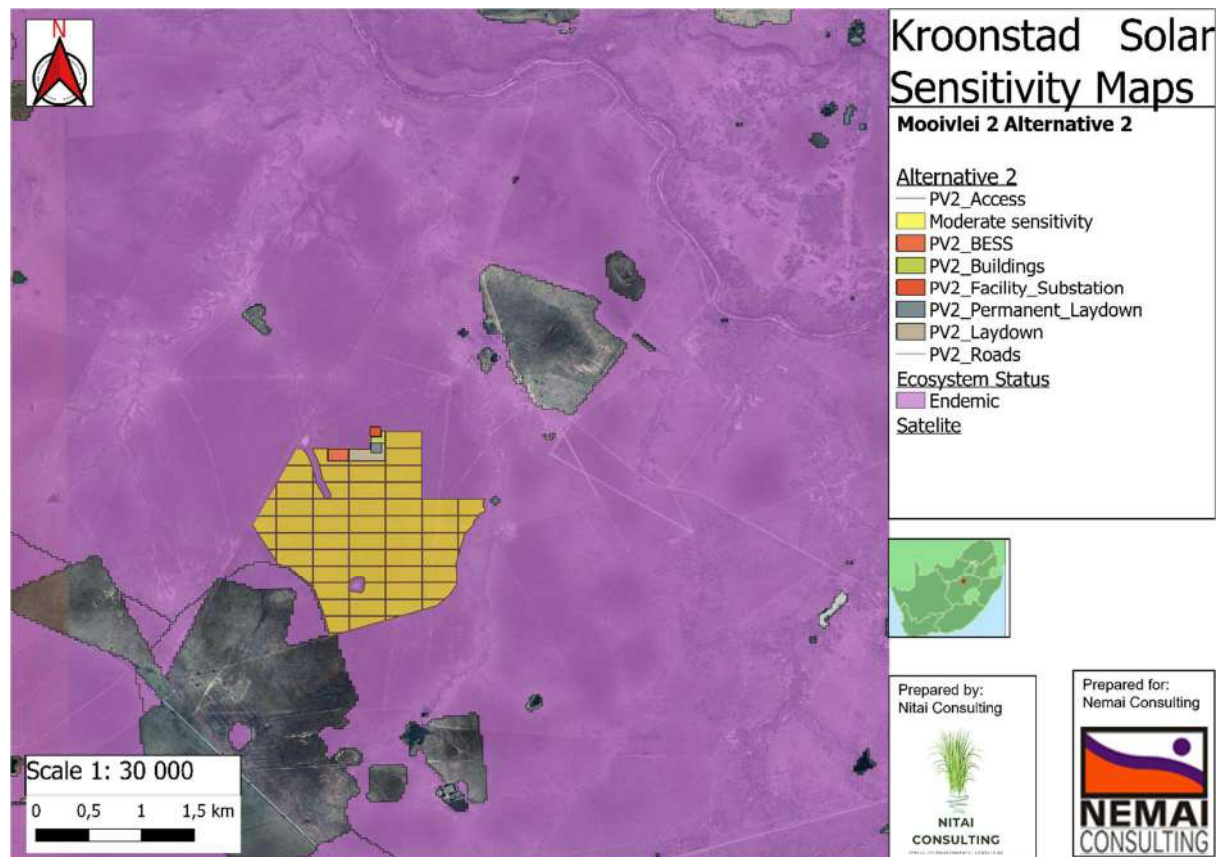


Figure 7: Study site with Endemic classification

#### 6.1.1.2 Protected Areas

According to the spatial data for SAPAD (2022) and SACAD (2022), the project area lies within the 5 km buffer for Boslaagte Private Nature Reserve Park and is thus inside the regulated area (Figure 8).



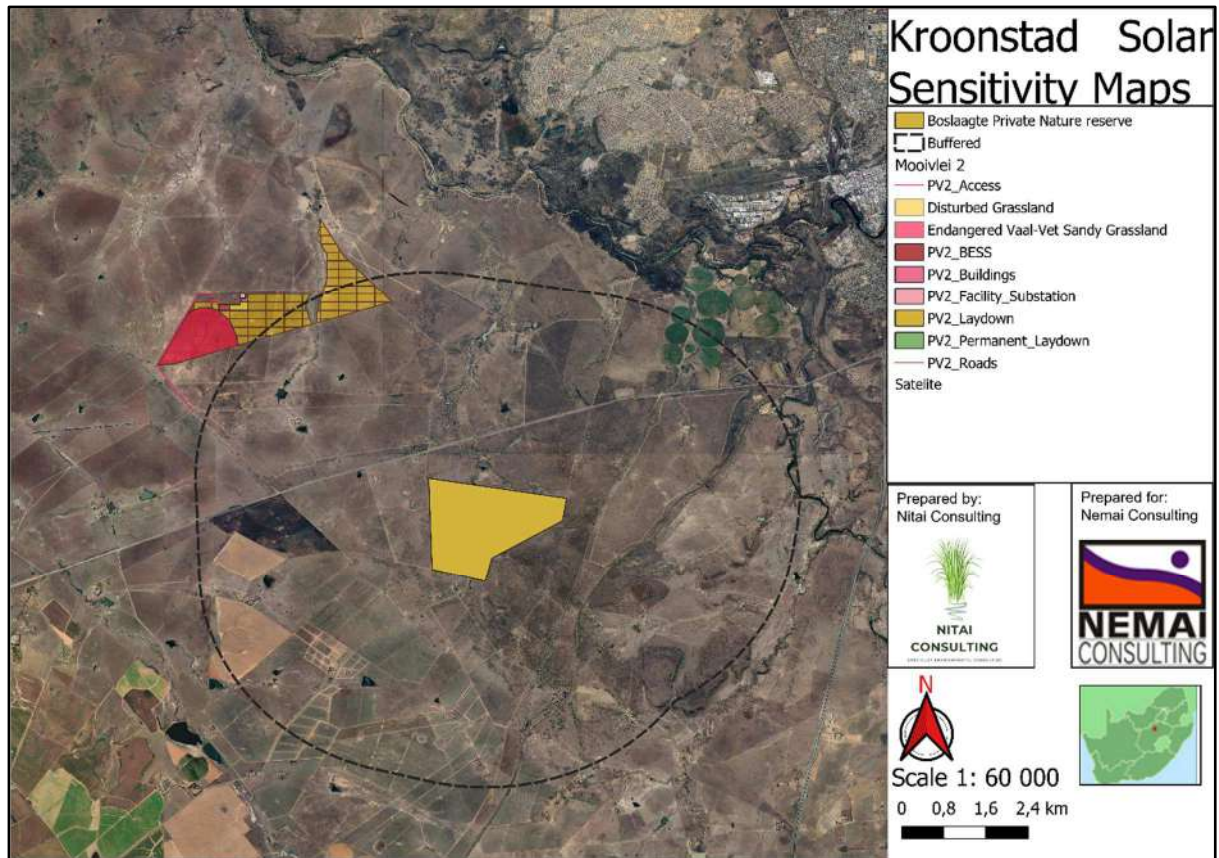


Figure 8: Map illustrating the project area in relation to the nearest protected areas.

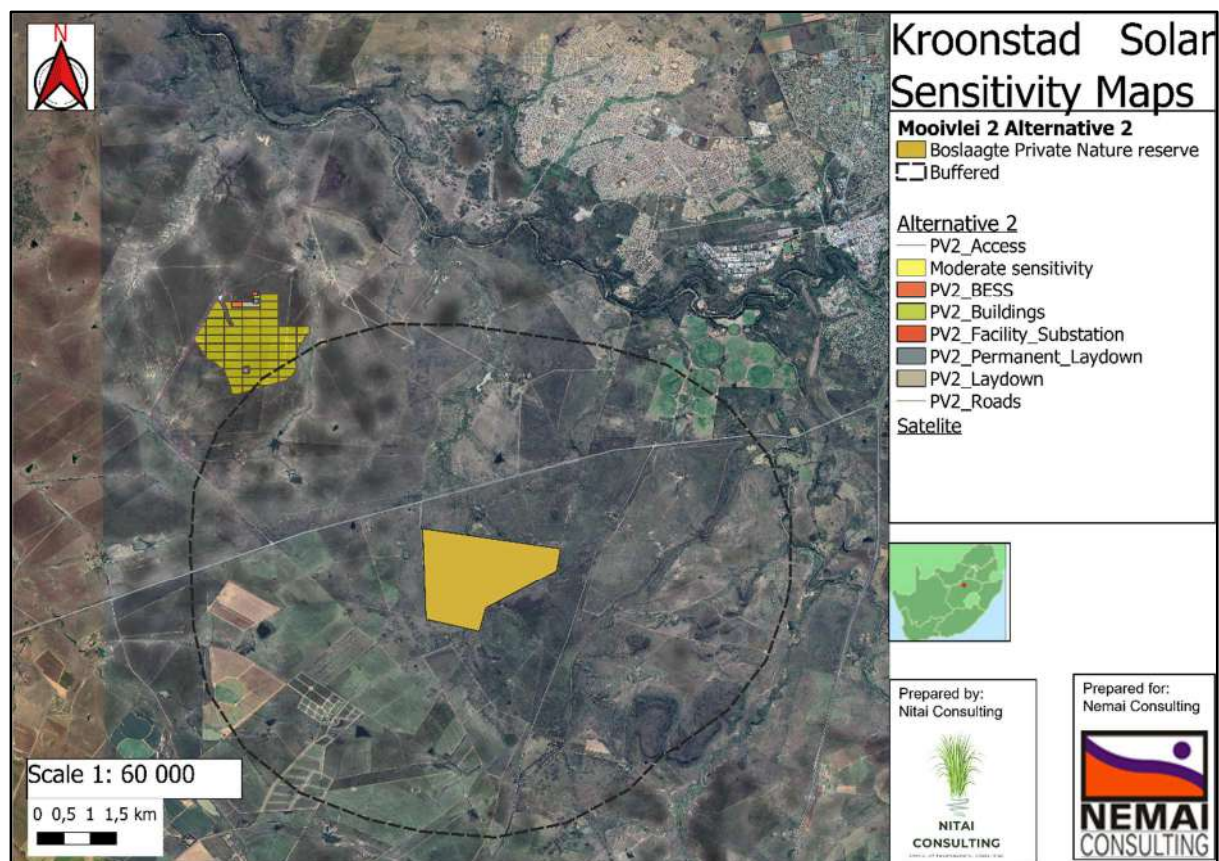


Figure 9: Map illustrating the project area in relation to the nearest protected areas.

### 6.1.1.3 Renewable Energy Development Zones (REDZ)

In 2018 the Government Notice No. 114 in Government Gazette No. 41445 was published where 8 renewable energy development zones important for the development of large-scale wind and solar photovoltaic facilities were identified. In 2021 an additional 3 sites were included. The REDZs were identified through the undertaking of 2 Strategic Environmental Assessments. The spatial dataset indicated that the project area does not overlap with any REDZ or Power line Corridors.

### 6.1.1.4 Critical Biodiversity Areas end Ecological Support Areas

The key output of a systematic biodiversity plan is a map of biodiversity priority areas. The CBA map delineates Critical Biodiversity Areas (CBAs), Ecological Support Areas (ESAs), Other Natural Areas (ONAs), Protected Areas (PAs), and areas that have been irreversibly modified from their natural state.

**Critical Biodiversity Areas (CBAs)** are terrestrial and aquatic areas of the landscape that need to be maintained in a natural or near-natural state to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. CBAs are areas of high biodiversity value and need to be kept in a natural state, with no further loss of habitat or species. Thus, if these areas are not maintained in a natural or near natural state then biodiversity targets cannot be met.



Maintaining an area in a natural state can include a variety of biodiversity compatible land uses and resource uses (SANBI-BGIS, 2017).

**Ecological Support Areas (ESAs)** are not essential for meeting biodiversity targets but play an important role in supporting the ecological functioning of Critical Biodiversity Areas and/or in delivering ecosystem services. Critical Biodiversity Areas and Ecological Support Areas may be terrestrial or aquatic (SANBI-BGIS, 2017).

**Other Natural Areas (ONAs)** consist of all those areas in good or fair ecological condition that fall outside the protected area network and have not been identified as CBAs or ESAs. A biodiversity sector plan or bioregional plan must not specify the desired state/management objectives for ONAs or provide land-use guidelines for ONAs (SANBI-BGIS, 2017).

Figure 10 shows the project area superimposed on the Terrestrial CBA map. The project area overlaps with CBA 1, CBA2, an ESA1, and ESA 2 areas. Figure 11 shows the CBA areas for Alternative 2.

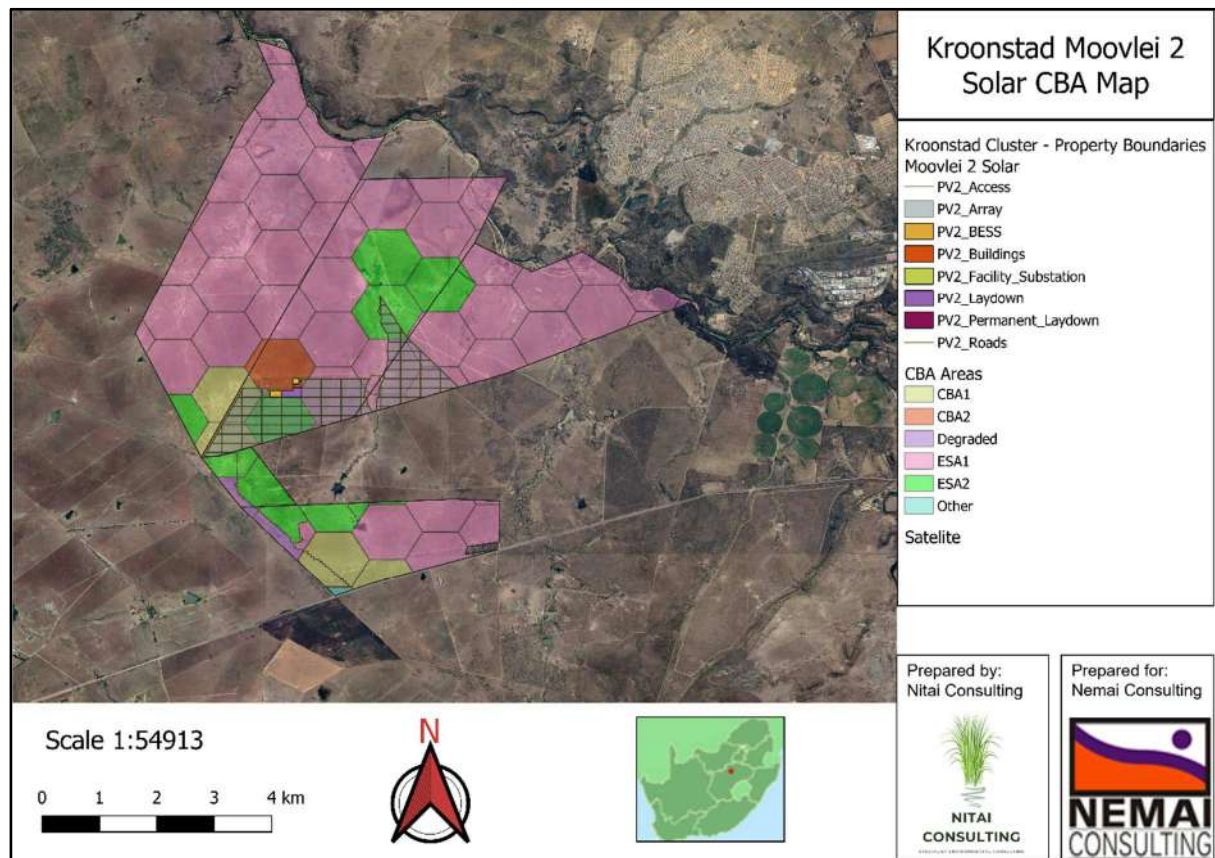


Figure 10: Map illustrating the locations of CBAs in the project area.

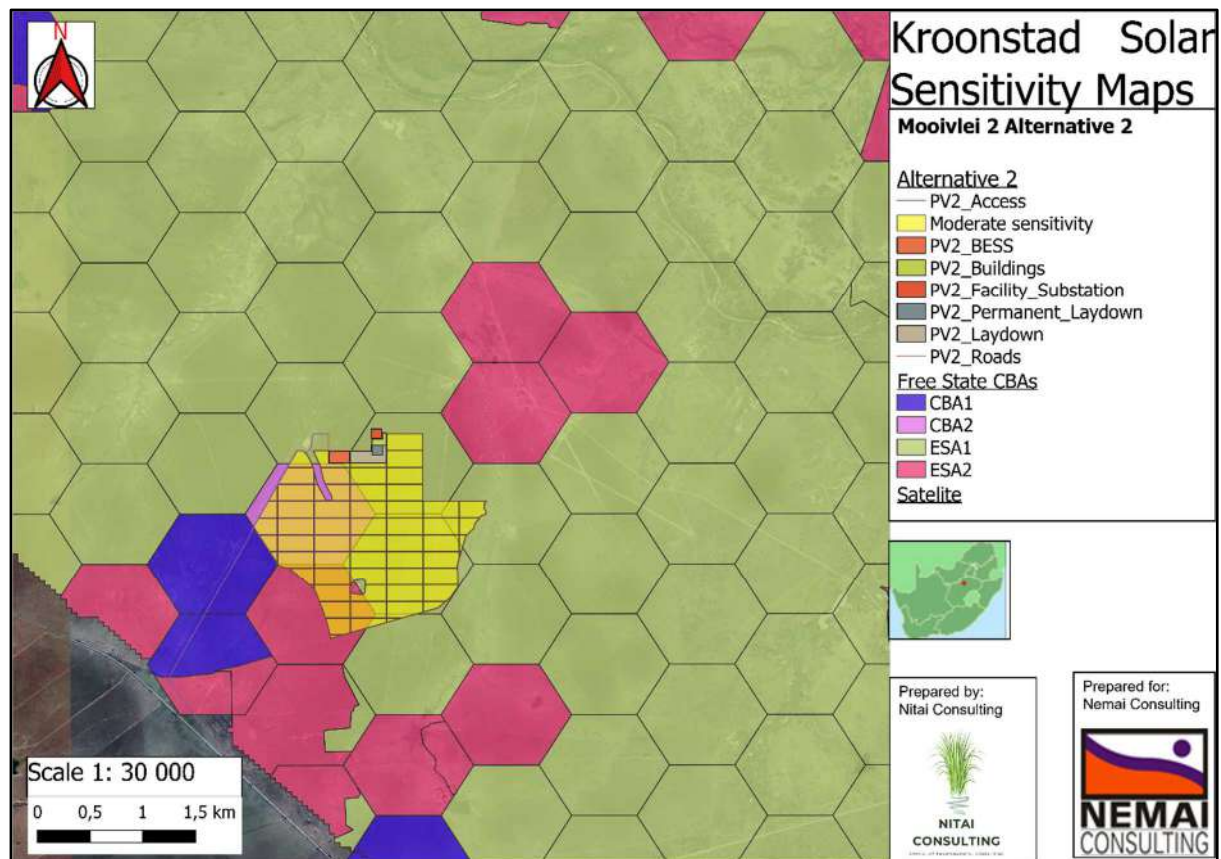


Figure 11: Map illustrating the locations of CBAs in the project area.

#### 6.1.1.5 National Protected Areas expansion Strategy

National Protected Area Expansion Strategy 2017 (NPAES) were identified through a systematic biodiversity planning process. They present the best opportunities for meeting the ecosystem-specific protected area targets set in the NPAES and were designed with strong emphasis on climate change resilience and requirements for protecting freshwater ecosystems. These areas should not be seen as future boundaries of protected areas, as in many cases only a portion of a particular focus area would be required to meet the protected area targets set in the NPAES. They are also not a replacement for fine scale planning which may identify a range of different priority sites based on local requirements, constraints, and opportunities (NPAES, 2017). The project area does overlap with the Priority Focus Areas, as per the NPAES (Figure 12, Figure 13).

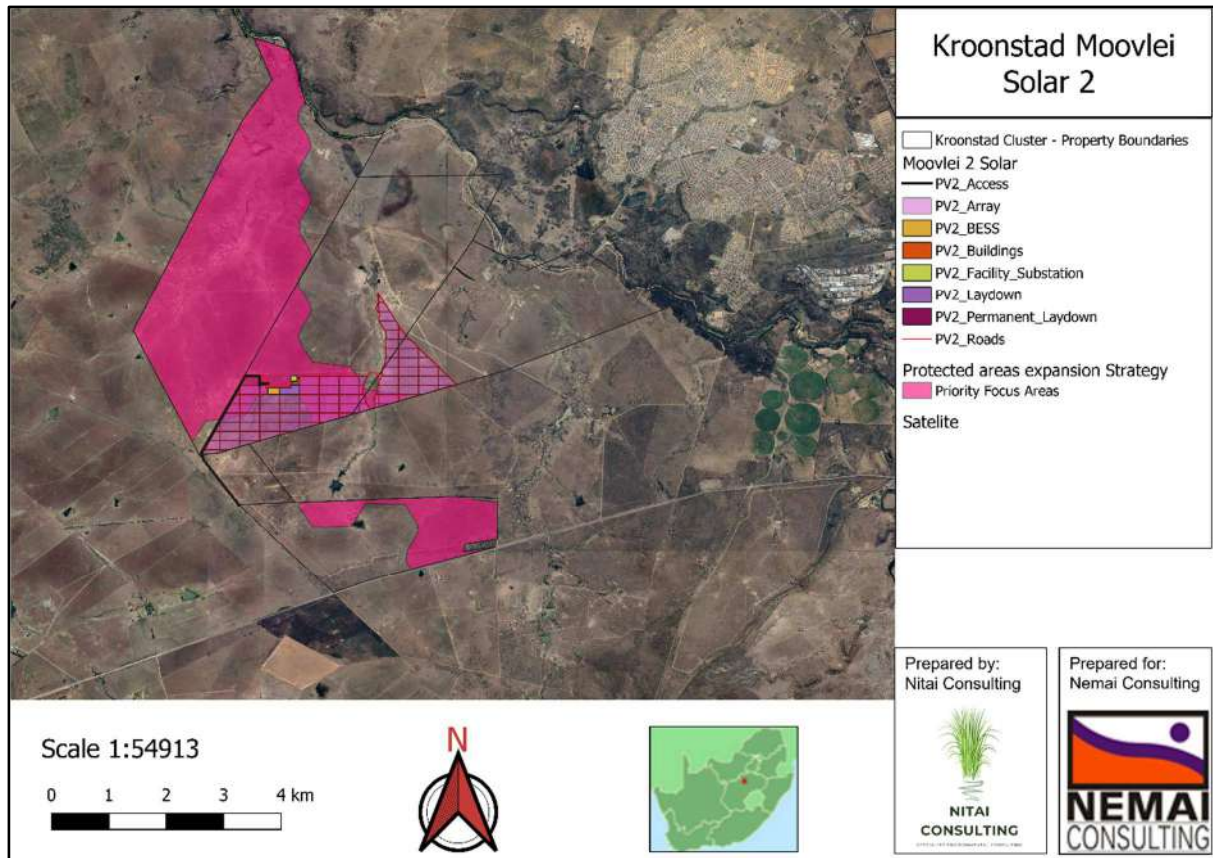


Figure 12: The project area in relation to the National Protected Area Expansion Strategy.



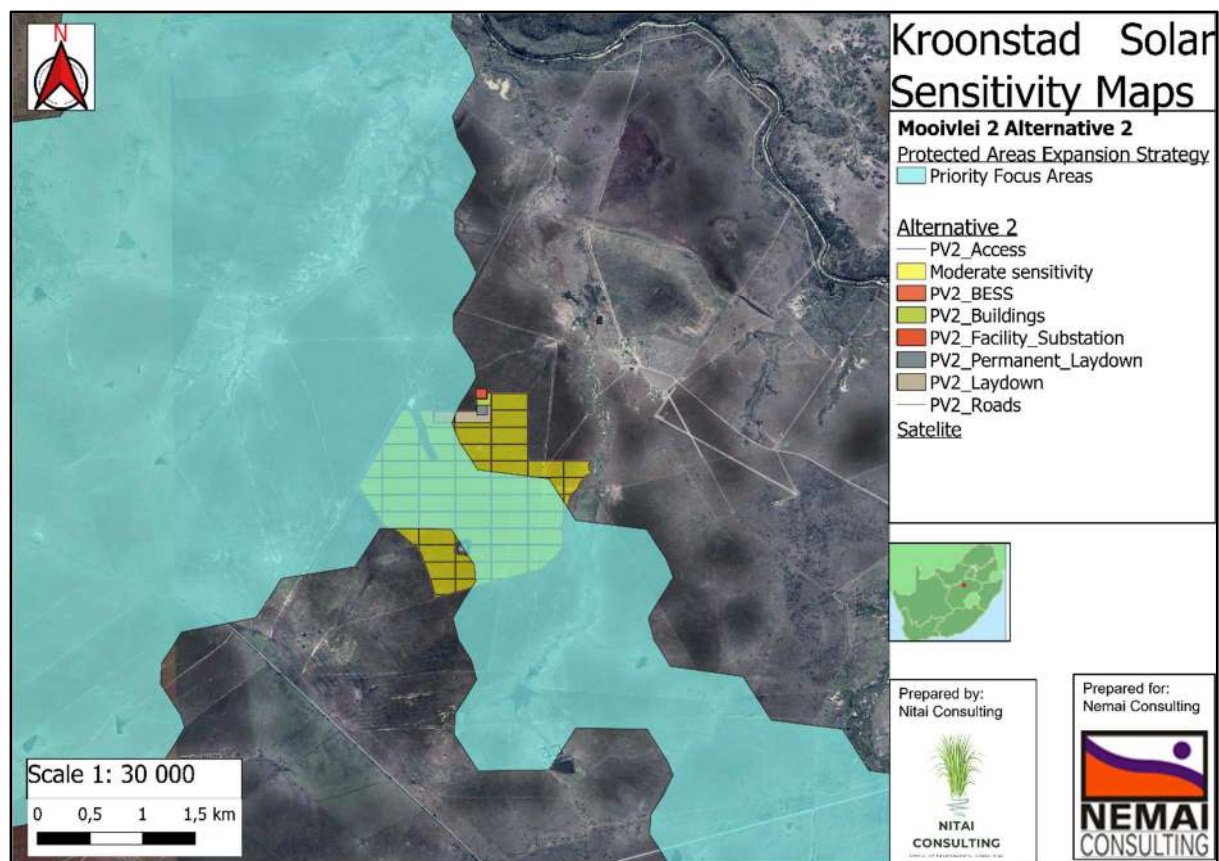


Figure 13: The project area in relation to the National Protected Area Expansion Strategy.

#### 6.1.1.6 Renewable Energy projects

The South African Renewable Energy EIA Application Database (REEA) contains spatial data for renewable energy applications for environmental authorisation. It includes spatial and attribute information for both active (in process and with valid authorisations) and non-active (lapsed or replaced by amendments) applications. Data is captured and managed on a parcels level as well as aggregated to the project level. Only outer boundaries are provided in this release. The purpose of the spatial data is to produce and maintain a comprehensive spatial database on renewable energy EIA applications in the country. The database is suitable for a wide range of planning, assessment, analysis, and display purposes. One existing and approved application for developments are found in the vicinity of the project site (Figure 14, Figure 15), but the scoping report for this project indicates it is a small area to the west of the border of this proposed project (Savannah Environmental, 2020). The data used to determine the number of applications in the nearby area were obtained from SA Renewable Energy EIA Application Database (REEA) (<https://egis.environment.gov.za/>) and were accurate as per 4 May 2023.

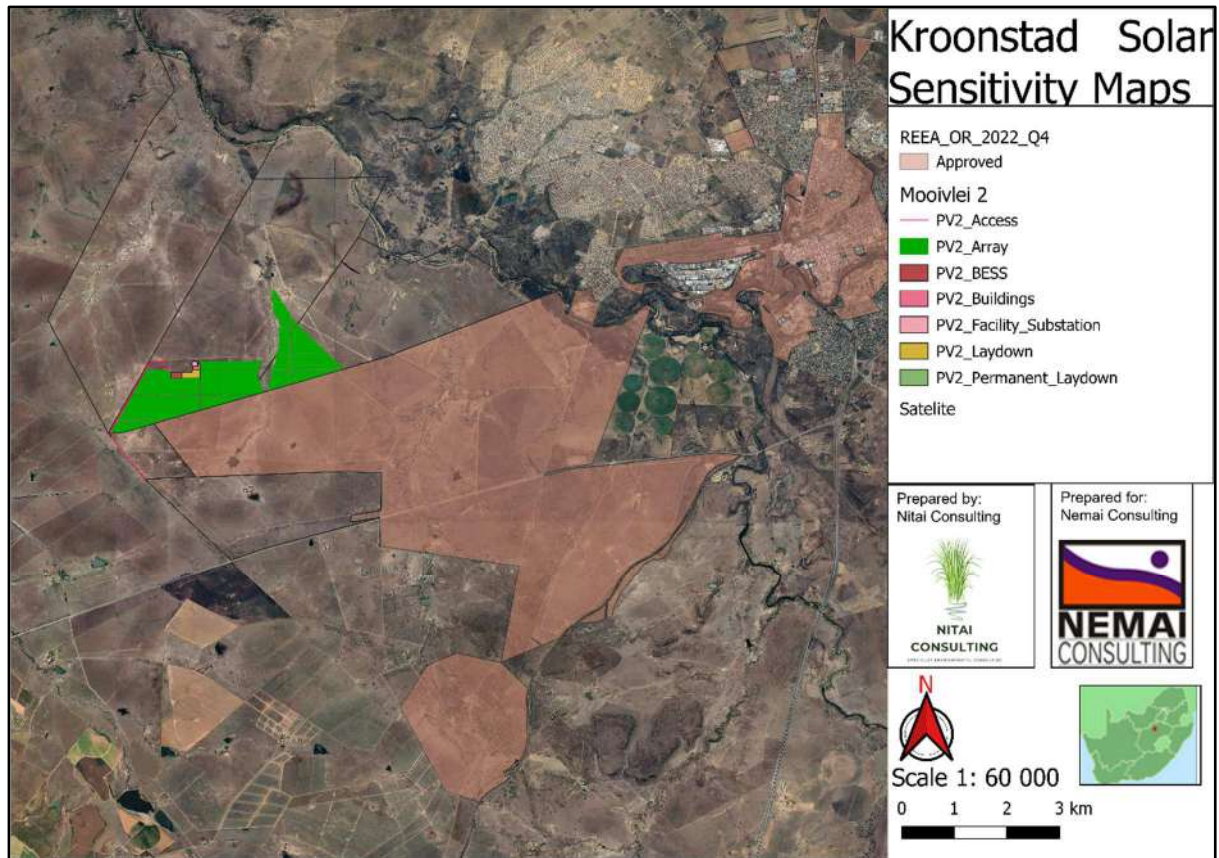


Figure 14: Existing, approved Renewable Energy EIA project.



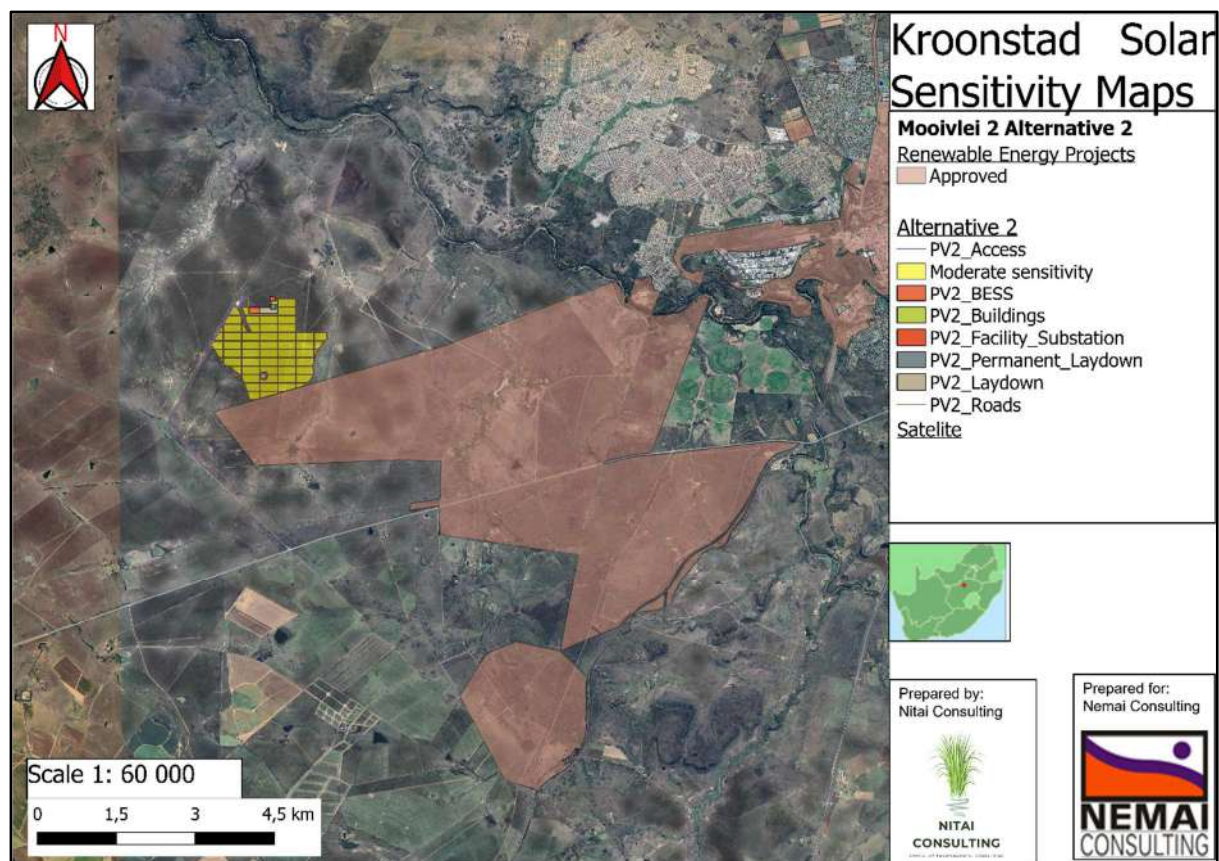


Figure 15: Existing, approved Renewable Energy EIA project.

### 6.1.2 Flora Assessment

This section is divided into a description of the vegetation type expected under natural conditions and the expected flora species.

#### 6.1.2.1 Vegetation Type

The project area is situated within the Grassland Biome. In South Africa, the Grassland Biome occurs mainly on the high central plateau (Highveld), the inland areas of the eastern seaboard, the mountainous areas of KwaZulu-Natal (KZN) and the central parts of the Eastern Cape (Mucina & Rutherford, 2006). However, grasslands can also be found below the Drakensberg, both in KZN and the Eastern Cape, with floristic links to the high-altitude Drakensberg grassland (Mucina & Rutherford, 2006).

The topography is mainly flat to rolling, but also includes mountainous regions and the Escarpment (Mucina & Rutherford, 2006). Altitude is mostly from about 300 to 400 m.a.s.l, but reaches up to 3 482 m on Thabana Ntlenyana, the highest mountain in southern Africa (Mucina & Rutherford, 2006). In terms of climate, the temperate grasslands of the Highveld in South Africa have cold and dry conditions, with rainfall during the summer (which can sometimes be a strong summer rainfall) and winter drought (Mucina & Rutherford, 2006).

Frost is common and there is a high risk of lightning-induced fires (Mucina & Rutherford, 2006). In terms of vegetation structural composition, grasslands are characteristically dominated by grasses of the Poaceae Family (Mucina & Rutherford, 2006). On the Lesotho Plateau and highest peaks of the Drakensberg, grassland plants xeromorphic characteristics due to the severity of the climate in these places (Mucina & Rutherford, 2006).

On a fine-scale vegetation type, the project area overlaps with Central free State Grassland and the Vaal-Vat Sandy Grassland (Figure 16, Figure 17 does not include the Vaal-Vet Sandy Grassland).

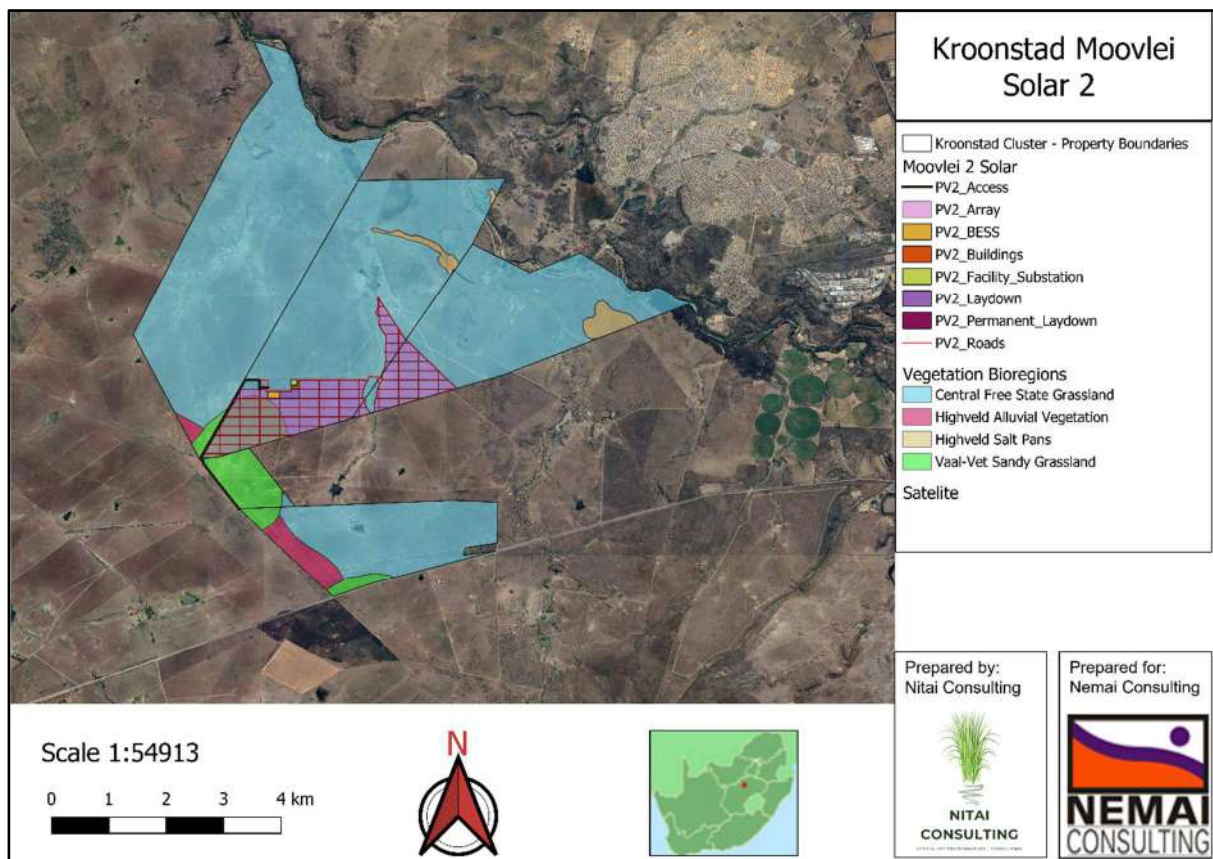


Figure 16: Map illustrating the vegetation type associated with the project area.

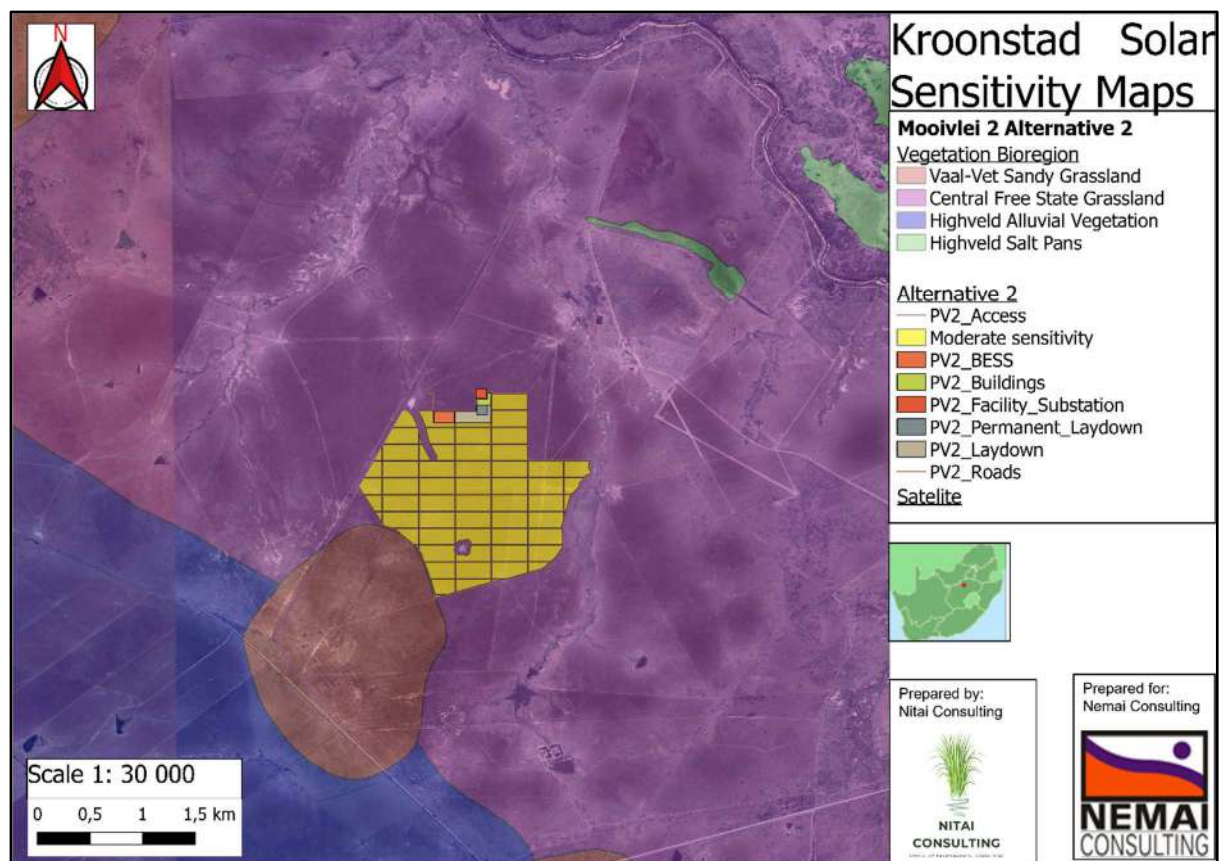


Figure 17: Map illustrating the vegetation type associated with the project area.

### Central Free State Grassland

**Distribution:** Free State Province and marginally into Gauteng Province: A broad zone from around Sasolburg in the north to Dewetsdorp in the south. Other major settlements located within this unit include Kroonstad, Ventersburg, Steynsrus, Winburg, Lindley and Edenville

**Altitude:** 1 300–1 640 m.

**Vegetation & Landscape Features:** Undulating plains supporting short grassland, in natural condition dominated by *Themeda triandra* while *Eragrostis curvula* and *E. chloromelas* become dominant in degraded habitats. Dwarf karoo bushes establish in severely degraded clayey bottomlands. Overgrazed and trampled low-lying areas with heavy clayey soils are prone to *Acacia karroo* encroachment.

**Geology & Soils:** Sedimentary mudstones and sandstone mainly of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) as well as those of the Ecca Group (Karoo Supergroup) found in the extreme northern section of this grassland, giving rise to vertic, melanic and red soils (typical forms are Arcadia, Bonheim, Kroonstad, Valsrivier and Rensburg)—typical of Dc land type (dominating the landscape). The less common intrusive dolerites of the Jurassic Karoo Dolerite Suite support dry clayey soils typical of the Ea land type



**Climate:** Summer-rainfall seasonal precipitation region, with MAP 560 mm. Much of the rainfall is of convectonal origin and peaks in December to January. The overall MAT around 15°C. Incidence of frost relatively high (43 days on average).

**Important Taxa**

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

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

Geophytic Herbs: *Oxalis depressa*, *Raphionacme dyeri*. Succulent Herb: *Tripteris aghillana* var. *integrifolia*.

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

**Conservation Status:** The ecosystem is rated as Least concern according to the 2022 Red List ecosystem (Table 9) data since there is 66% remaining of this ecosystem. It has experienced low rates of natural habitat loss and biotic disruptions, placing this ecosystem at low risk of collapse and 2.3% is currently formally protected (DFFE, 2022).

*Table 9: Conservation status of different Central Free State Grassland types occurring in the study area (SANBI, 2021)*

Ecosystem Detail	Central free State Grassland
Reference number	Gh6
Threat status	LC (Least Concern)
Listed under criterion	(No Criteria for LC)
Biome	Grassland
Original area	1601284 (ha)
Remaining area	66 %
Protected area	2.3 %

Description	<p>A broad zone from around Sasolburg in the north to Dewetsdorp in the south. Other major settlements located within this unit include Kroonstad, Ventersburg, Steynsrus, Winburg, Lindley and Edenville. Undulating plains supporting short grassland, in natural condition dominated by <i>Themeda triandra</i> while <i>Eragrostis curvula</i> and <i>E. chloromelas</i> become dominant in degraded habitats. Dwarf karoo bushes establish in severely degraded clayey bottomlands. Overgrazed and trampled low-lying areas with heavy clayey soils are prone to <i>Acacia</i> karoo encroachment. Pressures &amp; threats: Agriculture is a key pressure on this ecosystem type, with 3958.7 km<sup>2</sup> of the ecosystem consisting of croplands and a further 879.11 km<sup>2</sup> of old fields. Urban development has added to the pressures with 203.19 km<sup>2</sup> of the ecosystem consisting of built-up areas. Approximately 187.2 km<sup>2</sup> covered by artificial water bodies. Additionally, the ecosystem is degraded by erosion and bush encroachment, especially by dwarf karoo shrubs (Mucina et al. 2006).</p>
Notes	<p>Central Free State Grassland has experienced low rates of natural habitat loss and biotic disruptions, placing this ecosystem at low risk of collapse. Scope: Global &amp; national status (global extent assessed).</p>

### Vaal-Vet Sandy Grassland

**Distribution:** North-West and Free State Provinces: South of Lichtenburg and Ventersdorp, stretching southwards to Klerksdorp, Leeudoringstad, Bothaville and to the Brandfort area north of Bloemfontein.

**Altitude:** 1 220–1 560 m, generally 1 260–1 360 m.

**Vegetation & Landscape Features:** Plains-dominated landscape with some scattered, slightly irregular undulating plains and hills. Mainly low-tussock grasslands with an abundant karroid element. Dominance of *Themeda triandra* is an important feature of this vegetation unit. Locally low cover of *T. triandra* and the associated increase in *Elionurus muticus*, *Cymbopogon pospischilii* and *Aristida congesta* is attributed to heavy grazing and/or erratic rainfall.

**Geology & Soils:** Aeolian and colluvial sand overlying sandstone, mudstone, and shale of the Karoo Supergroup (mostly the Ecca Group) as well as older Ventersdorp Supergroup andesite and basement gneiss in the north. Soil forms are mostly Avalon, Westleigh and Clovelly. Dominant land type Bd, closely followed by Bc, Ae and Ba.

**Climate:** Warm-temperate, summer-rainfall climate, with overall MAP of 530 mm. High summer temperatures. Severe frost (37 days per year on average) occurs in winter.

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

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

Geophytic Herbs: *Bulbine narcissifolia*, *Ledebouria marginata*.

Succulent Herb: *Tripteris aghillana var. integrifolia*.

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

**Endemic Taxon Herb:** *Lessertia phillipsiana*.

**Conservation Status:** The ecosystem is rated as Endangered according to the 2022 Red List ecosystem data since there is 28% remaining of this ecosystem (Table 10). National land cover data show that Vaal-Vet Sandy Grassland has experienced extensive spatial declines of approximately 72% since 1750 and only 0.7% is currently formally protected (DFFE, 2022).

**Table 10:: Conservation status of different Vaal-Vet Sandy Grassland types occurring in the study area (SANBI, 2021)**

Ecosystem Detail	Vaal-Vet Sandy Grassland
Reference number	Gh10
Threat status	Endangered
Listed under criterion	A (Criterion A)
Biome	Grassland
Original area	2284382 (ha)
Remaining area	28 %
Protected area	0.7 %

<p>Description</p>	<p>South of Lichtenburg and Ventersdorp, stretching southwards to Klerksdorp, Leeudoringstad, Bothaville and to the Brandfort area north of Bloemfontein. Plains-dominated landscape with some scattered, slightly irregular undulating plains and hills. Mainly low-tussock grasslands with an abundant karroid element. Dominance of <i>Themeda triandra</i> is an important feature of this vegetation unit. Locally low cover of <i>T. triandra</i> and the associated increase in <i>Elionurus muticus</i>, <i>Cymbopogon pospischilii</i> and <i>Aristida congesta</i> is attributed to heavy grazing and/or erratic rainfall. Pressures &amp; threats: This ecosystem has a broad range of pressures. This ecosystem has experienced a loss in natural habitat of approximately 1 139.14 km<sup>2</sup> in the last 28 years (1990-2018). These spatial declines have been primarily driven by agriculture, with 13757 km<sup>2</sup> of the ecosystem consisting of croplands and a further 2092 km<sup>2</sup> of old fields. Urban development has also been a pressure with 262.74 km<sup>2</sup> of the ecosystem consisting of built-up areas. Additionally, mining has transformed 97.19 km<sup>2</sup> of the ecosystem. Artificial water bodies cover 102.26 km<sup>2</sup>. It is further degraded by overgrazing (Mucina et al. 2006).</p>
<p>Notes</p>	<p>Trigger Sub-Criteria: A3 - National land cover data show that Vaal-Vet Sandy Grassland has experienced extensive spatial declines of approximately 72 % since 1750. Scope: Global &amp; national status (global extent assessed)</p>

#### 6.1.2.2 Expected Flora Species

Based on the Plants of Southern Africa (BODATSA-POSA, 2019) database, 42 plant species could potentially occur on the study site. The screening tool identifies no potential SCC species and rated the area “Low”.

Appendix A provides the list of species found through the survey and their respective conservation status and endemism. No SCC species were identified as potentially occurring on the study site.

### 6.1.3 Faunal Assessment

#### 6.1.3.1 Amphibians

Based on the IUCN Red List Spatial Data, 14 amphibian species are expected to occur within the area (Appendix B). None are regarded as threatened.

### 6.1.3.2 Reptiles

Based on the IUCN Red List Spatial Data, 21 reptile species are expected to occur within the area (Appendix C). One species is regarded as vulnerable. This venerable species is the subject of a different species-specific specialist report and will be covered in more detail and sensitivity mapping.

### 6.1.3.3 Mammals

The IUCN Red List Spatial Data lists 61 mammal species that could be expected to occur within the area (Appendix D). This list excludes large mammal species that are limited to protected areas. Two of these expected species are regarded as vulnerable and three are considered near threatened (Table 11). All these species have a low likelihood of occurrence based on the lack of suitable habitat and the level of disturbance nearby to the project area.

*Table 11: Threatened mammal species that are expected to occur within the project area. \* Moderate likelihood of occurrence.*

Family	Taxon	Common name	Status
<b>Nesomyidae</b>	<i>Mystromys albicaudatus</i>	African White-tailed Rat	Vulnerable (2016)
<b>Muridae</b>	<i>Otomys auratus</i>	Southern African Vlei Rat (Grassland type)	Near Threatened (2016)
<b>Bovidae</b>	<i>Pelea capreolus</i>	Vaal Rhebok	Near Threatened (2016)
<b>Hyaenidae</b>	<i>Parahyaena brunnea</i>	Brown Hyena	Near Threatened (2015)
<b>Mustelidae</b>	<i>Hydrictus maculicollis</i>	Spotted necked otter	Vulnerable (IUCN 2016)
<b>Felidae</b>	<i>Felis nigripes</i>	Black-footed cat	Vulnerable (IUCN 2016)

#### ***Mystromys albicaudatus***

The White-tailed Rat is a Highveld grassland specialist (whilst also marginally occurring in Succulent Karoo and Fynbos biomes; Dean 1978) and is endemic to South Africa and Lesotho. Although it occurs widely across the assessment region, it has an extremely patchy and fragmented area of occupancy due to its preference for microhabitats within vegetation types and transitory habitats created after fire.

Within South Africa, it occurs in the following provinces: southern Mpumalanga, Free State, the high-lying areas of KwaZulu-Natal (KZN), Eastern Cape, south-eastern North-West, and marginally into Northern Cape (Skinner, 2005; Avery & Avery, 2011).



The habitat requirements and ecology of White-tailed Rats merits further research. They are often associated with calcrete soils within grasslands. They are never found on soft, sandy substrate, rocks, wetlands, or river banks. They do not occur in transformed habitat (croplands, fallow fields, or old fields). However, as they select microhabitats, such as slopes and ridges, small numbers may survive in non-arable patches within an agricultural matrix. It is unlikely that this species is found within the study site.

### ***Otomys auratus***

The species is widely distributed throughout the Highveld grasslands and Drakensberg Escarpment of South Africa, Lesotho and Swaziland, with isolated populations in the Soutpansberg Mountains of northern Limpopo and the Eastern Highlands of Zimbabwe (Monadjem et al. 2015).

This species is associated with mesic grasslands and wetlands within alpine, montane and sub-montane regions (Monadjem et al. 2015), typically occurring in dense vegetation in close proximity to water (for example, Wandrag et al. 2002, Watson 2006).

Vlei rats are important food for a number of mammalian predators, as well as raptors such as marsh owls and barn owls (Skinner and Chimimba 2005, Monadjem et al. 2015). For example, Vlei rats are favoured food by the Serval (Bowland 1990), so their range expansion could be interrelated (Power 2014). It is unlikely that this species is found within the study site.

### ***Pelea capreolus***

Grey Rhebok are endemic to South Africa, Lesotho and parts of Swaziland (although they formerly occurred widely in the western regions), existing patchily in areas of suitable habitat. Grey Rhebok are associated with rocky hills, grassy mountain slopes, and plateau grasslands in the eastern extent of their distribution.

They are predominantly browsers, often feeding on ground-hugging forbs, and largely water independent, obtaining most of their water requirements from their food (Avenant 2013). Forbs constitutes most of their diet, especially the flowers and leaves of the plants (Esser 1973, Rowe-Rowe 1983a, Beukes 1988). They require good grass cover within their home ranges for shelter and to hide from predators, but often use steep open areas with little cover when feeding. It is unlikely that this species is found within the study site.

### ***Parahyaena brunnea***

The Brown Hyaena is widespread within the assessment region, but it is absent from Lesotho and Swaziland. It faces multiple threats across unprotected areas, especially in regions dominated by livestock and game ranching. The species is difficult to census due to it occurring at low density and due to its nocturnal and secretive nature. Despite the evidence of locally stable and increasing

populations, the species does face persistent threats of direct and indirect persecution within the assessment region.

Brown Hyaenas occupy a range of ranch land, but typically avoid agricultural and heavily urbanised habitats (Thorn et al. 2011). It is unlikely that this species is found within the study site.

### ***Hydrictis maculicolis***

The Spotted-necked otter is a vulnerable species according to SANBI (Ponsonby et al., 2016). Factors that contribute to their status include habitat degradation and pollution occurring within these areas, as well as possible climate changes and human-otter conflict over resources (Reed-smith, Jacques and Somers, 2021).

This species has limited movement capabilities on land restricting it to streams, or open water areas (Estes, 1992). They have been seen to avoid riverbanks with short grass and favour undisturbed areas of tall grass (Perrin and Carugati, 2000). The Spotted-necked otter prefers deep waters as the primary source of food is fish and the deep water allows for easier hunting. Other sources of food include frogs and invertebrates (Estes, 1992).

The reproduction of the Spotted-necked otter is not well documented, however the terrestrial habitats where they may reproduce, and rest (holts) are often present just inland from the water source. Perrin and Carugati (2000) found that where human disturbance or overgrazing by livestock had altered the landscape, these otters showed no presence. It is unlikely that this species is found within the study site.

### ***Felis nigripes***

Black-footed Cats are endemic to the arid regions of southern Africa, occurring widely across the western reaches of the assessment region, and have a relatively restricted and patchy distribution. The historical paucity of data has led to inconsistencies and perpetuated inaccuracies in current literature, which in turn has affected the accuracy of conservation measures.

The naturally rare, cryptic colouring, small size and secretive nocturnal nature of this species has contributed considerably to the lack of information. Black-footed Cats are known to occur at low densities, and it is difficult to establish population sizes. The stronghold of the species is suspected to be in the central Karoo region where highest densities are reached, whereas other regions (Kalahari, North West Province, northern KwaZulu-Natal Province, Free State Province, and the Lowveld) are suspected to have medium or low densities.

Black-footed Cats have the most restricted distribution of any of the African felid species (Nowell & Jackson 1996). The species is endemic to the arid grasslands, dwarf shrub, and savannah of the Karoo and Kalahari in southern Africa. Most of the range occurs within the boundaries of South Africa,

thinning out northwards into Botswana, Namibia and Zimbabwe. It is unlikely that this species is found within the study site.

## 6.2 Field Assessment

This section details the observations recorded during an on-site field survey conducted to ground truth the floral, faunal, and habitat features of the project area. Sampling took place from 8:00 to 15:00 on 16<sup>th</sup> and 17<sup>th</sup> January 2023 and again on the 17<sup>th</sup>, 18<sup>th</sup> and 28<sup>th</sup> of April 2023 from 7:00 to 15:00.

### 6.2.1 Flora Assessment

This section is divided into two sections:

- Indigenous flora; and
- Invasive Alien Plants (IAPs).

#### 6.2.1.1 Indigenous Flora

The vegetation assessment was conducted throughout the extent of the project area. A total of 70 tree, shrub, herbaceous and graminoid plant species were recorded in the project area during the field assessment (Table 12) (Appendix 3: Plant species list). Plants listed as Category 1 alien or invasive species under the NEMBA appear in green text. Plants listed in Category 2 or as ‘not indigenous’ or ‘naturalised’ according to NEMBA, appear in blue text. Species listed in red are protected within the province. The list of plant species recorded is by no means comprehensive, and repeated surveys during different phenological periods not covered, may likely yield up to 30% additional flora species for the project area. However, floristic analysis conducted to date is however regarded as a sound representation of the local flora for the project Area. Three species that are provincially protected were recorded on site.

*Table 12: Trees, shrub and herbaceous plant species recorded in the project area.*

Family	Taxon	Common name	Protection Status	Endemism	Invasive
Amaranthaceae	<i>Alternanthera pungens,</i>	Paper Thorn	LC	Not naturalised	Indigenous,

Proposed Solar development for Mooivlei Solar 2, Pty (LTD), Kroonstad, Free State, South Africa

<b>Amaranthaceae</b>	<i>Gomphrena celosioides</i>	Batchelor's button	LC	Not naturalised	Indigenous,	
<b>Amaranthaceae</b>	<i>Guilleminea densa,</i>	Small matweed	LC	Not naturalised	Indigenous,	
<b>Amaranthaceae</b>	<i>Kyphocarpa angustifolia</i>	Silver Burrweed	LC	Indigenous		
<b>Asparagaceae</b>	<i>Asparagus laricinus</i>	Emperor's asparagus	LC	Indigenous		
<b>Asteraceae</b>	<i>Arctotis arctotoides,</i>	Botter blom	LC	Indigenous		
<b>Asteraceae</b>	<i>Felicia muricata</i>	Bloublommetjie	LC	Indigenous; Endemic		
<b>Asteraceae</b>	<i>Geigeria burkei,</i>	Vermeerbos	LC	Indigenous		
<b>Asteraceae</b>	<i>Gerbera sp.</i>		LC	Indigenous		
<b>Asteraceae</b>	<i>Helichrysum acutatum</i>	Sticky Everlasting	Protected FS	Indigenous		
<b>Asteraceae</b>	<i>Helichrysum nudifolium</i>	Hottentot's Tea	Protected FS	Indigenous		
<b>Asteraceae</b>	<i>Helichrysum rugulosum</i>	Wrinkly Everlasting	Protected FS	Indigenous		
<b>Asteraceae</b>	<i>Nidorella hottentotta,</i>	Grassland Vleiweed	LC	Indigenous		
<b>Asteraceae</b>	<i>Nidorella resedifolia</i>	Stinkkruid	LC	Indigenous		
<b>Asteraceae</b>	<i>Senecio inaequidens</i>	Canary Weed	LC	Indigenous		
<b>Asteraceae</b>	<i>Seriphium plumosa</i>	Bankrupt bush	LC	Indigenous		
<b>Asteraceae</b>	<i>Tagetes minuta</i>	Khaki weed	LC	Not indigenous; Naturalised; Invasive		
<b>Cactaceae</b>	<i>Opuntia ficus-indica</i>	Sweet prickly pear	LC	Not indigenous; Cultivated; Invasive	Naturalised;	Nemba 1b
<b>Caryophyllaceae</b>	<i>Pollichia campestris</i>	Barley Sugar Bush	LC	Indigenous		
<b>Commelinaceae</b>	<i>Commelina benghalensis</i>	Benghal Wandering Jew	LC	Indigenous		

Proposed Solar development for Mooivlei Solar 2, Pty (LTD), Kroonstad, Free State, South Africa

<b>Cyperaceae</b>	<i>Bolboschoenus glaucus,</i>	Glaucus tuber-bulrush	LC	Indigenous	
<b>Cyperaceae</b>	<i>Bulbostylis hispidula,</i>	Slender Sedge	LC	Indigenous	
<b>Cyperaceae</b>	<i>Cyperus congestus,</i>	Purple Umbrella Sedge	LC	Indigenous	
<b>Cyperaceae</b>	<i>Cyperus denudatus,</i>		LC	Indigenous	
<b>Cyperaceae</b>	<i>Cyperus fastigiatus,</i>		LC	Indigenous	
<b>Cyperaceae</b>	<i>Kyllinga alba</i>	Witbiesie	LC	Indigenous	
<b>Cyperaceae</b>	<i>Kyllinga erecta,</i>	Greater Kyllinga	LC	Indigenous	
<b>Dipsacaceae</b>	<i>Scabiosa columbaria</i>	Rice Flower	LC	Indigenous	
<b>Fabaceae</b>	<i>Sphenostylis angustifolia,</i>	Wild Sweet pea	LC	Indigenous	
<b>Fabaceae</b>	<i>Vachelia robusta</i>	Ankle thorn	LC	Indigenous	
<b>Geraniaceae</b>	<i>Monsonia glauca</i>	Grey Dysentery-Herb	LC	Indigenous	
<b>Hypoxidaceae</b>	<i>Hypoxis hemerocallidea</i>	Starflower	Declining	Indigenous	
<b>Juncaceae</b>	<i>Juncus oxycarpus,</i>		LC	Indigenous	
<b>Lamiaceae</b>	<i>Ocimum americanum,</i>	Wild Basil	LC	Indigenous	
<b>Malvaceae</b>	<i>Hibiscus trionum,</i>	Venice Mallow	LC	Indigenous	
<b>Phyllanthaceae</b>	<i>Phyllanthus angolensis</i>		LC	Indigenous	
<b>Plantaginaceae</b>	<i>Plantago media</i>	Hoary Plantain	LC	Not Indigenous, naturalised	
<b>Poaceae</b>	<i>Aristida canescens</i>	Pale Three Awn	LC	Indigenous	
<b>Poaceae</b>	<i>Aristida congesta subsp. barbicollis,</i>	Spreading Three Awn	LC	Indigenous	
<b>Poaceae</b>	<i>Aristida congesta subsp. congesta</i>	Tassle Three-Awn	LC	Indigenous	



Proposed Solar development for Mooivlei Solar 2, Pty (LTD), Kroonstad, Free State, South Africa

Poaceae	<i>Brachiaria serrata,</i>	Velvet Signal Grass	LC	Indigenous	
Poaceae	<i>Chloris virgata</i>	Feather-top Chloris	LC	Indigenous	
Poaceae	<i>Cymbopogon caesius,</i>	Broad-leaved Turpentine Grass	LC	Indigenous	
Poaceae	<i>Cymbopogon pospischilii</i>	Bushveld turpentine Grass	LC	Indigenous	
Poaceae	<i>Cynodon dactylon,</i>	Couch Grass	LC	Indigenous	
Poaceae	<i>Eragrostis chloromelas,</i>	Blue Lovegrass	LC	Indigenous	
Poaceae	<i>Eragrostis curvula,</i>	Weeping Love Grass	LC	Indigenous	
Poaceae	<i>Eragrostis gummiflua</i>	Gum Grass	LC	Indigenous	
Poaceae	<i>Eragrostis obtusa</i>	Dew Grass	LC	Indigenous	
Poaceae	<i>Eragrostis superba,</i>	Saw tooth love Grass	LC	Indigenous	
Poaceae	<i>Hyparrhenia hirta</i>	Common Thatching grass	LC	Indigenous	
Poaceae	<i>Melinis repens,</i>	Natal Red Top	LC	Indigenous	
Poaceae	<i>Panicum coloratum,</i>	Bamboeskwiek	LC	Indigenous	
Poaceae	<i>Panicum maximum,</i>	Guinea Grass	LC	Indigenous	
Poaceae	<i>Perotis patens.</i>	Cat's tail	LC	Indigenous	
Poaceae	<i>Setaria pumila</i>	Garden Bristle Grass	LC	Indigenous	
Poaceae	<i>Setaria sphacelate var torta</i>	Creeping Bristle Grass	LC	Indigenous	
Poaceae	<i>Sporobolus africanus.</i>	Rats tail dropseed	LC	Indigenous	
Poaceae	<i>Sporobolus ioclados</i>	Pan Dropseed	LC	Indigenous	
Poaceae	<i>Sporobolus pyramidalis,</i>	Vlei Grass	LC	Indigenous	

<b>Poaceae</b>	<i>Themeda triandra</i>	Red Grass	LC	Indigenous	
<b>Poaceae</b>	<i>Tragus berteronianus,</i>	Carrot Seed Grass	LC	Indigenous	
<b>Poaceae</b>	<i>Urochloa mossambicensis</i>	Bushveld Signal Grass	LC	Indigenous	
<b>Polygalaceae</b>	<i>Polygala hottentotta</i>	Small Purple Broom	LC	Indigenous	
<b>Rubiaceae</b>	<i>Oldenlandia herbacea</i>	False Spurry	LC	Indigenous	
<b>Rubiaceae</b>	<i>Pygmaeothamnus zeyheri,</i>	Common Sand Apple	LC	Indigenous	
<b>Solanaceae</b>	<i>Solanum elaeagnifolium</i>	Silverleaf Nightshade	LC	Not Indigenous, Invasive	Nemba 1b
<b>Solanaceae</b>	<i>Solanum mauritianum</i>	Bugweed	LC	Not Indigenous, Invasive	Nemba 1b
<b>Verbenaceae</b>	<i>Verbena bonariensis</i>	Wild Verbena	LC	Not Indigenous, Invasive	Nemba 1b
<b>Verbenaceae</b>	<i>Verbena tenuisecta</i>		LC	Not indigenous; Naturalised	

#### 6.2.1.2 Invasive Alien Plants

IAPs (Invasive Alien Plants) tend to encroach on or displace native vegetation, altering the structure, makeup, and functioning of ecosystems. Consequently, it is crucial that these plants be managed through an eradication and monitoring program. Some invasive plants may also harm ecosystems by displacing native plant species through their superior competitive abilities.

NEMBA is the most recent legislation pertaining to alien invasive plant species. In August 2014, the list of Alien Invasive Species was published in terms of the NEMBA. The Alien and Invasive Species Regulations were published in the Government Gazette No. 44182, 24th of February 2021. The legislation calls for the removal and / or control of IAP species (Category 1 species). In addition, unless authorised thereto in terms of the NWA, no land user shall allow Category 2 plants to occur within 30 meters of the 1:50 year flood line of a river, stream, spring, natural channel in which water flows regularly or intermittently, lake, dam or wetland. Category 3 plants are also prohibited from occurring within proximity to a watercourse. Below is a brief explanation of the three categories in terms of the NEMBA:

- Category 1a: Invasive species requiring compulsory control. Remove and destroy. Any specimens of Category 1a listed species need, by law, to be eradicated from the environment. No permits will be issued.

- Category 1b: Invasive species requiring compulsory control as part of an invasive species control programme. Remove and destroy. These plants are deemed to have such a high invasive potential that infestations can qualify to be placed under a government sponsored invasive species management programme. No permits will be issued.
- Category 2: Invasive species regulated by area. A demarcation permit is required to import, possess, grow, breed, move, sell, buy or accept as a gift any plants listed as Category 2 plants. No permits will be issued for Category 2 plants to exist in riparian zones.
- Category 3: Invasive species regulated by activity. An individual plant permit is required to undertake any of the following restricted activities (import, possess, grow, breed, move, sell, buy or accept as a gift) involving a Category 3 species. No permits will be issued for Category 3 plants to exist in riparian zones.

Note that according to the Alien and Invasive Species Regulations, a person who has under his or her control a category 1b listed invasive species must immediately:

- Notify the competent authority in writing
- Take steps to manage the listed invasive species in compliance with:
  - Section 75 of the NEMBA;
  - The relevant invasive species management programme developed in terms of regulation 4; and
  - Any directive issued in terms of section 73(3) of the NEMBA.

Nine (9) IAP species were recorded within the project area. Four (4) of these species are listed under the Alien and Invasive Species List 2020, Government Gazette No. GN1003 as Category 1b. These IAP species must be controlled by implementing an IAP Management Programme, in compliance of section 75 of the NEMBA, as stated above.

## **6.2.2 Faunal Assessment**

Herpetofauna and mammal observations and recordings fall under this section. A separate Avifauna impact assessment was conducted for the avifauna species associated with the project area.

### **6.2.2.1 Amphibians and reptiles**

No reptile species was recorded in the project area during survey period. However, there is the possibility of several species being present, as certain reptile species are secretive and longer-term surveys are required to ensure adequate sampling. No amphibian species were recorded during the survey period. However, due to the presence of various wetlands across the project area providing suitable habitat there is a possibility of more amphibian species being present. Sensitive species 15 was recorded by the EWT (April 2023) directly adjacent to the sensitive areas and these areas are within the buffer zone for these reptiles. See Appendix 5 section 7.1.2.

### 6.2.2.2 Mammals

Seven (7) mammal species were observed during this survey of the project area (Table 13) based on either direct observation or the presence of visual tracks and signs. None of the species recorded are regarded as a SCC. Five mammal species are provincially protected.

*Table 13: Summary of mammal species recorded within the project area.*

Family	Taxon	Common name	Status	Free State Nature Conservation Act
<b>Leporidae</b>	<i>Lepus victoriae</i>	Scrub hare	Least concern	Schedule 2
<b>Sciuridae</b>	<i>Xerus inauris</i>	Ground Squirrel	Least Concern	
<b>Bovidae</b>	<i>Kobus ellipsiprymnus</i>	Waterbuck	Least Concern (2016)	Schedule 2
<b>Bovidae</b>	<i>Syncerus caffer</i>	African Buffalo	Least Concern (2016)	Schedule 2
<b>Bovidae</b>	<i>Taurotragus oryx</i>	Common Eland	Least Concern (2016)	Schedule 2
<b>Suidae</b>	<i>Phacochoerus africanus</i>	Common Warthog	Least Concern (2016)	
<b>Bovidae</b>	<i>Hippotragus niger</i>	Sable Antelope	Vulnerable (IUCN 2016)	Schedule 1

## 7 HABITAT AND SITE ECOLOGICAL IMPORTANCE

### 7.1 Habitat Assessment

The main habitat types identified across the project area were initially identified largely based on aerial imagery. These main habitat types were refined based on the field coverage and data collected during the survey; the delineated habitats can be seen in Figure 18. Emphasis was placed on limiting

timed meander searches along the proposed project area within the natural habitats and therefore habitats with a higher potential of hosting SCC. The site is within an area of natural bushveld but degraded (from heavily to medium). A general view over the site is given in Figure 19.

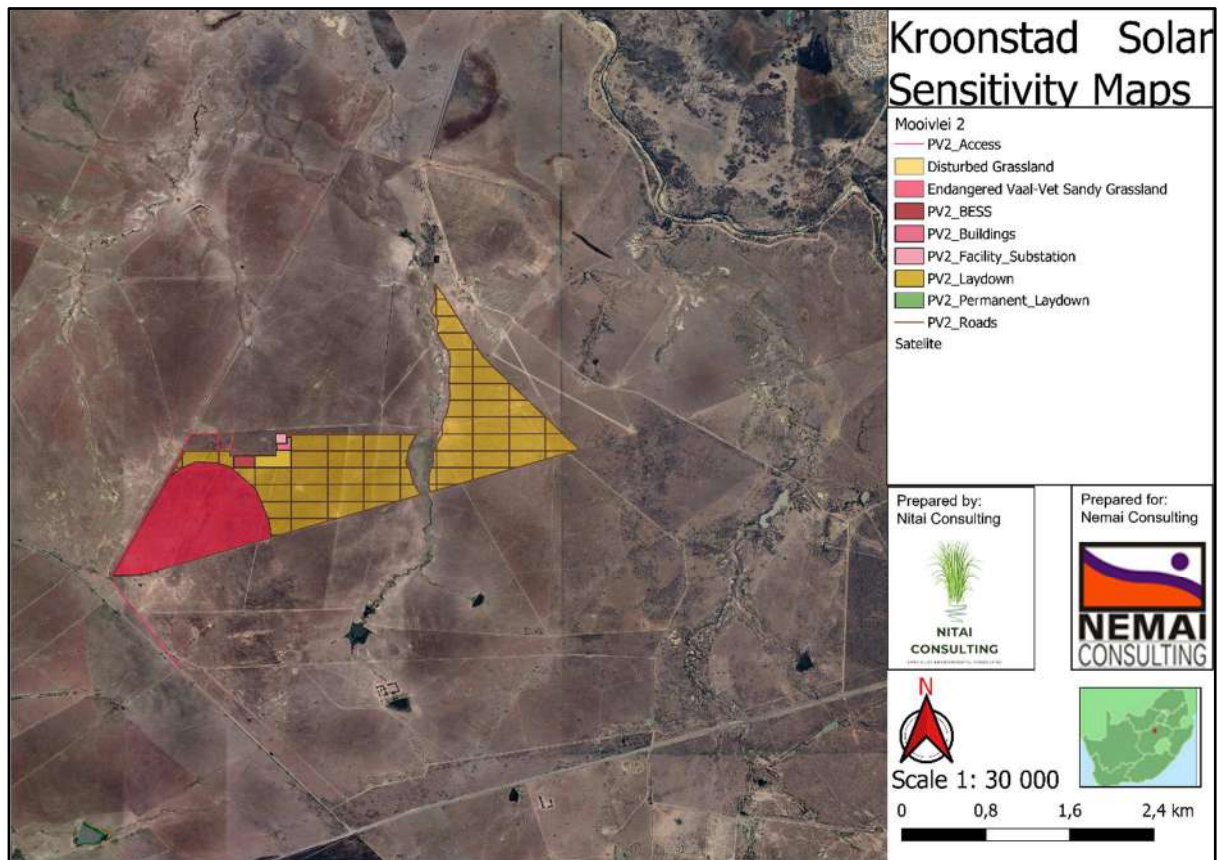


Figure 18: Habitat units found on site.





*Figure 19: General view of the dominant features*

The grassland areas contain variation due to changes in topography, slope inclination, surface rockiness and the influence of water-flow and water retention in the landscape. A broad classification of the habitat unit on site, which also reflects relatively uniform plant species compositional units, is as follows:

#### **7.1.1 Endangered Vaal-Vet Sandy Grassland**

This habitat type is dominated by perennial grass swards of good condition and no erosion (**Error! Reference source not found.**). Overall, this habitat has a high species richness and is characteristic of the vegetation bioregion. Forb diversity is high with a few geophytic forbs found throughout the area as well. Dominant grass species are *Themeda triandra*, *Setaria sphacelata* var. *sphacelata*, *Cynodon dactylon*, *Panicum maximum*, *Eragrostis obtusa*, *Urochloa mossambicensis*, *Chloris virgata* and *Setaria pumila*. Dominant forb species were *Felicia muricata*, *Helichrysum nudifolium*, *Nidorella resedifolia*, *Commelina benghalensis*, *Indigofera melanadenia*, *Bulbostylis hispidula*, *Scabiosa columbaria*, *Hypoxis hemerocallidea*, *Dipcadi gracillimum*, *Hypoxis linearis* and *Pollichia campestris*.



Figure 20: Plants found in the Endangered Vaal-Vet Sandy Grassland.

### 7.1.2 Disturbed Central Free State Grasslands

Any areas where the original vegetation is lost due to continuous degradation, such as trampling, severe overgrazing, or some other factor (Figure 21), is mapped as degraded. These areas are unlikely to restore to natural grassland, even with removal of the drivers of the degradation. These areas are mainly categorized by the presence of pioneer plants as well as alien vegetation. Non-grass species diversity usually consists of re-seeding and weedy species, and sometimes animal- and/or bird-dispersed woody species. Plants found in these areas are: *Tragus berteronianus*, *Hyparrhenia hirta*, *Cymbopogon pospischilii*, *Perotis patens*, *Nidorella hottentotta*, *Helichrysum rugulosum*, *Crabbea hirsuta*, *Aristida congesta* subsp. *barbicollis*, *Aristida canescens*.





*Figure 21: Degraded Grassland.*

### **7.1.3 Aquatic Habitats/ Wetlands**

The wetlands were mapped and delineated by an aquatic specialist using various databases and ground truthing. There are several wetlands within the study area scattered throughout the footprint. These wetlands are in moderate condition with some erosion and only some exotic plants. This habitat forms part of the Aquatic specialist report and is mentioned here mainly because of the habitat discussion (Figure 22).

The following vegetation was found: *Bulbostylis hispidula*, *Cyperus congestus*, *Juncus effusus*, *Schoenoplectus sp.*

The aquatic habitat includes drainage areas that are seasonally wet with clay soils and smaller rivers and streams. The banks are mostly stable with moderate visible erosion and piospheres found around them in a degradation gradient. This habitat forms part of the Aquatic specialist report and is mentioned here mainly because of the habitat discussion.

Common plants found in the area are: *Heteropogon contortus*, *Panicum coloratum*, *Themeda triandra*, *Eragrostis curvula*, *Cyperus congestus*, *Cyperus margaritaceus*, *Bulbostylis hispidula*, *Cynodon dactylon*.



*Figure 22: General view of aquatic habitats*



#### 7.1.4 Alien species

These species are found throughout the site but with fairly low densities but especially around disturbed areas like feeding kraals and water troughs (Figure 23). The presence of *Seriphium plumosum* and *Opuntia ficus-indica* is worrying since these are an aggressive invader of grassy areas. *Plantago media* was also found in vast areas over the disturbed habitat unit. The natural habitat will become lost due to the presence of the invasive and alien species if an intensive eradication plan is not followed.



*Figure 23: General view of areas with alien species*

#### 7.1.5 Transformed areas.

Areas where natural habitat no longer exists due to development of infrastructure, such as roads, buildings, and other hard surfaces.



Habitat	Status	Size	Proportion of total area
Endangered Vaal-Vet Sandy Grassland	Natural	108 ha	25.4%
Degraded Central Free State Grassland	Moderate	304 ha	71.5%
Wetlands	Natural	3 ha	0.007%
Aquatic Habitats	Natural		
Alien species	Degraded	4 ha	0.01%
Transformed areas	Transformed	6 ha	0.015%

## 7.2 Site sensitivity Verification

The national web-based Environmental Screening Tool was queried in relation to the following infrastructure:

- Utilities Infrastructure | Electricity | Generation | Renewable | Solar | PV

According to the The National Web based Environmental Screening Tool the terrestrial biodiversity sensitivity theme is very high (Figure 24) due the fact it forms part of Critical Biodiversity areas (CBA 1 and 2), Ecological support area 1 & 2 (ESA 1&2), Protected Areas Expansion Strategy as well as part of and Endangered Ecosystem – Vaal-Vet Sandy Grassland.



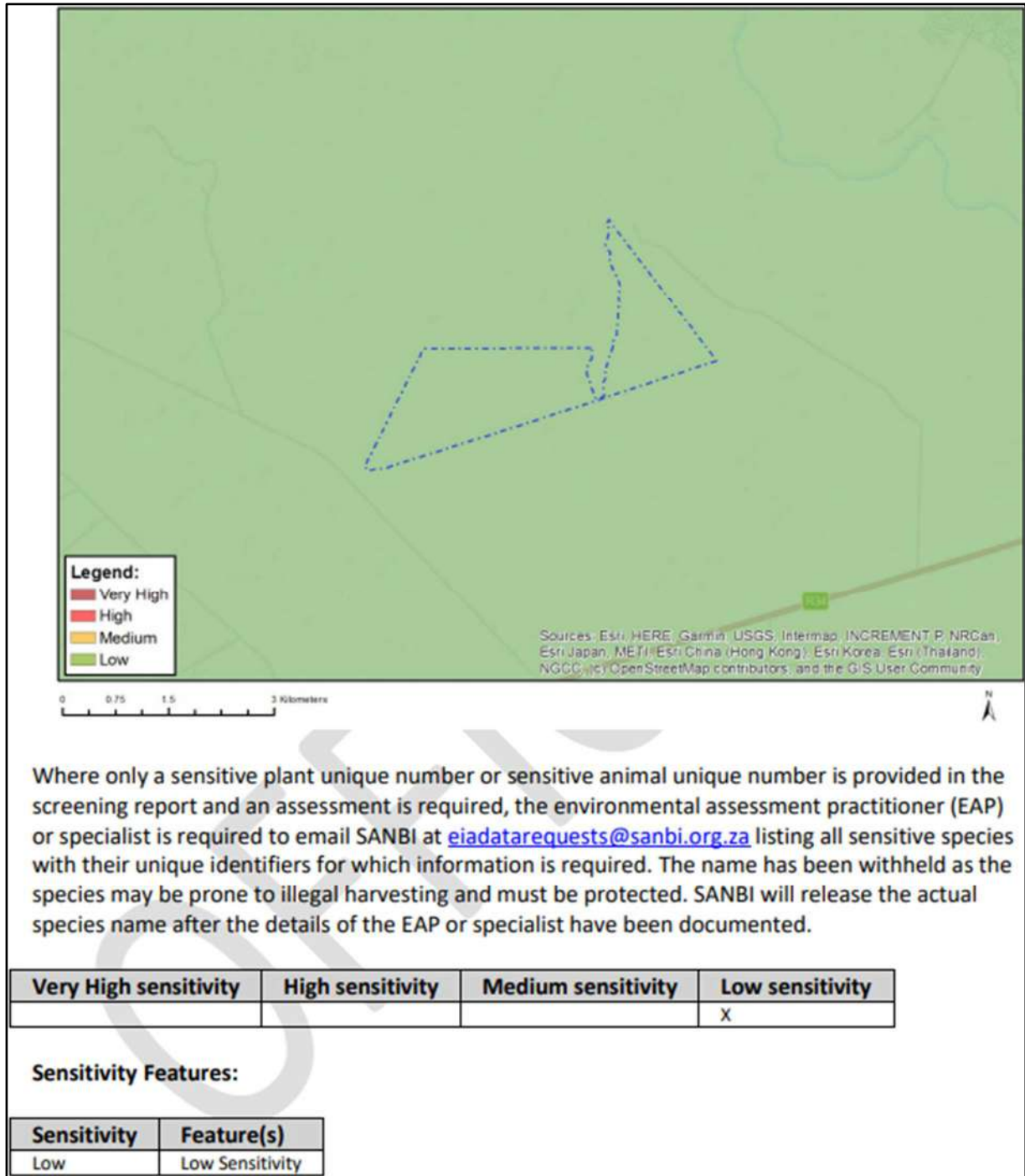
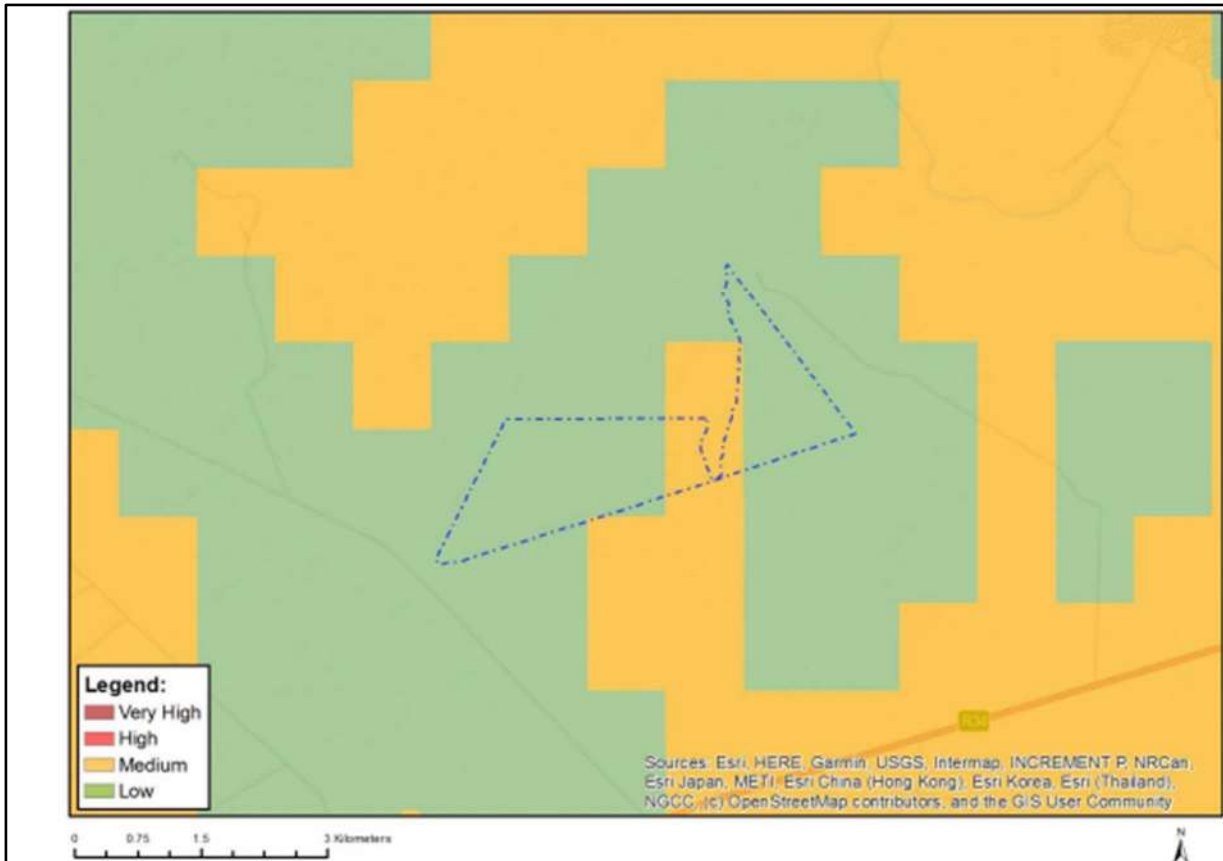


Figure 25: Plant Theme Sensitivity, National Web based Environmental Screening Tool.

According to the The National Web based Environmental Screening Tool the Animal species theme is medium (Figure 26) due to potential presence of *Hydrictis maculicolis*.



Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at [eiadatarequests@sanbi.org.za](mailto:eiadatarequests@sanbi.org.za) listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

**Sensitivity Features:**

Sensitivity	Feature(s)
Low	Subject to confirmation
Medium	Mammalia-Hydrictris maculicollis

Figure 26: Animal species theme sensitivity

Section 2.2 of the Site Sensitivity Verification requirements were addressed in Section 6.1 and 6.2 of this report. Section 2.3 a) of the Site Sensitivity Verification requirements were addressed in Section 7.2 of this report. Section 2.3 b) of the Site Sensitivity Verification requirements were addressed in Section 7 of this report. This report fulfils the requirements of Section 2.3 c) of the Site Sensitivity Verification.

The completion of the **terrestrial biodiversity** assessment found that the Disturbed Central free State Grassland, Alien Invasives and Transformed habitats does not corroborate the screening tool’s ‘Very High’ sensitivity of the biodiversity theme and should rather be considered of **medium** sensitivity since there is remaining natural habitat but in degraded condition. The endangered Vaal-vet sandy Grassland habitat area corroborates the screening tool’s **very high** sensitivity due to the healthy nature of the habitat.

The **plant sensitivity** was indeed found to be **low** and corroborates the screening tool’s results.

The **animal sensitivity** theme is disputed since there were no suitable habitat found for SCC animal species to be resident and consequently the sensitivity should be **low** and not medium as the screening tool suggests.

As per the terms of reference for the project, GIS sensitivity maps are required to identify sensitive features in terms of the relevant specialist discipline/s within the project area. The sensitivity scores identified during the field survey for each terrestrial habitat are mapped. Five (5) different terrestrial habitat types were delineated within the project area. Based on the criteria provided in Section 4.4 of this report, all habitats within the assessment area of the proposed project were allocated a sensitivity category (Figure 27)(Table 14, Table 15). The sensitivities of the habitat types delineated are illustrated in Figure 27: Sensitivity of the project area

### 7.2.1 Biodiversity Importance

*Table 14: BI Summary of habitat types delineated within field assessment area of project.*

Habitat type	Conservation Importance	Functional Integrity	Biodiversity Importance
Endangered Vaal-Vet Sandy Grassland	High	High	High
Disturbed Central Free State Grassland	Low	High	Medium
Wetlands	Low	Medium	Low
Aquatic Habitats	Low	Medium	Low
Alien species	Low	Low	Low
Transformed areas	Low	Low	Low



## 7.2.2 Site ecological Importance

*Table 15: SEI Summary of habitat types delineated within field assessment area of project.*

	Receptor resilience	Biodiversity Importance	Site Ecological Importance
Endangered Vaal-Vet Sandy Grassland	Medium	High	High
Disturbed Central Free State Grassland	Medium	Medium	Medium
Wetlands	Medium	Low	Low
Aquatic Habitats	Medium	Low	Low
Alien species	High	Low	Very Low
Transformed areas	Medium	Low	Low

## 7.2.3 Guidelines for interpreting SEI in the context of the proposed development activities

The calculation of Site Ecological Importance matches the sensitivity classification given in the previous section of this report but includes an explicit recognition of the ability of each ecosystem to tolerate and recover from disturbance. Guidelines for development activities within different importance levels are given in the below:

- Very High – Avoidance mitigation – no destructive development activities should be considered. Offset mitigation not acceptable/ not possible (i.e., last remaining populations of species, last remaining good condition patches of ecosystems/ unique species assemblages). Destructive impacts for species/ecosystems where persistence target remains.
- High – Avoidance mitigation wherever possible. Minimisation mitigation – changes to project infrastructure design to limit the amount of habitat impacted, limited development activities of low impact acceptable. Offset mitigation may be required for high impact activities.
- Medium – Minimisation and restoration mitigation – development activities of medium impact acceptable followed by appropriate restoration activities.

- Low - Minimisation and restoration mitigation – development activities of medium to high impact acceptable followed by appropriate restoration activities.

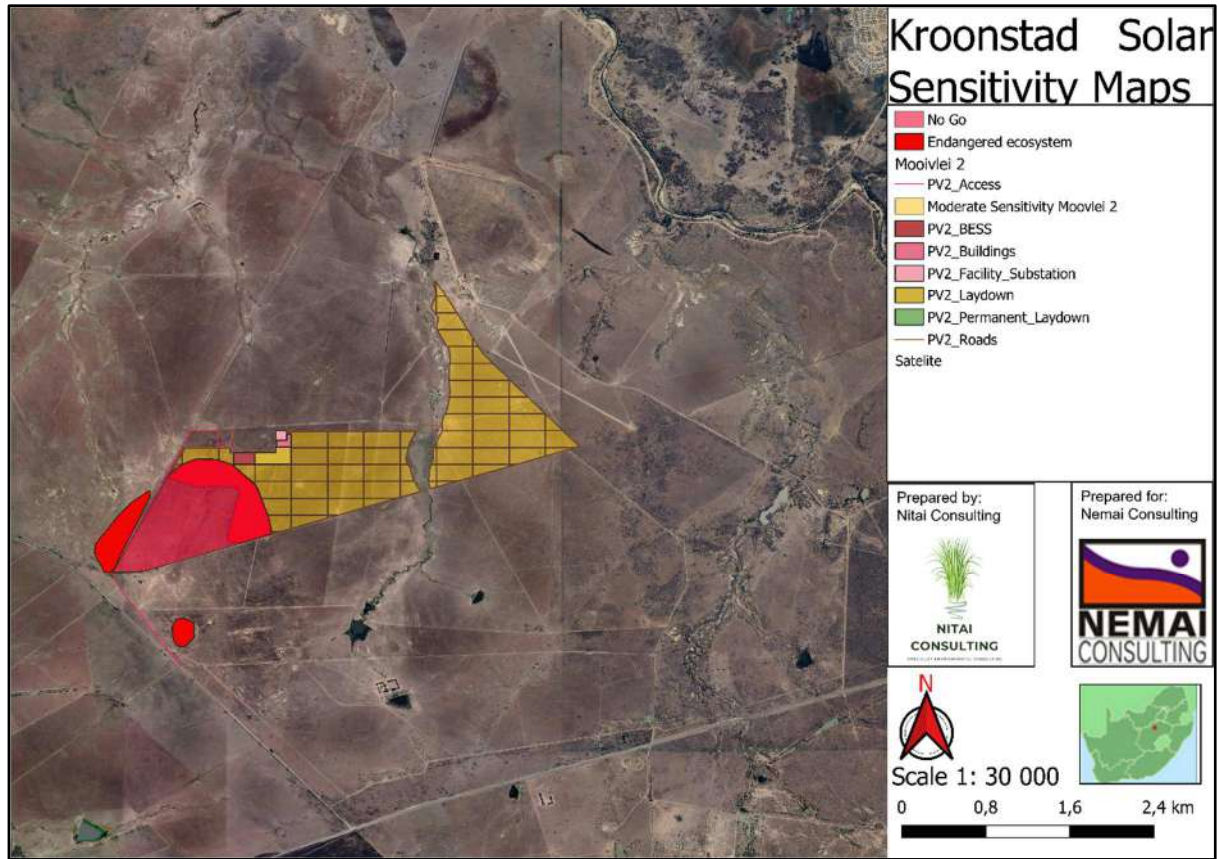


Figure 27: Sensitivity of the project area alternative 1.

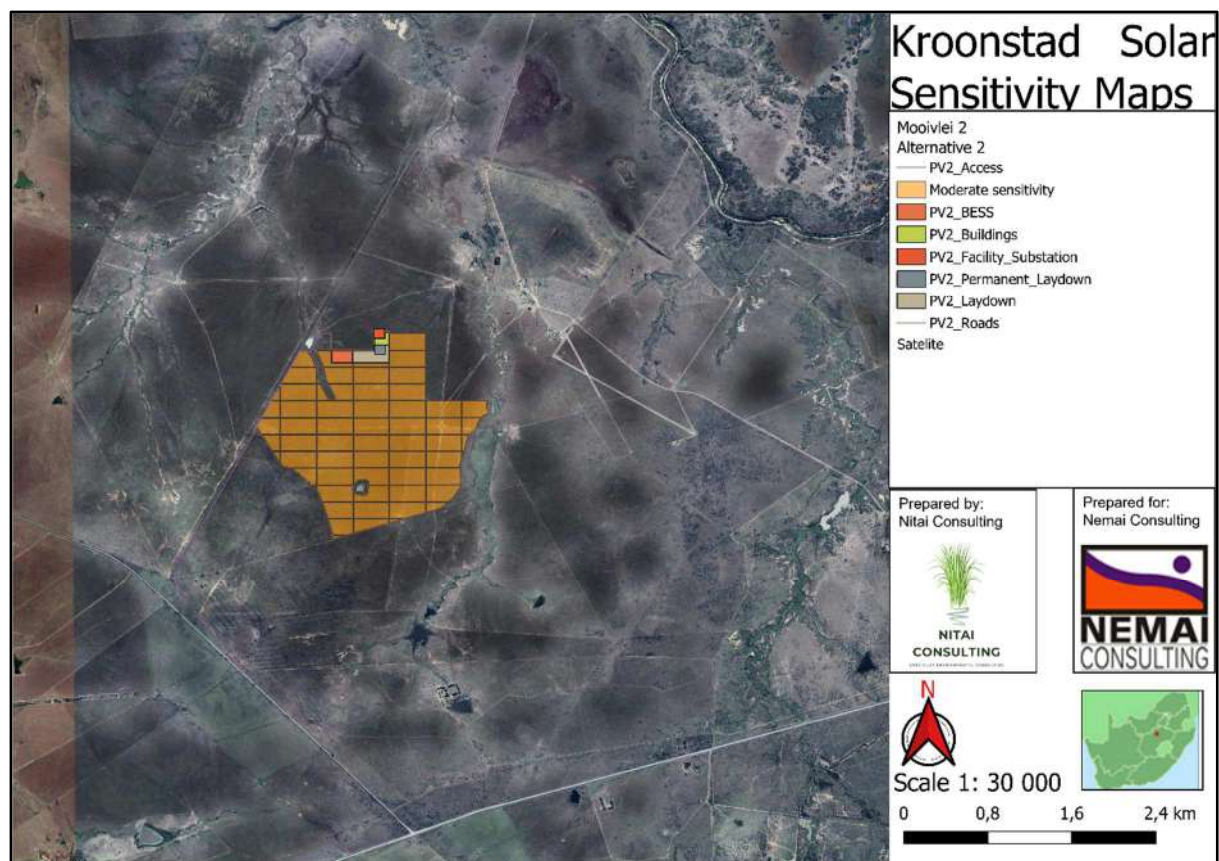


Figure 28: Sensitivity of the project area alternative 2.

## 8 IMPACT ASSESSMENT

The section below and associated tables serve to indicate and summarise the significance of perceived impacts on the terrestrial ecology of the project area. Potential impacts were evaluated against the data captured during the desktop and field assessment to identify relevance to the project area. The relevant impacts associated with the proposed construction of the development were then subjected to a prescribed impact assessment methodology and is available on request. The impact assessment was undertaken based on the two alternative layouts provided, and sections were only duplicated where the impact between the two layouts were considered different.

### 8.1 Biodiversity Impact Assessment

#### 8.1.1 Current Impacts to Biodiversity

Considering the anthropogenic activities and influences within the landscape, several negative impacts to biodiversity were observed within the project area

These include:

- Agricultural practises;
- Farm roads and main roads (and associated traffic and wildlife road mortalities);
- Grazing and trampling of natural vegetation by livestock;
- Invasive species; and
- Fences and associated maintenance.

### 8.1.2 Terrestrial Impact assessment

Anthropogenic activities drive habitat destruction causing displacement of fauna and flora and possibly direct mortality. Land clearing destroys local wildlife habitat and can lead to the loss of local breeding grounds, nesting/burrowing sites and wildlife movement corridors such as rivers, streams and drainage lines, or other locally important features. The removal of natural vegetation may reduce the habitat available for fauna species and may reduce animal populations and species compositions within the area.

### 8.1.3 Alternatives Considered

Two layout alternatives were provided and considered within the project area. Table 18 sets out the impacts and mitigation for the two alternatives.

### 8.1.4 Loss of Irreplaceable Resources

An Area of CBA 2 and Endangered Ecosystem will be lost (Alternative 1) that is still in acceptable condition and is within the buffer area for Sensitive Species 15 recorded directly adjacent to the Endangered ecosystem.

### 8.1.5 Anticipated Impacts

The impacts anticipated for the proposed activities are considered to predict and quantify these impacts and assess & evaluate the magnitude on the identified terrestrial biodiversity (Table 16).

*Table 16: Anticipated impacts for the proposed activities on terrestrial biodiversity.*

Main Impact	Project activities that can cause loss/impacts to habitat (especially about the proposed infrastructure areas):	Secondary impacts anticipated
1. Destruction, fragmentation and	Physical removal of vegetation, including protected species.	Displacement/loss of flora & fauna

<b>degradation of habitats and ecosystems</b>	Access roads and servitudes	Increased potential for soil erosion
	Soil dust precipitation	Habitat fragmentation
	Dumping of waste products	Increased potential for establishment of alien & invasive vegetation
	Random events such as fire (cooking fires or cigarettes)	Erosion
<b>Main Impact</b>	<b>Project activities that can cause the spread and/or establishment of alien and/or invasive species</b>	<b>Secondary impacts anticipated</b>
<b>2. Spread and/or establishment of alien and/or invasive species</b>	Vegetation removal	Habitat loss for native flora & fauna
	Vehicles potentially spreading seed	Spreading of potentially dangerous diseases due to invasive and pest species
	Unsanitary conditions surrounding infrastructure promoting the establishment of alien and/or invasive rodents	Alteration of fauna assemblages due to habitat modification
	Creation of infrastructure suitable for breeding activities of alien and/or invasive birds	
<b>Main Impact</b>	<b>Project activities that can cause direct mortality of fauna</b>	<b>Secondary impacts anticipated</b>
	Clearing of vegetation	Loss of habitat
<b>3. Direct mortality of fauna</b>	Roadkill due to vehicle collision	Loss of ecosystem services



	Pollution of water resources due to dust effects, chemical spills, etc.	Increase in rodent populations and associated disease risk
	Intentional killing of fauna for food (hunting)	
<b>Main Impact</b>	<b>Project activities that can cause reduced dispersal/migration of fauna</b>	<b>Secondary impacts anticipated</b>
<b>4. Reduced dispersal/migration of fauna</b>	Loss of landscape used as corridor	Reduced dispersal/migration of fauna
	Compacted roads	Loss of ecosystem services
	Removal of vegetation	Reduced plant seed dispersal
<b>Main Impact</b>	<b>Project activities that can cause disruption/alteration of ecological life cycles due to sensory disturbance.</b>	<b>Secondary impacts anticipated</b>
<b>5. Disruption/alteration of ecological life cycles (breeding, migration, feeding) due to noise, dust and light pollution.</b>	Operation of machinery (Large earth moving machinery, vehicles)	Disruption/alteration of ecological life cycles due to noise
		Loss of ecosystem services
	Project activities that can cause disruption/alteration of ecological life cycles due to dust	Secondary impacts associated with disruption/alteration of ecological life cycles due to dust
	Vehicles	Loss of ecosystem services

Main Impact	Project activities that can cause staff to interact directly with potentially dangerous fauna	Secondary impacts anticipated
6. Staff and others interacting directly with fauna (potentially dangerous) or poaching of animals	All unregulated/supervised activities outdoors	Loss of SCCs

### 8.1.6 Unplanned Events

The planned activities will have anticipated impacts as discussed; however, unplanned events may occur on any project and may have potential impacts which will need management.

Table 17 is a summary of the findings of an unplanned event assessment from a terrestrial ecology perspective. Note, not all potential unplanned events may be captured herein, and this must therefore be managed throughout all phases according to recorded events.

*Table 17: Summary of unplanned events for terrestrial biodiversity.*

Unplanned Event	Potential Impact	Mitigation
<b>Spills into the surrounding environment</b>	Contamination of habitat as well as water resources associated with a spillage.	A spill response kit must be available at all times. The incident must be reported on and if necessary, a biodiversity specialist must investigate the extent of the impact and provide rehabilitation recommendations.
<b>Fire</b>	Uncontrolled/unmanaged fire that spreads to the surrounding natural areas.	Appropriate/Adequate fire management plan need to be implemented.
<b>Erosion caused by water runoff from the surface</b>	Erosion on the side of the road	Storm water management plan must be compiled and implemented.

### **8.1.7 Identification of Additional Potential Impacts**

#### 8.1.7.1 Assessment of Impact Significance

The assessment of impact significance considers pre-mitigation as well as implemented of postmitigation scenarios. The mitigation actions required to lower the risk of the impact are provided in Section 8.1.8 of this report.

#### 8.1.7.2 Construction Phase

The following potential main impacts on the biodiversity (based on the framework above) were considered for the construction phase of the proposed development. This phase refers to the period during construction when the proposed features are constructed; and is considered to have the largest direct impact on biodiversity. The main anticipated impact includes the clearing of vegetation, proliferation of alien plant species along the roads and cleared areas as well as the severing of movement corridors for fauna, and the fragmentation of habitat. The following potential impacts to terrestrial biodiversity were considered:

- Destruction, further loss and fragmentation of the of habitats, ecosystems and vegetation community;
- Introduction of alien species, especially plants;
- Destruction of protected plant species;
- Displacement of faunal community due to habitat loss, direct mortalities, and disturbance (road collisions, noise, dust, vibration and poaching); and
- Chemical pollution associated with dust suppressants.

#### 8.1.7.3 Operational Phase

The operational phase of the impact of daily activities is anticipated to further spread the IAP, as well as the deterioration of the habitats due to the increase of dust and edge effect impacts. Dust reduces the ability of plants to photosynthesize and thus leads to degradation/retrogression of the veld. Moving maintenance vehicles do not only cause sensory disturbances to fauna, affecting their life cycles and movement, but will lead to direct mortalities due to collisions. The use of non-environmentally friendly chemical for the cleaning of the PV panels can lead to the pollution of water sources and ultimately death of fauna and flora. The following potential impacts were considered:

- Continued fragmentation and degradation of habitats and ecosystems ;
- Spread of alien and/or invasive species;
- Ongoing displacement and direct mortalities of faunal community due to disturbance (road collisions, collisions with substation, noise, light, dust, vibration);
- Reduced dispersal of fauna;
- Chemical pollution associated with measures to keep PV clean; and

- Fencing of PV site.

### **Assessment of Significance**

The assessment of impact significance considers pre-mitigation as well as implemented of post-mitigation scenarios.

#### **Construction Phase**

Table 18 summarises the significance of potential impacts associated with the project on fauna and flora before and after implementation of mitigation measures. The loss of habitat and the degradation of habitat were rated as ‘High’ prior to mitigations being implemented for Alternative 1 and as ‘Moderately High’ prior to mitigations being implemented for Alternative 2. Through the implementation of mitigations such as the restriction and demarcation of the project footprint this can only be lowered to ‘Moderate’ for both Alternatives 1 and 2, it can however not be mitigated completely as habitat will still be lost. The habitat and vegetation type recorded are not restricted and is well represented in the general area.

#### **Operational Phase**

Table 18 summarises the significance of the operational phase impacts on biodiversity before and after implementation of mitigation measures. The continued loss of habitat and the degradation of habitats within the area (spread of alien invasive plants causing loss of habitat, death/ roadkill of faunal species and plate erosion/ soil crusting will degrade the habitat and prevent establishment of plants) were rated as ‘Moderately High’ prior to mitigations being implemented for Alternative 1 and as ‘Moderately High’ prior to mitigations being implemented for Alternative 2. Through the implementation of mitigations this can be reduced to a ‘Moderate’ level for both Alternatives 1 and 2. The impact significance of displacement and direct mortalities of fauna were rated as ‘Moderate’ prior to mitigation for the project. Implementation of mitigation measures reduced the significance of the impact to a ‘Low’ level.

*Table 18: Assessment of significance of potential impacts on the terrestrial fauna and flora associated with the construction phase.*

<b>Impact 1</b>	<b>Destruction, fragmentation and degradation of habitats and ecosystems</b>
<b>Problem</b>	Construction activities will require clearing of natural habitat, to be replaced by the infrastructure. This will result in permanent

	local loss of habitat. Daily operational activities will permanently damage habitat and fragment it further.			
<b>Type</b>	Direct			
<b>Nature</b>	Negative			
<b>Phases</b>	Construction			
	<b>Alternative 1 (includes CBA areas and endangered ecosystem)</b>		<b>Alternative 2</b>	
<b>Criteria</b>	Without mitigation	With mitigation	Without mitigation	With mitigation
<b>Extent</b>	4	3	3	2
<b>Duration</b>	5	5	5	5
<b>Sensitivity</b>	4	3	2	1
<b>Severity</b>	3	2	3	2
<b>Probability</b>	5	5	5	5
<b>Significance</b>	75 High	65 Moderately High	65 Moderately High	50 Moderate
<b>Mitigation actions</b>				
<b>Recommendations</b>	<ol style="list-style-type: none"> <li>1. Restrict impact to development footprint only and limit disturbance in surrounding areas.</li> <li>2. Prior to commencement of construction, compile a Rehabilitation Plan including monitoring specifications, to be included into the EMPr during final approval.</li> <li>3. Prior to commencement of construction, compile an Alien Plant Management Plan, to be included into the EMPr during final approval.</li> </ol>			
<b>Monitoring</b>				



<b>Recommendations</b>	As per management plans			
<b>Impact 2</b>	Spread and/or establishment of alien and/or invasive species			
<b>Problem</b>	Establishment and continued spread of alien invasive plants due to the clearing and disturbance of indigenous vegetation			
<b>Type</b>	Indirect			
<b>Nature</b>	Negative			
<b>Phases</b>	Construction and Operational			
	<b>Alternative 1 (includes CBA areas and endangered ecosystem)</b>		<b>Alternative 2</b>	
<b>Criteria</b>	Without mitigation	With mitigation	Without mitigation	With mitigation
<b>Extent</b>	3	2	3	2
<b>Duration</b>	5	5	5	5
<b>Sensitivity</b>	4	2	2	1
<b>Severity</b>	3	2	3	2
<b>Probability</b>	4	3	4	3
<b>Significance</b>	60 Moderately High	33 Low	52 Moderate	30 Low
<b>Mitigation actions</b>				
<b>Recommendations</b>	1. Prior to commencement of construction, compile and implement an alien management plan, which highlights control priorities and areas and provides a programme for long-term control, including monitoring specifications.			

	2. Undertake regular monitoring to detect alien invasions early so that they can be controlled.			
	3. Implement control measures.			
<b>Monitoring</b>				
<b>Recommendations</b>	As per management plans			
<b>Impact 3</b>	Ongoing displacement and direct mortality of fauna due to disturbance			
<b>Problem</b>	Mortality of fauna due to higher traffic (Vehicles and staff) on site and disturbances including noise, dust, and vibrations			
<b>Type</b>	Direct			
<b>Nature</b>	Negative			
<b>Phases</b>	Construction and Operational			
	<b>Alternative 1 (includes CBA areas and endangered ecosystem)</b>		<b>Alternative 2</b>	
<b>Criteria</b>	Without mitigation	With Mitigation	Without mitigation	With Mitigation
<b>Extent</b>	3	2	3	2
<b>Duration</b>	4	3	4	3
<b>Sensitivity</b>	3	2	2	2
<b>Severity</b>	3	2	3	1
<b>Probability</b>	5	3	4	3
<b>Significance</b>	65 Moderately High	27 Low	48 Moderate	24 Low
<b>Mitigation actions</b>				

<b>Recommendations</b>	Education and awareness of staff and construction personal regarding importance of faunal populations and ecosystem functioning			
<b>Monitoring</b>				
<b>Recommendations</b>	Continued monitoring of faunal populations and awareness programs as per management plan			
<b>Impact 4</b>	Reduced dispersal/migration of fauna			
<b>Problem</b>	Internal roads, fencing and infrastructure will cut off migratory routes of faunal populations			
<b>Type</b>	Direct			
<b>Nature</b>	Negative			
<b>Phases</b>	Construction and Operational			
	<b>Alternative 1 (includes CBA areas and endangered ecosystem)</b>		<b>Alternative 2</b>	
<b>Criteria</b>	Without mitigation	With Mitigation	Without mitigation	With Mitigation
<b>Extent</b>	3	2	2	2
<b>Duration</b>	5	5	5	5
<b>Sensitivity</b>	3	2	2	1
<b>Severity</b>	3	2	3	1
<b>Probability</b>	5	4	5	4
<b>Significance</b>	70 High	44 Moderate	60 Moderate	36 Low
<b>Mitigation actions</b>				

<b>Recommendations</b>	Create corridors during construction phase for faunal species to move through artificial barriers			
<b>Monitoring</b>				
<b>Recommendations</b>	Continuously monitor faunal populations as per management plans			
<b>Impact 5</b>	Environmental pollution due to water runoff, spills from vehicles and erosion			
<b>Problem</b>				
<b>Type</b>	Direct and Indirect			
<b>Nature</b>	Negative			
<b>Phases</b>	Construction and Operational			
	<b>Alternative 1 (includes CBA areas and endangered ecosystem)</b>		<b>Alternative 2</b>	
<b>Criteria</b>	Without mitigation	With mitigation	Without mitigation	With mitigation
<b>Extent</b>	3	2	4	1
<b>Duration</b>	5	5	5	5
<b>Sensitivity</b>	4	2	3	1
<b>Severity</b>	4	3	4	1
<b>Probability</b>	3	2	3	2
<b>Significance</b>	51 Moderate	24 Low	48 Moderate	16 Very Low
<b>Mitigation actions</b>				
<b>Recommendations</b>	Proper storage of harmful fluids or powders			

<b>Monitoring</b>				
<b>Recommendations</b>	Diligence checks as per storage SOP according to management plans			
<b>Impact 6</b>	Disruption/alteration of ecological life cycles (breeding, migration, feeding) due to noise, dust, and light pollution.			
<b>Problem</b>	Construction and maintenance vehicles moving around on site			
<b>Type</b>	Direct and Indirect			
<b>Nature</b>	Negative			
<b>Phases</b>	Construction and Operational			
	<b>Alternative 1 (includes CBA areas and endangered ecosystem)</b>		<b>Alternative 2</b>	
<b>Criteria</b>	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
<b>Extent</b>	3	2	3	2
<b>Duration</b>	5	3	5	3
<b>Sensitivity</b>	3	2	2	1
<b>Severity</b>	4	3	3	2
<b>Probability</b>	5	5	4	3
<b>Significance</b>	75 High	50 Moderate	52 Moderate	24 Low
<b>Mitigation actions</b>				
<b>Recommendations</b>	Keep within footprint, drive within speed limits, do not idle vehicle for unnecessary periods			
<b>Monitoring</b>				



<b>Recommendations</b>	Follow SOP's as set out in Management plan, monitor faunal populations			
<b>Impact 7</b>	Staff and others interacting directly with fauna (potentially dangerous) and flora or poaching of animals and plants			
<b>Problem</b>	Staff interacting/ killing/ poaching fauna or flora species			
<b>Type</b>	Direct			
<b>Nature</b>	Negative			
<b>Phases</b>	Construction and Operational			
	<b>Alternative 1 (includes CBA areas and endangered ecosystem)</b>		<b>Alternative 2</b>	
<b>Criteria</b>	Without mitigation	With mitigation	Without mitigation	With mitigation
<b>Extent</b>	3	2	3	1
<b>Duration</b>	5	5	5	5
<b>Sensitivity</b>	4	2	3	1
<b>Severity</b>	4	2	3	1
<b>Probability</b>	4	3	4	3
<b>Significance</b>	64 Moderate	33 Low	52 Moderate	24 Low
<b>Mitigation actions</b>				
<b>Recommendations</b>	Awareness training for staff on site regarding sensitive fauna and flora species, including relevant laws for protection of species			
<b>Monitoring</b>				

<b>Recommendations</b>	Monitoring of area for snares and disturbed soil (plant poaching), monitoring of personal effects of staff
------------------------	------------------------------------------------------------------------------------------------------------

#### 8.1.7.4 Cumulative Impacts

Cumulative impacts are assessed in context of the extent of the proposed project area; other developments in the area; and general habitat loss and transformation resulting from other activities in the area.

Localised cumulative impacts include the cumulative effects from operations that are close enough to potentially cause additive effects on the environment or sensitive receivers (such as nearby renewable energy activities within the area). These include dust deposition, noise and vibration, disruption of corridors or habitat, groundwater drawdown, groundwater and surface water quality, and transport.

Long-term cumulative impacts due to extensive solar farm footprint, powerlines and substations can lead to the loss of endemic species and threatened species, loss of habitat and vegetation types and even degradation of well conserved areas, this however needs to be quantified by monitoring.

The PV panels and associated infrastructure are expected to have a moderate cumulative impact when considering the project in isolation, while the cumulative impacts associated with the proposed project as well as other project in the area are moderately high due to planned applications for renewable developments in the vicinity of the project area.

Cumulatively these developments will be responsible for the destruction of a low portion of Grassland in the area. In isolation this project will only affect 0.02% of the total area for the remaining extant of Vaal-Vet Sandy Grassland and 0.03% for the Central free State Grassland vegetation bioregions; but cumulatively it will affect 0.33% of the total area for the Central Free State Grassland.

*Table 19: Cumulative impacts of Solar Pv Projects around study*

Cumulative Impacts	Contribution to cumulative habitat loss, especially in the ecological corridors such as the wetlands which will also have an impact on the water resource and ecological processes in the region
Problem	Continued and extensive habitat loss including ecosystem services
Type	Direct

Nature	Negative	
Phases	Construction and Operational	
Criteria	In isolation	Cumulative
Extent	2	3
Duration	5	5
Sensitivity	3	3
Severity	2	2
Probability	5	5
Significance	60 Moderate	65 Moderately High

## 8.2 Mitigation Measures

### 8.2.1 **Vegetation and habitats**

The following mitigation measures are recommended to address known potential impacts:

- Areas of indigenous vegetation, even secondary communities outside of the direct project footprint, should under no circumstances be fragmented or disturbed further.
- Clearing of vegetation should be minimized and avoided where possible. All activities must be restricted within the low/medium sensitivity areas. Existing roads and powerline areas are considered transformed and is deemed low sensitivity.
- In situations where the threatened and protected plants must be removed, the proponent may only do so after the required permission/permits have been obtained in accordance with national and provincial legislation. In the abovementioned situation the development of a search, rescue and recovery program is suggested for the protection of these species.
- All activities must be restricted within the low/medium sensitivity areas.
- No further loss of high sensitivity areas should be permitted.
- It is recommended that high sensitive areas be specifically demarcated so that during the construction phase, only the demarcated areas be impacted upon.
- Existing access routes, especially roads must be made use of
- All laydown, chemical toilets etc. should be restricted to medium/low sensitivity areas. Any materials may not be stored for extended periods of time and must be removed from the project area once the construction phase has been concluded. No permanent construction

phase structures should be permitted, except in areas demarcated for permanent laydown structures. Construction buildings should preferably be prefabricated or constructed of reusable/recyclable materials. No storage of vehicles or equipment will be allowed outside of the designated project areas.

- Areas that are denuded during construction need to be re-vegetated with indigenous vegetation to prevent erosion during flood and wind events. This will also reduce the likelihood of encroachment by alien invasive plant species. All livestock must always be kept out of the project area, especially areas that have been recently revegetated.
- A hydrocarbon spill management plan must be put in place to ensure that should there be any chemical spill out or over that it does not run into the surrounding areas. The Contractor shall be in possession of an emergency spill kit that must always be complete and available on site. Drip trays or any form of oil absorbent material must be placed underneath vehicles/machinery and equipment when not in use. No servicing of equipment on site unless necessary. All contaminated soil / yard stone shall be treated in situ or removed and be placed in containers. Appropriately contain any generator diesel storage tanks, machinery spills (e.g. accidental spills of hydrocarbons oils, diesel etc.) in such a way as to prevent them leaking and entering the environment. Construction activities and vehicles could cause spillages of lubricants, fuels and waste material potentially negatively affecting the functioning of the ecosystem. All vehicles and equipment must be maintained, and all re-fuelling and servicing of equipment is to take place in demarcated areas outside of the project area.
- It should be made an offence for any staff to take/ bring any plant species into/out of any portion of the project area. No plant species whether indigenous or exotic should be brought into/taken from the project area, to prevent the spread of exotic or invasive species or the illegal collection of plants.
- Any individual of the protected plants that are present needs a relocation or destruction permit in order for any individual that may be removed or destroyed due to the development. High visibility flags must be placed near any threatened/protected plants in order to avoid any damage or destruction of these specimens especially if those specimens are not destroyed by construction activities.
- Infrastructure, development areas and routes where protected plants cannot be avoided, these plants mainly being succulents/ geophytes should be removed from the soil and relocated/ re-planted in similar habitats where they should be able to resprout and flourish again instead of being destroyed as part of the construction phase..
- A fire management plan needs to be complied and implemented to restrict the impact fire might have on the surrounding areas.
- Noise must be kept to an absolute minimum during the evenings and at night to minimize all possible disturbances to amphibian species and nocturnal mammals.
- Restrict impact to development footprint only and limit disturbance in surrounding areas.

- Prior to commencement of construction, compile a Rehabilitation Plan including monitoring specifications, to be included into the EMPr during final approval.
- Prior to commencement of construction, compile an Alien Plant Management Plan, to be included into the EMPr during final approval.
- Prior to commencement of construction, compile and implement an alien management plan, which highlights control priorities and areas and provides a programme for long-term control, including monitoring specifications.
- Undertake regular monitoring to detect alien invasions early so that they can be controlled.
- Prior to commencement of construction, compile and implement a stormwater management plan including monitoring specifications.
- Monitor surfaces for erosion, repair and/or upgrade, where necessary.
- Prior to decommissioning commencing, compile a Rehabilitation Plan in compliance with the regulatory requirements at the time of decommissioning.

### 8.2.2 Fauna

The following mitigation measures are recommended to address known potential impacts:

- A qualified environmental control officer must be on site when construction begins.
- A site walk through is recommended by a suitably qualified ecologist prior to any construction activities, preferably during the wet season. Should animals not move out of the area on their own relevant specialists must be contacted to advise on how the species can be relocated.
- Outside lighting should be designed and limited to minimize impacts on fauna. Fluorescent and mercury vapor lighting should be avoided, and sodium vapor (green/red) lights should be used wherever possible.
- Try incorporating motion detection lights as much as possible to reduce the duration of illumination. Heights of light columns to be minimised to reduce light spill. Baffles, hoods or louvres to also be used to reduce light spill.
- All construction and maintenance motor vehicle operators should undergo an environmental induction that includes instruction on the need to comply with speed limits, to respect all forms of wildlife. Speed limits (30km/h) must still be enforced to ensure that road killings and erosion is limited.
- The areas to be developed must be specifically demarcated to prevent movement of staff or any individual into the surrounding environments,
  - Signs must be put up to enforce this.
- No trapping, killing, or poisoning of any wildlife is to be allowed
  - Signs must be put up to enforce this;



- Outside lighting should be designed and limited to minimize impacts on fauna. Fluorescent and mercury vapor lighting should be avoided, and sodium vapor (green/red) lights should be used wherever possible.
- All construction and maintenance motor vehicle operators should undergo an environmental induction that includes instruction on the need to comply with speed limits, to respect all forms of wildlife. Speed limits (30km/h) must still be enforced to ensure that road killings and erosion is limited.
- All areas to be developed must be walked through prior to any activity to ensure no fauna species are found in the area. Should any Species of Conservation Concern not move out of the area, a suitably qualified specialist must be consulted to advise on the correct actions to be taken
- Any holes/deep excavations must be dug and planted in a progressive manner and shouldn't be left open overnight;
  - Should the holes be left open overnight they must be covered temporarily to ensure no small fauna species fall in.
- Ensure that cables and connections are insulated successfully to reduce electrocution risk
- Any exposed parts must be covered (insulated) to reduce electrocution risk.
- Heat generated from the substations must be monitored to ensure it does not negatively affect the local fauna
- Use environmentally friendly cleaning and dust suppressant products
- Fencing mitigations:
  - Wildlife-permeable fencing with holes large enough for mongoose and other smaller mammals should be installed every 50 m along the fence (with a size of 30 x 20 cm), the holes must not be placed in the fence where it is next to a major road as this will increase road killings in the area.

### **8.2.3 Alien Species**

- Compilation of and implementation of an alien vegetation management plan.
- The footprint area of the construction should be kept to a minimum. The footprint area must be clearly demarcated to avoid unnecessary disturbances to adjacent areas. Footprint of the roads must be kept to prescribed widths.
- Waste management must be a priority and all waste must be collected and stored adequately. It is recommended that all waste be removed from site on a weekly basis to prevent rodents and pests entering the site.
- A pest control plan must be put in place and implemented; it is imperative that poisons not be used.

#### **8.2.4 Dust**

- Dust-reducing mitigation measures must be put in place and must be strictly adhered to. This includes wetting of exposed soft soil surfaces.
  - No non environmentally friendly suppressants may be used as this could result in pollution of water sources

#### **8.2.5 Waste Management**

- Waste management must be a priority and all waste must be collected and stored effectively
- Litter, spills, fuels, chemicals and human waste in and around the project area
- Portable toilets must be pumped dry to ensure the system does not degrade over time and spill into the surrounding area. These toilets must be serviced regularly to avoid spill over and not degrade the habitat by nutrient enrichment in the form of excess nitrogen.
- The Contractor should supply sealable and properly marked domestic waste collection bins and all solid waste collected shall be disposed of at a licensed disposal facility.
- Where a registered disposal facility is not available close to the project area, the Contractor shall provide a method statement with regard to waste management. Under no circumstances may domestic waste be burned on site.
- Refuse bins will be emptied and secured. Temporary storage of domestic waste shall be in covered waste skips. Maximum domestic waste storage period will be 10 days.

#### **8.2.6 Environmental Awareness Training**

The Contractor should supply sealable and properly marked domestic waste collection bins and all solid waste collected shall be disposed of at a licensed disposal facility. All personnel and contractors to undergo Environmental Awareness Training. A signed register of attendance must be kept for proof. Discussions are required on sensitive environmental receptors within the project area to inform contractors and site staff of the presence of protected species, their identification, conservation status and importance, biology, habitat requirements and management requirements as within the Environmental Authorisation and EMP. The avoidance and protection of the wetland areas must be included into a site induction. Contractors and employees must all undergo the induction and made aware of the “no-go” to be avoided.

#### **8.2.7 Erosion**

- Speed limits must be put in place to reduce erosion.
  - Reducing the dust generated by the listed activities above, especially the earth moving machinery, through wetting the soil surface and putting up signs to enforce speed limit as well as speed bumps built to force slow speeds;

- Signs must be put up to enforce this.
- Where possible, existing access routes and walking paths must be made use of.
- Areas that are denuded during construction need to be re-vegetated with indigenous vegetation to prevent erosion during flood events and strong winds.
- A stormwater management plan must be compiled and implemented.

### **8.3 Summary of Monitoring recommendations**

Specific monitoring recommendations should be provided in the Alien Invasive Management Plan, and the Rehabilitation Plan. The following are broad recommendations:

Alien Invasive Species:

- Monitor for early detection, to find species when they first appear on site. This should be as per the frequency specified in the management plan and should be conducted by an experienced botanist. Early detection should provide a list of species and locations where they have been detected. Summer (vegetation maximum growth period) is usually the most appropriate time, but monitoring can be adaptable, depending on local conditions – this must be specified in the management plan.
- Monitor for the effect of management actions on target species, which provides information on the effectiveness of management actions. Such monitoring depends on the management actions taking place. It should take place after each management action.
- Monitor for the effect of management actions on non-target species and habitats.

Rehabilitated areas:

- Rehabilitation Plan must be compiled by an approved ecologist prior to achieving COD and prior to the start of decommissioning.
- All management actions associated with rehabilitation must be recorded after each management action has taken place.
- All rehabilitated areas should be monitored to assess vegetation recovery. This should be for a minimum of three years after post-construction rehabilitation, but depends on the assessed trajectory of rehabilitation (whether it is following a favourable progression of vegetation establishment or not – this depends on the total vegetation cover present, and the proportion that consists of perennial growth of desired species). For each monitoring site, an equivalent comparative site in adjacent undisturbed vegetation should be similarly monitored. Monitoring data collection should include the following:

- total vegetation cover and height, as well as for each major growth form;

- species composition, including relative dominance;
- soil stability and/or development of erosion features;
- representative photographs should be taken at each monitoring period.
- Monitoring of rehabilitated areas should take place at the frequency and for the duration determined in the rehabilitation plan, or until vegetation stability has been achieved.

## 9 CONCLUSION AND IMPACT STATEMENT

### 9.1 Conclusion

The completion of a comprehensive desktop study, in conjunction with the results from the field survey, suggest there is a good confidence in the information provided. The survey ensured that there was an extensive ground truth coverage of the assessment area, and most habitats and ecosystems were assessed to obtain a general species (fauna and flora) overview and the major current impacts.

Six habitat units were identified during the assessment and included Endangered Vaal-Vet Sandy Grasslands, Wetland and Riparian areas, Disturbed Central Free State Grassland, alien invaded habitats, and Transformed areas. The disturbed habitats are of medium terrestrial sensitivity, as the area still provides habitat to various fauna and flora species, while the transformed habitat is considered to have a low sensitivity. The Endangered Vaal-Vet Sandy Grassland habitat is considered high sensitivity due to the Endangered nature and CBA classification and the presence of protected plant species.

Two layout alternatives are considered for the proposed project, (Alternative 1 and Alternative 2). Alternative 1 is considered to have high to low impact and alternative 2 is considered to have a moderate to low negative impact on the terrestrial ecosystem associated with the project area after implementation of mitigation measures.

Alternative 1 characteristics:

- The assessment area possesses a moderate diversity and density flora species, which is well represented in the general area. Moreover, fauna is ubiquitous within the assessment area and surrounding landscape.
- This area has a sensitive CBA 1 and 2 (part of endangered habitat) area with protected plants which cannot be feasibly relocated or re-planted as they are very small and plentiful.
- The area includes an endangered ecosystem – Vaal-vet sandy Grassland.
- This area is within the buffer zone for Sensitive species 15 recorded in April 2023 by the EWT.

Alternative 2 is, however, the preferred layout alternative due to the following:

- All areas indicated by the database as CBA1, and Endangered Vaal-Vet Sandy Grassland and buffer areas for Sensitive species 15 will be excluded from development.

Biodiversity maintenance is one key ecological service provided by the identified terrestrial biodiversity areas through their ecological integrity, importance, and functioning. As such the preservation of these systems is an important aspect to consider for the proposed project.

Any development in high sensitivity areas must be avoided, which will occur with the selection of the project area. Development within the high sensitivity areas within the project area will lead the direct destruction and loss of functional habitats; and the faunal species that are expected to utilise this habitat. Thus, if these areas are not maintained in a natural or near natural state, destroyed or fragmented, then meeting targets for biodiversity features will not be achieved. The mitigation measures, management and associated monitoring regarding the expected impacts will be the most important factor of this project and must be considered by the issuing authority.

## 9.2 Impact Statement

The main expected impacts of the proposed infrastructure will include the following:

- Habitat loss and fragmentation;
- Degradation of surrounding habitat;
- Disturbance and displacement caused during the construction and maintenance phases; and
- Direct mortality during the construction phase.

Mitigation measures as described in this report must be implemented to reduce the significance of the risk, but there is still a possibility of impacts occurring. Considering that the area that has been identified as being of significance for biodiversity maintenance and ecological processes (Moderate and High sensitivity), development may proceed but with caution and only with the implementation of mitigation measures.

Considering the above-mentioned information, no fatal flaws are evident for the proposed project. It is the opinion of the specialists that the project location, may be favourably considered on condition that all prescribed mitigation measures and supporting recommendations are implemented.

## 10 REFERENCES

- Branch, W. (2008). *Tortoises, terrapins and Turtles of Africa*. Pretoria: Struik Publishers.
- Broadley, D., & Boycott, R. (2008). *A compilation project of the IUCN SSC Tortoise and Freshwater Turtle Specialist groups*. Conservation Biology of freshwater turtles and tortoises.



- DEA. (2016). *National Protected Areas Expansion Strategy for South*. Pretoria: Department of Environmental Affairs.
- DEA. (2018). *National Protected Areas Expansion Strategy for South*. Pretoria: Department of Environmental Affairs.
- Dean, W. (1978). Conservation of the white-tailed rat in South Africa. *Biological Conservation*, 133-140.
- DFFE. (2022). *Revised national list of ecosystems that are threatened and in need of protection*. Pretoria: S.A. Government.
- Driver, L., & Maze, K. (2012). *National Biodiversity Assessment 2011: An assessment of South Africa's biodiversity and ecosystems*. . Pretoria: SANBI and the Department of Environmental Affairs.
- Friedmann, Y., & Daly, B. (2004). Red Data book of mammals of South Africa: A conservation Assessment. *Conservation Breeding Specialist*, Endangered Wildlife Trust.
- Monadjem, C., & Cotterill, F. (2015). *Rodents of Sub-Saharan Africa: A biogeographic and taxonomic synthesis*. Berlin, Germany.: De Gruyter.
- Pillay, N. (2003). Reproductive biology of a rare African Rodent, the water rat - *Dasymys incomptus*. (Rodentia, Murinae). *Journal of Mammology*., 505-512.
- SANBI. (2021). Rates and patterns of habitat loss across South Africa's vegetation biomes. In A. Skowno, D. Jewitt, J. Slingsby, L. Mucina, M. Rutherford, & L. Powrie (Eds.).
- Savannah Environmental. (2020). *Environmental Impact Assessment Process: Scoping Report for the proposed construction and operation of the 100 MWac Rondavel Photovoltaic Solar Energy Facility, Battery Energy Storage System (BESS) and associated infrastructure located near Kroonstad...* Claremont, Cape Town: South Africa Mainstream Renewable Power Developments (Pty) Ltd.
- Skinner, J. C. (2005). *The mammals of the Southern African subregion*. United Kingdom: Cambridge University Press.
- South African Government, .. (2005). *National Environmental Biodiversity Act: Threatened or Protected species Acts*. RSA Government.
- Taylor, A., Avenant, N., Schulze, E., & Viljoen, P. (2016). *Redunca fulvorufula fulvorufula*. In M. Child, L. D. Roxburgh, D. Raimondo, & H. Davies-Mostert, *he Red List of Mammals of South Africa, Swaziland and Lesotho*. SANBI and EWT.
- Thorn, M., & Scott, D. (2011). Large-scale distribution patterns of carnivores in northern South Africa: implications for conservation and monitoring. *Oryx*, 579-586.
- Wandrag, G., & Collins, N. (2002). Rodent and insectivore species diversity of Seekoeivlei Provincial Nature Reserve, Free State province, South Africa. *South African Journal of Wildlife Research*, 137–143.

Watson, J. (2006). Check list of the mammals of Tussen-die-Riviere Provincial Nature Reserve, Free State Province, South Africa. *Koedoe*, 111-117.

## 11 APPENDIX 1: SPECIALIST CV

### 1. Personal Particulars

<b>Profession:</b>	Biodiversity Specialist
<b>Date of Birth:</b>	13 March 1987
<b>Name of Firm:</b>	Nitai Consulting
<b>Name of Staff:</b>	Elzet Human
<b>Nationality:</b>	RSA
<b>Membership of Professional Societies</b>	SACNASP (Pr. Sci. Nat. 147031)

### 2. Education:

M-Tech Nature Conservation, (Plant DNA Barcoding and phylogenetics), TUT, South Africa, 2021

B-Tech Nature Conservation, (Resource Management, Vegetation ecology and rehabilitation) TUT, South Africa, 2011

N. Dip Nature Conservation, TUT, South Africa, 2008

### 3. Employment Record:

2022 – Present Biodiversity Specialist, Nitai Consulting

Conduct Biodiversity Impact Assessments.

Conduct Plant Ecological Assessments.

Conduct Animal Ecological Assessments

Biodiversity monitoring programs; and,

GIS Mapping

2013 – 2022 Lecturer: Nature Management, Centurion academy

Lectured various subjects for undergraduate students in Nature Management:

Botany and Vegetation Ecology, Zoology, Animal Health, Conservation Development, Ecology, Game Ranch Management, Biostatistics, Research Methodology, Genetics, Soil Science

2009 – 2013 HOD Rangers Department, Zebula Gold Estate and Spa

Ecological Monitoring, Reserve Maintenance, Animal Husbandry, Neonatal care of Endangered carnivore species, Zoological display, and permit compliance

2008 – Conservation Student, Ann van Dyk Cheetah Research Centre

Neonatal Care of Carnivore species,

Veterinary assistance work – vaccine, diets, Endo scoping, pregnancy tests, health monitoring, quarantine care of species, emergency c-sections, bleeding procedures on vultures

Enclosure Maintenance

Tracking wild cheetahs

Rewilding cheetahs

Anatolian Shepard project assistance

#### **4. Selected Consultancies**

##### **4.1 Ecological assessment for Victorious Game farm, Visgat, Ellisras, Limpopo**

2018, Ecologist, Ecological condition assessment and game carrying capacity for game farm. Habitat evaluation and rehibition program for problem areas

##### **4.2 Elephant impact study on Mabula Game Reserve, Bela-Bela, Limpopo,**

2019, Ecologist, Ecological impact study on Private Nature reserve to see extent of elephant utilisation and impact. Woody species analysis – structure classification and net primary production. Elephant movement patterns and carrying capacity. Identification of vulnerable habitats and management program.

##### **4.3 Faan Meintjies Municipal Nature Reserve, Matlosana, North West**

2018-2022, Ecologist, Habitat assessments, game carrying capacities, ecological condition assessments, game counts and game recommendations, ecological rehabilitation programs, white rhino monitoring, anti-poaching programs, Environmental Education programs.

#### **4.4 Kroonstad Solar PV Facilities**

2022, Biodiversity Specialist. Development of three Solar PV facilities near Kroonstad, Free State Province, South Africa, Assess and map all wetlands associated with the three solar PV facilities as well as perform aquatic biomonitoring of the Vals River.

#### **4.5 Kroonstad South Solar PV Facilities**

2022, Biodiversity Specialist. Development of five Solar PV facilities near Kroonstad, Free State Province, South Africa, Assess and map all wetlands associated with the five solar PV facilities as well as perform aquatic biomonitoring of the Blomspruit.

#### **4.6 Proposed PPM Regional Bulk Water Scheme Project**

2023, Biodiversity Specialist. Nketoana Local Municipality is experiencing severe water shortages in its towns Reitz/Petsana/ Petrus Steyn/ Mamafubedu/ Arlington/ Leratswana and Lindley. Solutions to the water shortages are the proposed Nketoana Regional Bulk Water Scheme Pipeline, South Africa, Assess and map all biodiversity, plant and animal features associated within the footprint of the bulk water scheme project.

#### **4.7 Rustenburg Solar PV Facilities**

2023, Biodiversity Specialist. Development of three Solar PV facilities near Rustenburg, North West Province, South Africa, Assess and map all biodiversity, plant and animal features associated with the three solar PV facilities.

#### **4.8 Grootvlei Solar PV Facility**

2023, Biodiversity Specialist. Development of three Solar PV facilities near Carletonville, North West Province, South Africa, Assess and map all biodiversity, plant and animal features associated with the one solar PV facility.

#### **4.9 400kV Transmission and 132kV distribution power lines for the Apollo-Lepini-Mesong Project**

2023, Biodiversity Specialist. Proposed development of a 400kV transmission and 132kV power lines for the Apollo-Lepini-Mesong Project, Gauteng Province, South Africa, undertake assessments and map all biodiversity, plant, and animal features along the proposed routes for the 400kV and 132kV power lines.

**4.10 CCUS 3D Seismic Survey & Drilling**

2023, Biodiversity Specialist. Proposed 3D Seismic Survey within the Leandra area, Mpumalanga Province, South Africa Assess and map all biodiversity, plant and animal features within the footprint of the survey area.

**4.11 Paulputs 400 kV Strengthening (Transmission Line Loop in Loop Out) Project**

2023, Biodiversity Specialist. Proposed Paulputs 400kv Strengthening Project (Transmission Line Loop In Loop Out From Aries – Kokerboom Transmission Line), South Africa, Assess and map all biodiversity, plant and animal features within the power line footprint as well as perform biodiversity monitoring.

**4.12 Seelo Solar PV Facilities**

2023, Biodiversity Specialist. Development of three Solar PV facilities near Carletonville, North West Province, South Africa, Assess and map all biodiversity, plant, and animal features within the three solar PV facilities as well as perform biodiversity monitoring.

**5. Languages:**

English - excellent speaking, reading, and writing

Afrikaans – excellent speaking, reading and writing

**6. Certification:**

I, the undersigned, certify that to the best of my knowledge and belief, this CV correctly describes me, my qualifications, and my experience.

Name of Candidate ...Elzet Human.....



Signature .....

Date ...02/03/2023.....



## 12 APPENDIX 2: DECLARATION OF INDEPENDENCE

I, Elzet Human declare that:

- 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 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 form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.



Elzet Human

Pr. Sci. Nat 147031

May 2023

## 13 APPENDIX 3: PLANT SPECIES LIST

Family	Taxon	Common name	Protection Status	Endemism	Invasive
Amaranthaceae	<i>Alternanthera pungens,</i>	Paper Thorn	LC	Not naturalised	Indigenous,
Amaranthaceae	<i>Gomphrena celosioides</i>	Batchelor's button	LC	Not naturalised	Indigenous,
Amaranthaceae	<i>Guilleminea densa,</i>	Small matweed	LC	Not naturalised	Indigenous,
Amaranthaceae	<i>Kyphocarpa angustifolia</i>	Silver Burrweed	LC	Indigenous	
Asparagaceae	<i>Asparagus laricinus</i>	Emperor's asparagus	LC	Indigenous	
Asteraceae	<i>Arctotis arctotoides,</i>	Botter blom	LC	Indigenous	
Asteraceae	<i>Felicia muricata</i>	Bloublommetjie		Indigenous; Endemic	
Asteraceae	<i>Geigeria burkei,</i>	Vermeerbos	LC	Indigenous	
Asteraceae	<i>Gerbera</i>			Indigenous	
Asteraceae	<i>Helichrysum acutatum</i>	Sticky Everlasting	LC	Indigenous	
Asteraceae	<i>Helichrysum nudifolium</i>	Hottentot's Tea	LC	Indigenous	
Asteraceae	<i>Helichrysum rugulosum</i>	Wrinkly Everlasting	LC	Indigenous	
Asteraceae	<i>Nidorella hottentotta,</i>	Grassland Vleiweed	LC	Indigenous	
Asteraceae	<i>Nidorella resedifolia</i>	Stinkkruid	LC	Indigenous	
Asteraceae	<i>Senecio inaequidens</i>	Canary Weed	LC	Indigenous	
Asteraceae	<i>Seriphium plumosa</i>	Bankrupt bush	LC	Indigenous	

Proposed Solar development for Mooivlei Solar 2, Pty (LTD), Kroonstad, Free State, South Africa

<b>Asteraceae</b>	<i>Tagetes minuta</i>	Khaki weed	Invasive	Not indigenous; Naturalised; Invasive	
<b>Cactaceae</b>	<i>Opuntia ficus-indica</i>	Sweet prickly pear	Invasive	Not indigenous; Cultivated; Naturalised; Invasive	Nemba 1b
<b>Caryophyllaceae</b>	<i>Pollichia campestris</i>	Barley Sugar Bush		Indigenous	
<b>Commelinaceae</b>	<i>Commelina benghalensis</i>	Benghal Wandering Jew	LC	Indigenous	
<b>Cyperaceae</b>	<i>Bolboschoenus glaucus,</i>	Glaucus tuberculush	LC	Indigenous	
<b>Cyperaceae</b>	<i>Bulbostylis hispidula,</i>	Slender Sedge	LC	Indigenous	
<b>Cyperaceae</b>	<i>Cyperus congestus,</i>	Purple Umbrella Sedge	LC	Indigenous	
<b>Cyperaceae</b>	<i>Cyperus denudatus,</i>		LC	Indigenous	
<b>Cyperaceae</b>	<i>Cyperus fastigiatus,</i>		LC	Indigenous	
<b>Cyperaceae</b>	<i>Kyllinga alba</i>	Witbiesie	LC	Indigenous	
<b>Cyperaceae</b>	<i>Kyllinga erecta,</i>	Greater Kyllinga	LC	Indigenous	
<b>Dipsacaceae</b>	<i>Scabiosa columbaria</i>	Rice Flower	LC	Indigenous	
<b>Fabaceae</b>	<i>Sphenostylis angustifolia,</i>	Wild Sweet pea	LC	Indigenous	
<b>Fabaceae</b>	<i>Vachelia robusta</i>	Ankle thorn	LC	Indigenous	
<b>Geraniaceae</b>	<i>Monsonia glauca</i>	Grey Dysentery-Herb	LC	Indigenous	
<b>Hypoxidaceae</b>	<i>Hypoxis hemerocallidea</i>	Star-flower	Declining	Indigenous	
<b>Juncaceae</b>	<i>Juncus oxycarpus,</i>		LC	Indigenous	
<b>Lamiaceae</b>	<i>Ocimum americanum,</i>	Wild Basil	LC	Indigenous	
<b>Malvaceae</b>	<i>Hibiscus trionum,</i>	Venice Mallow	LC	Indigenous	
<b>Phyllanthaceae</b>	<i>Phyllanthus angolensis</i>		LC	Indigenous	

Proposed Solar development for Mooivlei Solar 2, Pty (LTD), Kroonstad, Free State, South Africa

<b>Plantaginaceae</b>	<i>Plantago media</i>	Hoary plantain	LC	Not naturalised	Indigenous,
<b>Poaceae</b>	<i>Aristida canescens</i>	Pale Three Awn	LC	Indigenous	
<b>Poaceae</b>	<i>Aristida congesta subsp. barbicollis,</i>	Spreading Three Awn	LC	Indigenous	
<b>Poaceae</b>	<i>Aristida congesta subsp. congesta</i>	Tassle Three-Awn	LC	Indigenous	
<b>Poaceae</b>	<i>Brachiaria serrata,</i>	Velvet Signal Grass	LC	Indigenous	
<b>Poaceae</b>	<i>Chloris virgata</i>	Feather-top Chloris	LC	Indigenous	
<b>Poaceae</b>	<i>Cymbopogon caesius,</i>	Broad-leaved Turpentine Grass	LC	Indigenous	
<b>Poaceae</b>	<i>Cymbopogon pospischilii</i>	Bushveld turpentine Grass	LC	Indigenous	
<b>Poaceae</b>	<i>Cynodon dactylon,</i>	Couch Grass	LC	Indigenous	
<b>Poaceae</b>	<i>Eragrostis chloromelas,</i>	Blue Lovegrass	LC	Indigenous	
<b>Poaceae</b>	<i>Eragrostis curvula,</i>	Weeping Love Grass	LC	Indigenous	
<b>Poaceae</b>	<i>Eragrostis gummiflua</i>	Gum Grass	LC	Indigenous	
<b>Poaceae</b>	<i>Eragrostis obtusa</i>	De Grass	LC	Indigenous	
<b>Poaceae</b>	<i>Eragrostis superba,</i>	Saw tooth love Grass	LC	Indigenous	
<b>Poaceae</b>	<i>Hyparrhenia hirta</i>	Common Thatching grass	LC	Indigenous	
<b>Poaceae</b>	<i>Melinis repens,</i>	Natal Red Top	LC	Indigenous	
<b>Poaceae</b>	<i>Panicum coloratum,</i>	Bamboeskweek	LC	Indigenous	
<b>Poaceae</b>	<i>Panicum maximum,</i>	Guinea Grass	LC	Indigenous	
<b>Poaceae</b>	<i>Perotis patens.</i>	Cat's tail	LC	Indigenous	

Proposed Solar development for Mooivlei Solar 2, Pty (LTD), Kroonstad, Free State, South Africa

<b>Poaceae</b>	<i>Setaria pumila</i>	Garden Bristle Grass	LC	Indigenous	
<b>Poaceae</b>	<i>Setaria sphacelate var torta</i>	Creeping Bristle Grass	LC	Indigenous	
<b>Poaceae</b>	<i>Sporobolus africanus.</i>	Rats tail dropseed	LC	Indigenous	
<b>Poaceae</b>	<i>Sporobolus ioclados</i>	Pan Dropseed		Indigenous	
<b>Poaceae</b>	<i>Sporobolus pyramidalis,</i>	Vlei Grass	LC	Indigenous	
<b>Poaceae</b>	<i>Themeda triandra</i>	Red Grass	LC	Indigenous	
<b>Poaceae</b>	<i>Tragus berteronianus,</i>	Carrot Seed Grass	LC	Indigenous	
<b>Poaceae</b>	<i>Urochloa mossambicensis</i>	Bushveld Signal Grass	LC	Indigenous	
<b>Polygalaceae</b>	<i>Polygala hottentotta</i>	Small Purple Broom	LC	Indigenous	
<b>Rubiaceae</b>	<i>Oldenlandia herbacea</i>	False Spurry	LC	Indigenous	
<b>Rubiaceae</b>	<i>Pygmaeothamnus zeyheri,</i>	Common Sand Apple	LC	Indigenous	
<b>Solanaceae</b>	<i>Solanum elaeagnifolium</i>	Silverleaf Nightshade	LC	Not Indigenous, Invasive	Nemba 1b
Solanaceae	<i>Solanum mauritianum</i>	Bugweed	LC	Not Indigenous, Invasive	Nemba 1b
<b>Verbenaceae</b>	<i>Verbena bonariensis</i>	Wild Verbena	LC	Not Indigenous, Invasive	Nemba 1b
Verbenaceae	<i>Verbena tenuisecta</i>		LC	Not indigenous; Naturalised	



## 14 APPENDIX 4: ANIMAL SPECIES LIST

### 14.1 Amphibian species expected to occur in the project area

Family	Scientific name	Common name	Red list category
<b>Bufonidae</b>	<i>Sclerophrys capensis</i>	Raucous Toad	Least Concern (IUCN, 2016)
<b>Bufonidae</b>	<i>Sclerophrys gutturalis</i>	Guttural Toad	Least Concern (IUCN, 2016)
<b>Bufonidae</b>	<i>Sclerophrys capensis</i>	Ranger's Toad	Least Concern (IUCN, 2016)
<b>Hyperoliidae</b>	<i>Kassina senegalensis</i>	Bubbling Kassina	Least Concern (IUCN, 2016)
<b>Phrynobatrachidae</b>	<i>Phrynobatrachus natalensis</i>	Snoring Puddle Frog	Least Concern (IUCN, 2013)
<b>Pipidae</b>	<i>Xenopus laevis</i>	Common Platanna	Least Concern (IUCN 2020)
<b>Pyxicephalidae</b>	<i>Amietia delalandii</i>	Delalande's River Frog	Least Concern (2017)
<b>Pyxicephalidae</b>	<i>Amietia fuscigula</i>	Cape Rana	Least Concern (IUCN, 2016)
<b>Pyxicephalidae</b>	<i>Amietia poyntoni</i>	Poynton's River Frog	Least Concern (IUCN, 2016)
<b>Pyxicephalidae</b>	<i>Cacosternum boettgeri</i>	Boettger's caco	Least Concern (IUCN, 2016)
<b>Pyxicephalidae</b>	<i>Pyxicephalus adspersus</i>	African Bullfrog	Least Concern (IUCN, 2016)
<b>Pyxicephalidae</b>	<i>Strongylopus fasciatus</i>	Striped Stream Frog	Least Concern (IUCN, 2016)
<b>Pyxicephalidae</b>	<i>Tomopterna cryptotis</i>	Common Sand Frog	Least Concern (IUCN, 2016)

<b>Pyxicephalidae</b>	<i>Tomopterna natalensis</i>	Natal Sand Frog	Least Concern (IUCN, 2016)
<b>Pyxicephalidae</b>	<i>Tomopterna tandyi</i>	Tandy's Sand Frog	Least Concern (IUCN, 2016)

#### 14.2 Reptile Species expected to occur in the study area

Family	Scientific name	Common name	Red list category
Amphisbaenidae	<i>Monopeltis capensis</i>	Cape Worm Lizard	Least Concern (IUCN, 2017)
<b>Colubridae</b>	<i>Dasypeltis scabra</i>	Rhombic Egg-eater	Least Concern (IUCN, 2017)
<b>Cordylidae</b>	<i>Smaug giganteus</i>	Giant Girdled Lizard	Vulnerable (IUCN, 2017)
<b>Elapidae</b>	<i>Elapsoidea sundevalli</i>	Sundevall's Garter Snake	Least Concern (IUCN, 2017)
<b>Elapidae</b>	<i>Naja nivea</i>	Cape Cobra	Least Concern (IUCN, 2017)
<b>Elapidae</b>	<i>Hemachatus haemachatus</i>	Rinkhals	Least Concern (IUCN, 2017)
<b>Gerrhosauridae</b>	<i>Gerrhosaurus flavigularis</i>	Yellow-throated Plated Lizard	Least Concern (IUCN, 2017)
<b>Lacertidae</b>	<i>Nucras holubi</i>	Holub's Sandveld Lizard	Least Concern (IUCN, 2017)
<b>Lacertidae</b>	<i>Nucras intertexta</i>	Spotted Sandveld Lizard	Least Concern (IUCN, 2017)
<b>Lacertidae</b>	<i>Pedioplanis lineocellata</i>	Spotted Sand Lizard	Least Concern (IUCN, 2017)

<b>Lamprophiidae</b>	<i>Lamprophis aurora</i>	Aurora House Snake	Least Concern (IUCN, 2017)
<b>Lamprophiidae</b>	<i>Lycophidion capense</i>	Cape Wolf Snake	Least Concern (IUCN, 2017)
<b>Lamprophiidae</b>	<i>Psammophylax rhombeatus</i>	Spotted Grass Snake	Least Concern (IUCN, 2017)
<b>Pelomedusidae</b>	<i>Pelomedusa galeata</i>	South African Marsh Terrapin	Least Concern (IUCN, 2017)
<b>Psammophiidae</b>	<i>Psammophis leightoni</i>	Cape Whip Snake	Least Concern (IUCN, 2017)
<b>Psammophiidae</b>	<i>Psammophylax rhombeatus</i>	Rhombic Skaapsteker	Least Concern (IUCN, 2017)
<b>Scincidae</b>	<i>Trachylepis punctatissima</i>	Montane Speckled Skink	Least Concern (IUCN, 2017)
<b>Scincidae</b>	<i>Trachylepis varia</i>	Common Variable Skink Complex	Least Concern (IUCN, 2017)
<b>Testudinae</b>	<i>Stigmochelys pardalis</i>	Leopard Tortoise	Least Concern (IUCN, 2017)
<b>Varanidae</b>	<i>Varanus albigularis</i>	Rock Monitor	Least Concern (IUCN, 2017)
<b>Varanidae</b>	<i>Varanus niloticus</i>	Water monitor	Least Concern (IUCN, 2017)
<b>Chamaeleonidae</b>	<i>Chamaeleo dilepis</i>	Flap necked chameleon	Least Concern (IUCN, 2017)

**14.3 Mammal Species expected to occur in the study area.**

Family	Scientific name	Common name	Red list category
<b>Bovidae</b>	<i>Alcelaphus buselaphus caama</i>	Red Hartebeest	Least Concern (IUCN, 2016)
<b>Bovidae</b>	<i>Antidorcas marsupialis</i>	Springbok	Least Concern (IUCN, 2016)
<b>Bovidae</b>	<i>Connochaetes gnou</i>	Black Wildebeest	Least Concern (IUCN, 2016)
<b>Bovidae</b>	<i>Connochaetes taurinus taurinus</i>	Blue Wildebeest	Least Concern (IUCN, 2016)
<b>Bovidae</b>	<i>Damaliscus pygargus phillipsi</i>	Blesbok	Least Concern (IUCN, 2016)
<b>Bovidae</b>	<i>Hippotragus niger</i>	Sable Antelope	Least Concern (IUCN, 2016)
<b>Bovidae</b>	<i>Kobus ellipsiprymnus</i>	Waterbuck	Least Concern (IUCN, 2016)
<b>Bovidae</b>	<i>Oryx gazella</i>	Gemsbok	Least Concern (IUCN, 2016)
<b>Bovidae</b>	<i>Raphicerus campestris</i>	Steenbok	Least Concern (IUCN, 2016)
<b>Bovidae</b>	<i>Sylvicapra grimmia</i>	Bush Duiker	Least Concern (IUCN, 2016)
<b>Bovidae</b>	<i>Syncerus caffer</i>	African Buffalo	Least Concern (IUCN, 2016)
<b>Bovidae</b>	<i>Tragelaphus s oryx</i>	Common Eland	Least Concern (IUCN, 2016)
<b>Canidae</b>	<i>Canis mesomelas</i>	Black-backed Jackal	Least Concern (IUCN, 2016)

<b>Canidae</b>	<i>Otocyon megalotis</i>	Bat Eared fox	Least Concern (IUCN, 2016)
<b>Canidae</b>	<i>Vulpes chama</i>	Silver Fox	Least Concern (IUCN, 2016)
<b>Erinaceidae</b>	<i>Atelerix frontalis</i>	South African hedgehog	Least Concern (IUCN, 2016)
<b>Felidae</b>	<i>Caracal caracal</i>	Caracal	Least Concern (IUCN, 2016)
<b>Felidae</b>	<i>Felis lybica</i>	African Wildcat	Least Concern (IUCN, 2016)
<b>Felidae</b>	<i>Felis nigripes</i>	Black Footed cat	Vulnerable (IUCN, 2016)
<b>Herpestidae</b>	<i>Cynictis penicillata</i>	Yellow Mongoose	Least Concern (IUCN, 2016)
<b>Herpestidae</b>	<i>Ichneumia albicauda</i>	White Tailed Mongoose	Least Concern (IUCN, 2016)
<b>Herpestidae</b>	<i>Herpestes sanguineus</i>	Slender Mongoose	Least Concern (IUCN, 2016)
<b>Herpestidae</b>	<i>Suricata suricatta</i>	Meerkat	Least Concern (IUCN, 2016)
<b>Hyaenidae</b>	<i>Parahyaena brunnea</i>	Brown Hyena	Near Threatened (IUCN, 2016)
<b>Hyaenidae</b>	<i>Proteles cristata</i>	Aardwolf	Least Concern (IUCN, 2016)
<b>Hyracoidea</b>	<i>Procavia capensis</i>	Rock dassie	Least Concern (IUCN, 2016)
<b>Hystriidae</b>	<i>Hystrix africaeaustralis</i>	Cape Porcupine	Least Concern (IUCN, 2016)



<b>Leporidae</b>	<i>Lepus capensis</i>	Cape Hare	Least Concern (IUCN, 2016)
<b>Leporidae</b>	<i>Lepus victoriae</i>	African Savanna Hare	Least Concern (IUCN, 2016)
<b>Macroscelididae</b>	<i>Elephantulus myurus</i>	Eastern Rock Elephant Shrew	Least Concern (IUCN, 2016)
<b>Molossidae</b>	<i>Tadarida aegyptiaca</i>	Egyptian free-tailed bat	Least Concern (IUCN, 2016)
<b>Muridae</b>	<i>Aethomys ineptus</i>	Tete Veld Aethomys	Least Concern (IUCN, 2016)
<b>Muridae</b>	<i>Gerbilliscus brantsii</i>	Highveld Gerbill	Least Concern (IUCN, 2016)
<b>Muridae</b>	<i>Gerbilliscus leucogaster</i>	Bushveld Gerbil	Least Concern (IUCN, 2016)
<b>Muridae</b>	<i>Mastomys coucha</i>	Southern African Mastomys	Least Concern (IUCN, 2016)
<b>Muridae</b>	<i>Micaelamys namaquensis</i>	Namakwa Rock rat	Least Concern (IUCN, 2016)
<b>Muridae</b>	<i>Mus musculus</i>	Southern African Pygmy Mouse	Least Concern (IUCN, 2016)
<b>Muridae</b>	<i>Otomys auratus</i>	Vlei Rat	Near Threatened (IUCN, 2016)
<b>Muridae</b>	<i>Rattus rattus</i>	Roof Rat	Least Concern (IUCN, 2016)
<b>Muridae</b>	<i>Rhabdomys dilectus</i>	Mesic four-striped grass rat	Least Concern (IUCN, 2016)
<b>Mustelidae</b>	<i>Ictonyx striatus</i>	Striped Polecat	Least Concern (IUCN, 2016)

<b>Mustelidae</b>	<i>Mellivora capensis</i>	Honey Badger	Least Concern (IUCN, 2016)
<b>Mustelidae</b>	<i>Poecilogale albinucha</i>	African Stripe weasel	Least Concern (IUCN, 2016)
<b>Nesomyidae</b>	<i>Malacothrix typica</i>	Gerbil Mouse	Least Concern (IUCN, 2016)
<b>Nesomyidae</b>	<i>Mystromys albicaudatus</i>	White-tailed rat	Vulnerable (IUCN, 2016)
<b>Nesomyidae</b>	<i>Saccostomus campestris</i>	Southern African Pouched Mouse	Least Concern (IUCN, 2016)
<b>Nesomyidae</b>	<i>Steatomys krebsii</i>	Krebs's Fat Mouse	Least Concern (IUCN, 2016)
<b>Nesomyidae</b>	<i>Steatomys pratensis</i>	Common African Fat Mouse	Least Concern (IUCN, 2016)
<b>Nycteridae</b>	<i>Nycteris thebaica</i>	Egyptian Slit-faced Bat	Least Concern (IUCN, 2016)
<b>Orycteropodidae</b>	<i>Orycteropus afer</i>	Aardvark	Least Concern (IUCN, 2016)
<b>Pedetidae</b>	<i>Pedetes capensis</i>	South African Spring Hare	Least Concern (IUCN, 2016)
<b>Pteropodidae</b>	<i>Eidolon helvum</i>	Straw-coloured fruit bat	Least Concern (IUCN, 2016)
<b>Rhinolophidae</b>	<i>Rhinolophus clivosus</i>	Geoffroy's horseshoe bat	Least Concern (IUCN, 2016)
<b>Rhinolophidae</b>	<i>Rhinolophus darlingi</i>	Darling's horseshoe bat	Least Concern (IUCN, 2016)
<b>Sciuridae</b>	<i>Xerus inauris</i>	Ground Squirrel	Least Concern (IUCN, 2016)

<b>Soricidae</b>	<i>Crocidura cyanea</i>	Reddish-gray Musk Shrew	Least Concern (IUCN, 2016)
<b>Soricidae</b>	<i>Suncus varilla</i>	Lesser dwarf Shrew	Least Concern (IUCN, 2016)
<b>Suidae</b>	<i>Phacochoerus africanus</i>	Common Warthog	Least Concern (IUCN, 2016)
<b>Vespertilionidae</b>	<i>Myotis welwitschii</i>	Welwitch's Bat	Least Concern (IUCN, 2016)
<b>Vespertilionidae</b>	<i>Neoromicia capensis</i>	Cape Serotine	Least Concern (IUCN, 2016)
<b>Vespertilionidae</b>	<i>Neoromicia zuluensis</i>	Zulu Serotine	Least Concern (IUCN, 2016)
<b>Vespertilionidae</b>	<i>Scotophilus dinganii</i>	Yellow-bellied House Bat	Least Concern (IUCN, 2016)
<b>Viverridae</b>	<i>Genetta genetta</i>	Small Spotted Genet	Least Concern (IUCN, 2016)

## 15 APPENDIX 5: SENSITIVE SPECIES 15 ASSESSMENT

### **A**

#### **TERRESTRIAL ANIMAL SPECIES SPECIALIST REPORT FOR SITES IDENTIFIED FOR SOLAR FARM DEVELOPMENTS: KROONSTAD DISTRICT FREE STATE PROVINCE**

#### **GIANT GIRDLED LIZARD (*Smaug giganteus*)**

*Commissioned by Nitai Consulting*

*147 Bram Fischer Drive, Ferndale, 2194, South Africa*

**PROF BRIAN REILLY**

**ECOFIN & BK REILLY CONSULTING ECOLOGISTS**

**APRIL 2023**

## CONTENTS

<b>1</b>	<b>DECLARATION OF INDEPENDENCE</b>	<b>124</b>
<b>2</b>	<b>TERMS OF REFERENCE</b>	<b>125</b>
<b>3</b>	<b>EXPERTISE OF SPECIALIST</b>	<b>126</b>
<b>4</b>	<b>AREA DESCRIPTION</b>	<b>127</b>
<b>5</b>	<b>METHODOLOGY</b>	<b>128</b>
<b>6</b>	<b>THE GIANT GIRDLED LIZARD (<i>SMAUG GIGANTEUS</i>)</b>	<b>129</b>
<b>7</b>	<b>RESULTS</b>	<b>131</b>
7.1	KROONSTAD CLUSTER	131
7.1.1	MOOIVLEI 1	131
7.1.2	MOOIVLEI 2	133
7.1.3	MOOIVLEI 3	136
<b>8</b>	<b>SUMMARY AND CONCLUSION</b>	<b>140</b>
<b>9</b>	<b>REFERENCES</b>	<b>140</b>

## LIST OF FIGURES



Figure 1: Google earth image showing orientation of the proposed development sites in relation to Kroonstad, northern Free State Province. .... 128

Figure 2: Smaug giganteus photographed on the 28th April south east of the Kroonstad Cluster..... 130

Figure 3: Proposed Mooivlei 1 PV development on the farm Mooivlei 284. .... 131

Figure 4: Proposed Mooivlei 2 PV development on the farm Mooivlei 284. .... 134

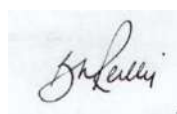
Figure 5: Lower landscapes dominated by shrubs *Asparagus laricinus*, *Searsia pyroides* and stunted *Vachelia karoo* on the farm Mooivlei, proposed Mooivlei 2 PV development... 135

Figure 6: Proposed Mooivlei 3 PV development on the farm Portion 1 of the Farm No. 1475 and the Farm Leidzaamheid No. 213..... 137

Figure 7: Soil profile in an upper landscape on the farm Mooivlei exhibiting a melanic A horizon on a pedocutanic B horizon with high clay content typical of a Bonheim soil form **Error! Bookmark not defined.**

## 1 DECLARATION OF INDEPENDENCE

I, Brian Kevin Reilly as sole proprietor of Ecofin Consulting Ecologists and BK Reilly Consulting Ecologist hereby confirm my independence as a specialist and declare that I have no interest, be it business, financial, personal or other, in any proposed activity, application or appeal in respect of which Nitai Consulting or Nemaï Consulting was appointed as environmental assessment practitioner in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), other than fair remuneration for worked performed, specifically in connection with the proposed new Kroonstad Cluster Solar PV Facility near Kroonstad in the Free State Province. I further declare that I am confident in the results of the studies undertaken and conclusions drawn because of it – as is described in this report.



---

Full Name: Brian Kevin Reilly

**Title / Position:** Ecologist

**Qualification(s):** BSc (Hons) Wildlife Management UP; MSc Wildlife management UP; PhD Nature Conservation US

**Experience (years/ months):** 40 years

**Registration:** SACNASP (400164/08)

**Tel:** +27 82 784 1895

**Email:** [reillybk@tut.ac.za](mailto:reillybk@tut.ac.za)

## 2 TERMS OF REFERENCE

As part of the scoping process of the proposed developments the Endangered Wildlife Trust (EWT)<sup>1</sup> indicated that certain areas fall within the distribution of the Giant Girdled Lizard (*Smaug giganteus*) and requested a walk-through survey for presence or absence by a specialist. Instruction was given by the primary consultants, Nitai Consulting<sup>2</sup> for walk-through surveys to be conducted on the Kroonstad development sites.

These surveys were conducted on the 27<sup>th</sup> and 28<sup>th</sup> April 2023.

---

<sup>1</sup> Plot 27 and 28 Austin Road, Glen Austin AH, Midrand, 1685 Gauteng, South Africa

<sup>2</sup> 147 Bram Fischer Drive, Ferndale, 2194, South Africa

### 3 EXPERTISE OF SPECIALIST

Currently Extended Full Professor and retired Head of Department, Department of Nature Conservation, Tshwane University of Technology, Pretoria, Past Adjunct Associate Professor, Department of Fisheries, Wildlife and Conservation Biology, University of Minnesota and Associated Full Professor and Fellow, Conservation Biology, University of Free State. He is a registered category A Professional Natural Scientist in the field of practice of ecology with the SA Council for Natural and Allied Scientific Professions and a member of the Royal Society of SA. He has practiced as an ecologist since 1984 and has consulted widely on environmental, ecological and wildlife management issues both locally and internationally.

He specializes in wildlife management and monitoring, biological conservation, ecological decision support systems, corporate governance, sustainability, higher education and training and quantitative biology.

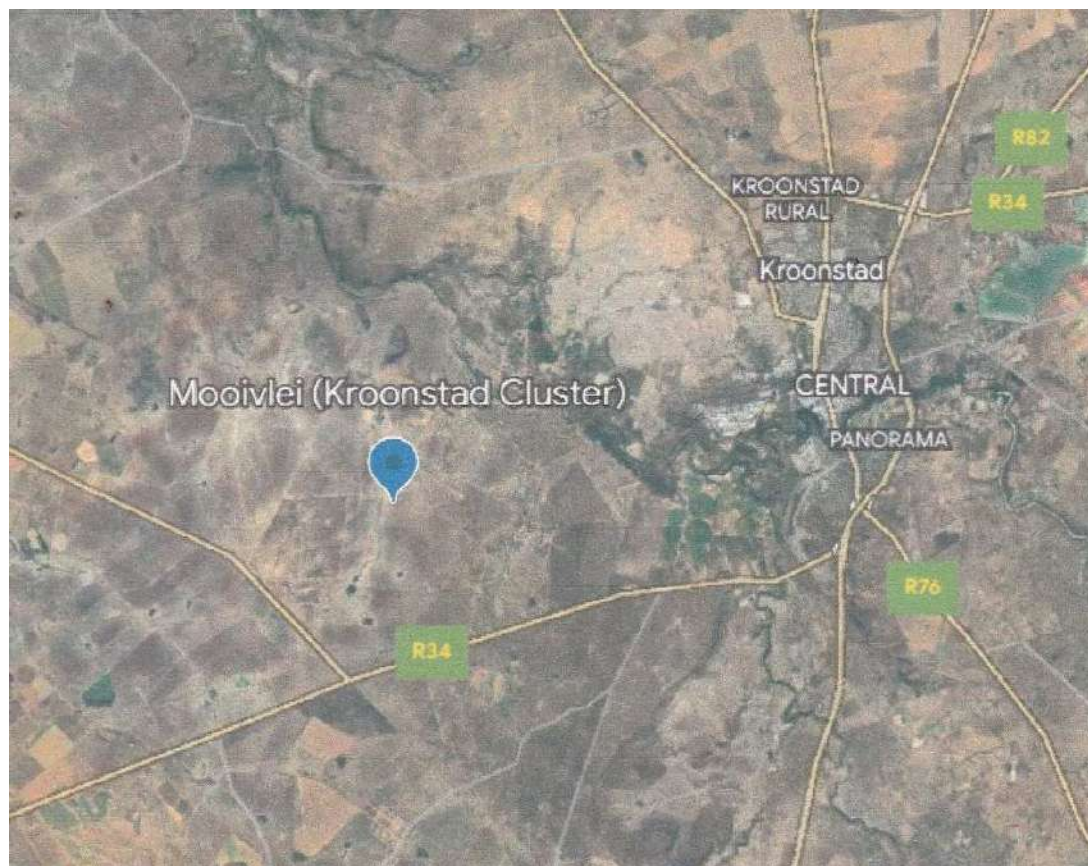
Widely published as a biologist with over a hundred authorships and co-authorships with 69 in scientific Journals. These include co-authoring the seven-volume *magnum opus* "A critical evaluation of conservation and development in sub-Saharan Africa. He has presented 73 papers and keynote addresses at scientific symposia including several workshops and keynote addresses.

He has specifically provided specialist inputs into impact studies for numerous developments since 1984 and these include developments by Anglo American, Anglo Platinum, Northam Platinum and Eskom in Limpopo, Mpumalanga, Northern Cape, Northwest, and Kwazulu Natal Provinces. Specific to these inputs he has undertaken the monitoring of girdled lizards for Eskom in southeastern Mpumalanga.

## 4 AREA DESCRIPTION

The area classified as the Kroonstad Cluster (Mooivlei 1, 2 and 3) comprises all or portions of the farms Mooivlei 284, Remaining Extent of Naseby Thoms 288, Portion 1 of Rondavel Noord 1475, Leidzaamheid 213 and Remaining Extent of Winningdale 200.

The Kroonstad Cluster is underlain by sedimentary mudstone and sandstone of the Karoo supergroup – Ecca and Beaufort groups with the latter represented by the Adelaide subgroup with some Karoo Doleritic Suite intrusions. All give rise to vertic or melanitic soils. Vegetation is classified as Central Free State Grassland and is dominated by perennial grasses of the genera *Eragrostis*, *Themeda* and *Setaria* with annuals of the *Aristida* and *Cynodon* increasing under grazing pressure.



*Figure 29: Google earth image showing orientation of the proposed development sites in relation to Kroonstad, northern Free State Province.*

## 5 METHODOLOGY

Initial interaction with the primary consultant established the terms of reference and information was gleaned on their site surveys of the vegetation and general habitat. They provided comprehensive maps covering the sensitivity of the area and other basic information. A field walk-through survey was undertaken on the 27<sup>th</sup> and 28<sup>th</sup> April. This was preceded by vehicle reconnaissance to establish the boundaries of the sites, general familiarization, proposed development footprints and likely habitats. Likely habitats were then traversed on foot with the primary objective to identify burrows either abandoned or active. Special attention was given to more open sandy areas. An English pointer was also used to range the area in conjunction with the walk through as reptiles give off a strong scent. Informal conversations were held with

landowners, managers and farm labourers on the potential occurrence and whereabouts of lizards and these areas used as focal points. Active interaction was undertaken with the EWT Highlands Grassland Field Officer Bradley Gibbons before and during the survey on their findings from recent field surveys. The terrestrial ecologist also completed a Specialist assessment during January and April and did not find evidence of lizard activity on the proposed Mooivlei 1,2, and 3 development areas.

## 6 THE GIANT GIRDLED LIZARD (*SMAUG GIGANTEUS*)

*Smaug giganteus* (formerly *Cordylus giganteus*) is the largest of the girdled lizard family and inhabits parts of the grasslands of Northwest Province, northern Free State and Mpumalanga (Bates *et al.* 2014). They are a large diurnal terrestrial lizard and are endemic to South Africa (Van Wyk 2000). They generally self-excavate burrows and occur in small groups (Gibbons 2014) at approximately four burrows per hectare (Jacobsen *et al.* 1990) in Mpumalanga and four to six burrows per hectare in the Free State (Stolz & Blom 1981). Jacobsen *et al.* (1990) found density to be relatively low at six and a half individuals per hectare whilst Van Wyk's (1992) seminal study in the northeastern Free State found between nine and 11 individuals per hectare. Females give birth to one or two live young after a long gestation period. They feed almost exclusively on invertebrates and are themselves preyed upon by various meso carnivores.





*Figure 30: Smaug giganteus photographed on the 28th of April 4km south east of the Kroonstad Cluster and directly adjacent to the southwestern boundary of Moovlei 2 by the EWT.*

They are classified as vulnerable in the IUCN red list (Bates *et al.* 2014) and are under threat from the muthi trade, open cast mining and agriculture. Their threat status is directly aligned to the conservation status of South Africa's grasslands and habitat fragmentation is probably the single greatest factor in isolating populations that cannot disperse and may ultimately sink below effective population size and ultimately disappear.

## 7 RESULTS

### 7.1 KROONSTAD CLUSTER

#### 7.1.1 MOOIVLEI 1

##### 7.1.1.1 Sensitivity

The sensitivity map for the Mooivlei 1 PV alternatives appears as Figure 31 and Figure 4.

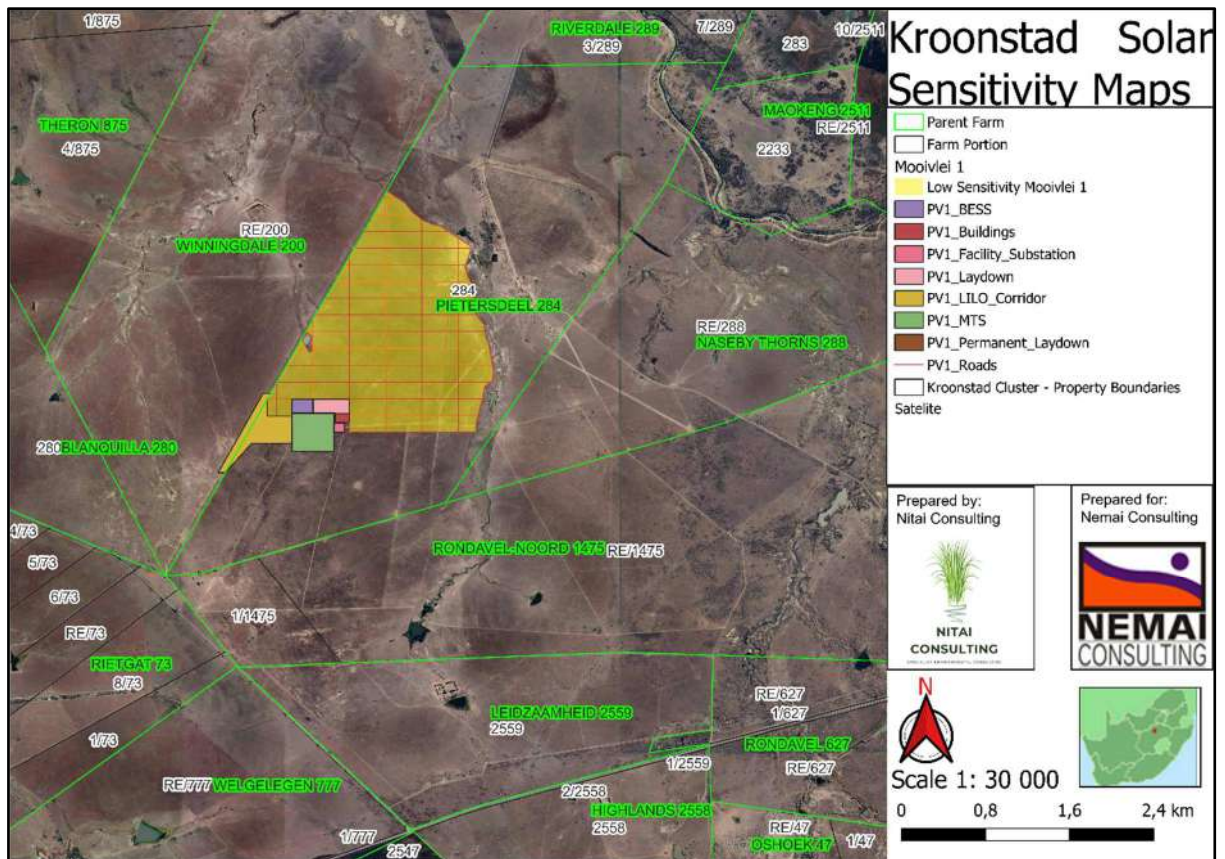


Figure 31: Proposed Mooivlei 1 PV development alternative 1.



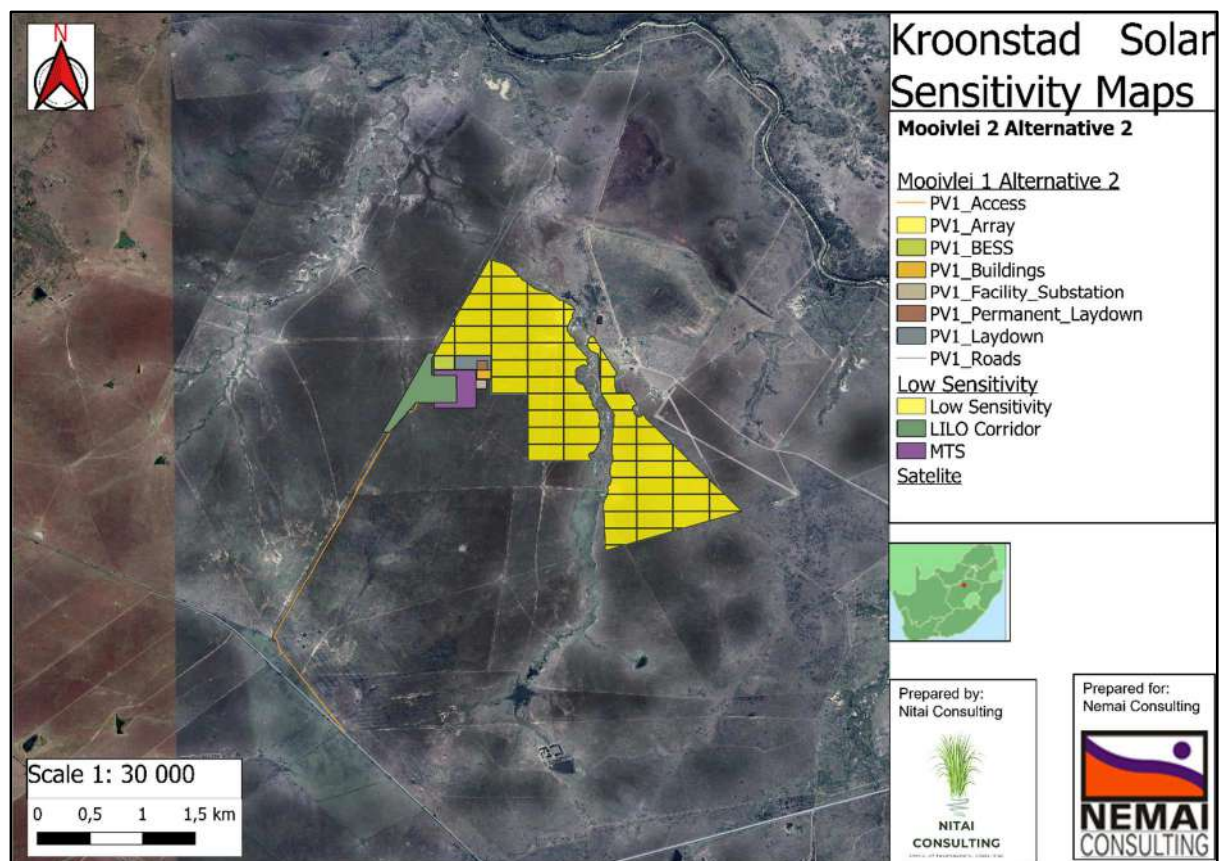


Figure 32: Proposed Mooivlei 1 PV development alternative 2.

This area overlaps in the southwest with CBA 2 on the farm Mooivlei 284 and has low sensitivity. This area comprises grasslands in midslopes, heavily grazed and very dense. No evidence could be found of any girdled lizard burrows, active or otherwise and indeed no evidence of burrowing of any sort. The entire area is underlain by clay soils which harden to a point where burrowing is extremely difficult. An excavation in an upper landscape gave access to a soil profile which showed a melanic A horizon on a pedocutanic B horizon with high clay content (slip & slides) typical of a Bonheim soil form (Figure 10). This will likely give rise to heavier clay soils in lower landscapes such as Arcadia, Katspruit or Kroonstad soil forms. This confirms the general unsuitability of the habitat for girdled lizards.

#### 7.1.1.2 Impacts

Impacts are currently grazing and likely further impacts from the development of

the PV will be minimal in terms of girdled lizards.

#### 7.1.1.3 Mitigation

Presence of girdled lizards could not be confirmed but considering soils and grazing regime no mitigation would reestablish them and the site would also be unsuitable for translocation from other areas.

### 7.1.2 MOOIVLEI 2

#### 7.1.2.1 Sensitivity

Figure 5 illustrates the proposed PV development which overlaps with CBA 1 in the far west. Sensitivity is considered low for both alternatives (Figure 5 and Figure 6). This area comprises grasslands in midslopes, heavily grazed and very dense (Figure 7). No evidence could be found of any girdled lizard burrows, active or otherwise and indeed no evidence of burrowing of any sort. The eastern half of the property comprised mostly lower landscapes which were dominated by shrubs *Asparagus laricinus*, *Searsia pyroides* and stunted *Vachellia karoo*, a great deal of which comprises floodplain of the Vals river and intersecting drainage lines and as such unsuitable habitat for girdled lizards. These areas are heavily over grazed as well.

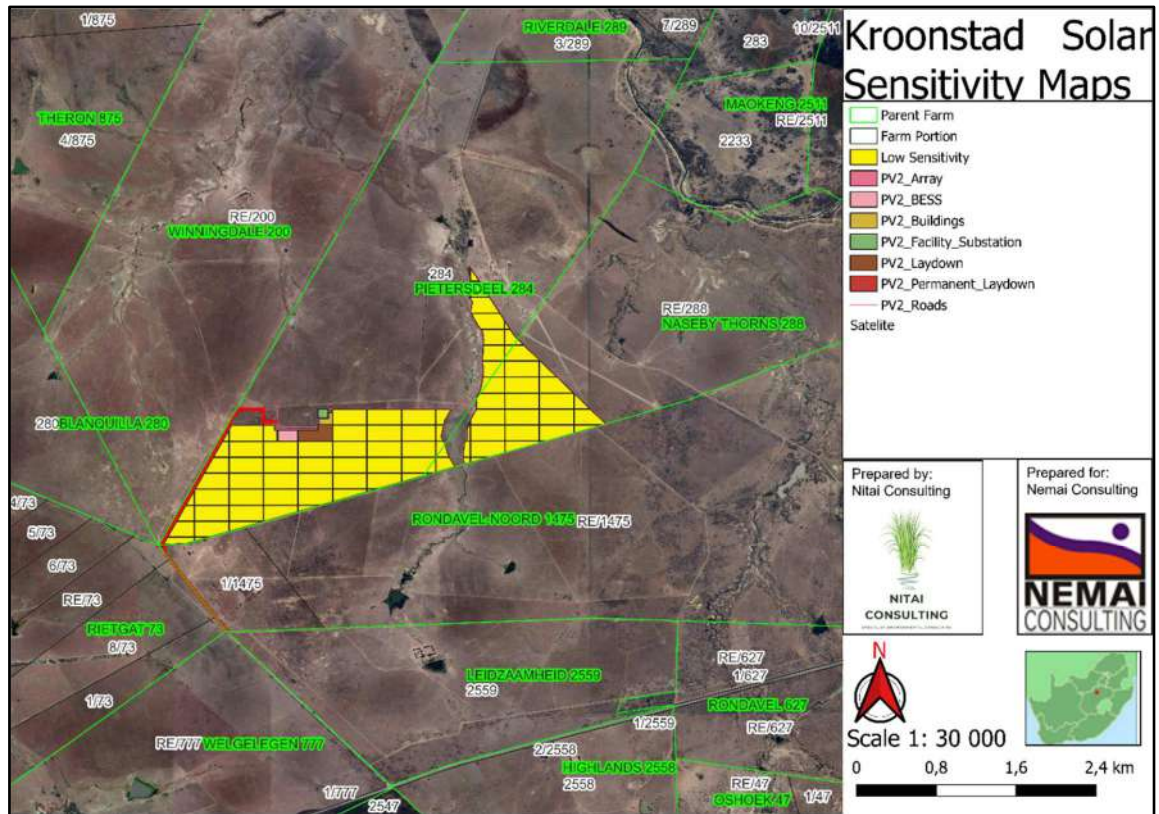


Figure 33: Proposed Mooivlei 2 PV development alternative 1 sensitivities.



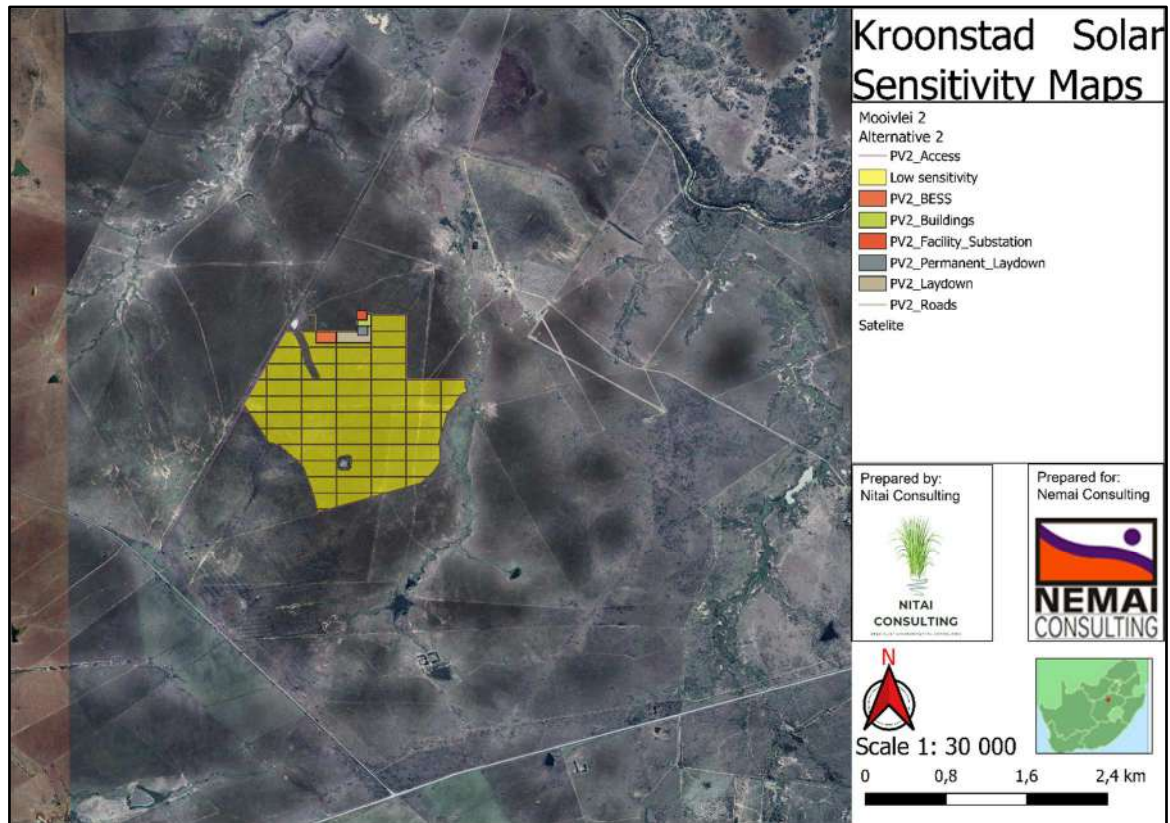


Figure 34: Proposed Mooivlei 2 PV development alternative 2 sensitivities.



Figure 35: Lower landscapes dominated by shrubs *Asparagus laricinus*, *Searsia pyroides* and stunted *Vachelia karoo* on the farm Mooivlei, proposed Mooivlei 2 PV development.

The entire area is underlain by clay soils which harden to a point where burrowing



is extremely difficult. An excavation in an upper landscape gave access to a soil profile which showed a melanic A horizon on a pedocutanic B horizon with high clay content (slip & slides) typical of a Bonheim soil form. This will likely give rise to heavier clay soils in lower landscapes such as Arcadia, Katspruit or Kroonstad soil forms. This confirms the general unsuitability of the habitat for girdled lizards (Figure 10).

#### 7.1.2.2 Impacts

Impacts are currently grazing and likely further impacts from the development of the PV will be minimal in terms of girdled lizards.

#### 7.1.2.3 Mitigation

Presence of girdled lizards could not be confirmed but considering soils and grazing regime no mitigation would reestablish them and the site would also be unsuitable for translocation from other areas.

### 7.1.3 MOOIVLEI 3

#### 7.1.3.1 Sensitivity

The sensitivity map for the proposed Mooivlei 3 PV development appears as Figure 8 and Figure 9 with low sensitivity for both alternatives and comprises heavily degraded upland grasslands in the west on the farm Leedzaamheid 213 with a slight overlap with CBA 2 in the southeast. The flat upper areas adjacent to the western boundary were severely degraded and dominated by increaser grass species and forbs. Some areas are infested with *Seriphium plumosum*. The eastern portion gives way to midslopes dominated by grassland and stunted *Vachellia karroo*. No evidence could be found of any girdled lizard burrows, active or otherwise.

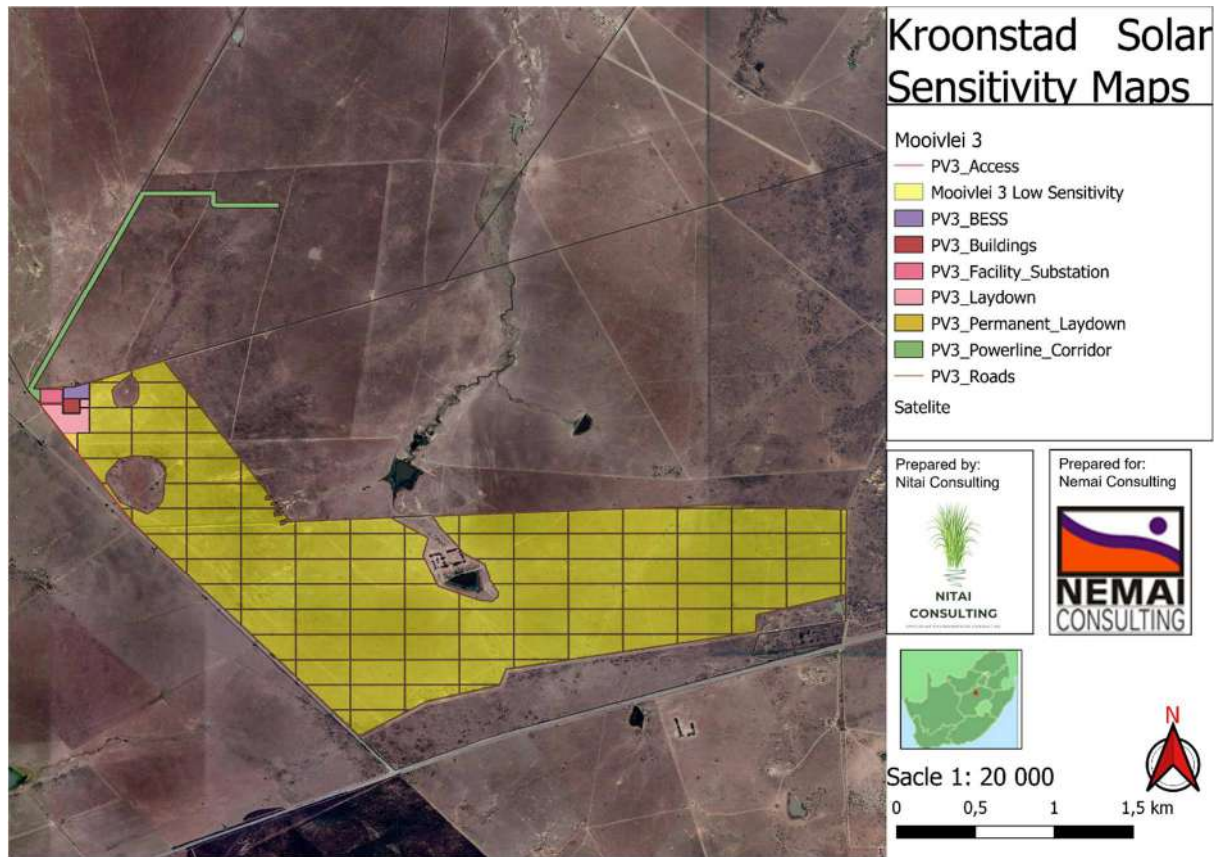
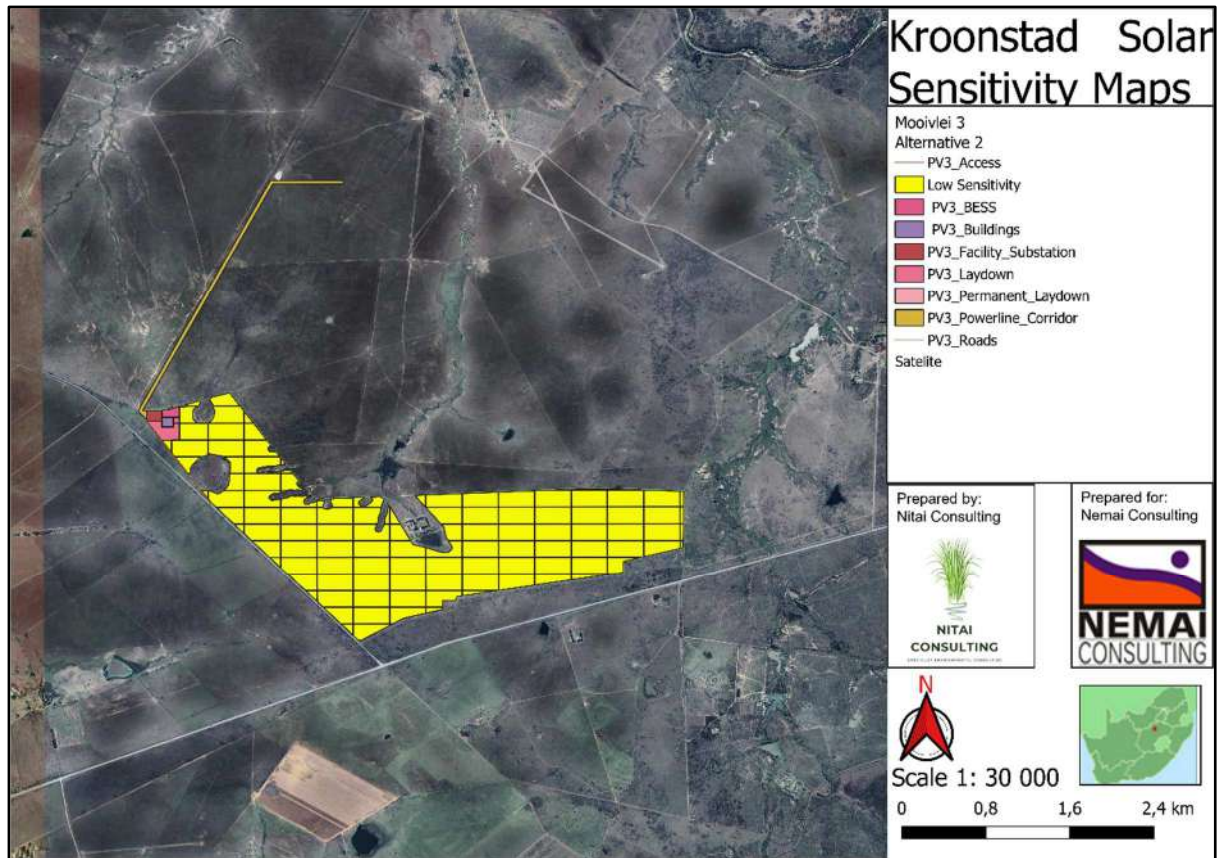


Figure 36: Proposed Mooivlei 3 PV development alternative 1.



*Figure 37: Proposed Mooivlei 3 PV development alternative 2.*

### 7.1.3.2 Impacts

There is unlikely to be any impact in terms girdled lizards with this development.

Impacts are currently grazing and heavy overgrazing in the east and likely further impacts from the development of the PV will be minimal in terms of girdled lizards. Soil profile showed a melanic A horizon on a pedocutanic B horizon with high clay content (slip & slides) typical of a Bonheim soil form (Figure 10). This confirms the general unsuitability of the habitat for girdled lizards.

### 7.1.3.3 Mitigation



Presence of girdled lizards could not be confirmed but considering soils and grazing regime no mitigation would reestablish them and the site would also be unsuitable for translocation from other areas.



*Figure 38: Soil profile in an upper landscape on the farm Mooivlei exhibiting a melanic A horizon on a pedocutanic B horizon with high clay content typical of a Bonheim soil form.*

## 8 SUMMARY AND CONCLUSION

Presence of girdled lizards could not be confirmed in this walk-through survey of the Kroonstad Clusters.

In areas of low sensitivity, no mitigation is required as no suitable habitat for girdled lizards were found.

This survey was limited in terms of time during the optimal survey season but since no suitable habitat was found it is unlikely that the lizards will be found on site.

## 9 REFERENCES

Bates, M.F. 2014. Gerrhosauridae. *In*: M.F. Bates, W.R. Branch, A.M. Bauer, M. Burger, J. Marais, G.J. Alexander & M.S. de Villiers (Eds). *Atlas and Red list of the reptiles of South Africa, Lesotho and Swaziland. Suricata* 1. South African National Biodiversity Institute, Pretoria.

EWT. 2013. Sungazer. <http://www.ewt.org.za/species%20factsheets/Sungazer.pdf>. [accessed 24 April 2023].

Gibbons, B. 2014. Sungazer lizards are desperately in need of conservation. [https://www.ewt.org.za/newsletter%20articals/SungazerBG\\_final.pdf](https://www.ewt.org.za/newsletter%20articals/SungazerBG_final.pdf). [accessed 22 April 2023].

Jacobsen, N.H.G., R.E. Newbery & W. Petersen. 1990. On the ecology and conservation status of *Cordylus giganteus* A. Smith in the Transvaal. *S.Afr. J. Zool.* 25(1): 61-66.



Stolz, L.P. & Blom, J. 1981. Ekologiese aspekte van die ouvolk (*Cordylus giganteus*) in die Oranje Vrystaat. Interne Verslag, Afdeling Natuurbewaring, O.V.S.

Van Wyk, J.H. 1992. Life history and physiological ecology of the lizard *Cordylus giganteus*. PhD thesis, University of Cape Town.

Van Wyk, J.H. 2000. Seasonal variation in stomach contents and diet composition in the large girdled lizard, *Cordylus giganteus* (Reptilia: Cordylidae) in the Highveld grasslands of the northeastern Free State, South Africa. *African Zoology* 35(1): 9–27.

## **APPENDIX E3: Avifaunal Baseline and Impact Assessment**

---



# Avifauna Assessment for the proposed Mooivlei 2 Photovoltaic (PV) Facility

## Kroonstad, Free State Province

April 2023 (Updated May 2023)

### CLIENT



### Prepared by:

**The Biodiversity Company**

Cell: +27 81 319 1225

Fax: +27 86 527 1965

[info@thebiodiversitycompany.com](mailto:info@thebiodiversitycompany.com)

[www.thebiodiversitycompany.com](http://www.thebiodiversitycompany.com)



## Table of Contents

1	Introduction .....	1
1.1	Background.....	1
1.2	Project Information.....	1
1.3	Specialist Details .....	6
1.4	Scope of Work .....	7
2	Key Legislative Requirements .....	8
3	Methods .....	8
3.1	Desktop Assessment .....	8
3.1.1	Desktop Avifaunal Assessment.....	8
3.1.2	Ecologically Important Landscape Features.....	9
3.1.3	Field Survey.....	10
3.1.4	Data Analysis.....	11
3.1.5	Site Ecological Importance (SEI).....	11
3.2	Assumptions and Limitations .....	13
4	Results & Discussion.....	14
4.1	Desktop Assessment .....	14
4.1.1	Ecologically Important Landscape Features.....	14
4.1.2	Avifauna Expected.....	23
5	Field Assessment .....	26
5.1	First Field Survey .....	26
5.1.1	Species List of First Field Survey .....	26
5.1.2	Priority Species.....	28
5.1.3	Dominant Species.....	30
5.1.4	Trophic Guilds.....	32
5.2	Second Survey .....	32
5.2.1	Species List of Second Field Survey .....	32
5.2.2	Risk Species .....	35
5.2.3	Dominant Species.....	36
5.2.4	Trophic Guilds.....	38
5.3	Nests .....	39

6	Fine-Scale Habitat Use.....	40
7	Site Ecological Importance (SEI) .....	44
7.1	Environmental Screening Tool .....	44
7.2	Site Ecological Importance (SEI).....	45
7.2.1	Site Sensitivity Verification .....	48
8	Impact Assessment .....	48
8.1	Present Impacts to Avifauna .....	49
8.2	Anticipated Impacts.....	49
8.3	Alternatives Considered .....	50
8.4	Loss of Irreplaceable Resources.....	50
8.5	Assessment of Impact Significance.....	50
8.5.1	Construction Phase.....	51
8.5.2	Operational Phase .....	58
8.5.3	Decommissioning Phase .....	66
8.6	Unplanned Events.....	69
8.7	Cumulative Impacts .....	69
9	Avifauna Impact Management Actions .....	72
10	Conclusion and Impact Statement.....	76
10.1	Conclusion .....	76
10.2	Impact Statement.....	76
11	References.....	77
12	Appendix Items.....	79
12.1	Appendix A: Summary of Expected species.....	79
12.2	Appendix A: Point count data of the first assessment.....	87
12.3	Appendix C: Incidental records during the first assessment .....	89
12.4	Appendix D: Point count data of the second assessment.....	89
12.5	Appendix E: Incidental records during the second survey .....	92
12.6	Appendix F: Specialist Declaration of Independence .....	93



## List of Tables

Table 1-1	Details of the proposed Solar PV Projects .....	1
Table 2-1	A list of key legislative requirements relevant to biodiversity and conservation in the Free State Province .....	8
Table 3-1	Summary of Conservation Importance (CI) criteria .....	11
Table 3-2	Summary of Functional Integrity (FI) criteria .....	12
Table 3-3	Matrix used to derive Biodiversity Importance (BI) from Functional Integrity (FI) and Conservation Importance (CI) .....	12
Table 3-4	Summary of Resource Resilience (RR) criteria.....	12
Table 3-5	Matrix used to derive Site Ecological Importance (SEI) from Receptor Resilience (RR) and Biodiversity Importance (BI).....	13
Table 3-6	Guidelines for interpreting Site Ecological Importance (SEI) in the context of the proposed development activities .....	13
Table 4-1	Summary of relevance of the proposed project to ecologically important landscape features.....	14
Table 4-2	Threatened avifauna species that are expected to occur within the PAOI.....	23
Table 5-1	Summary of the avifauna species of conservation concern recorded within the proposed PAOI during the field survey.....	26
Table 5-2	Summary of Priority Species recorded within and around the proposed PAOI.....	28
Table 5-3	Relative abundance and frequency of occurrence of dominant avifauna species recorded within the PAOI during the field survey. Dominant species cumulatively account for more than 83% of the overall abundance. Only data from the standardized point counts were considered.	30
Table 5-4	Summary of the avifauna species of conservation concern recorded within the proposed PAOI during the second field survey.....	32
Table 5-5	Summary of risk species recorded during the second survey within and around the proposed project. ....	35
Table 5-6	Relative abundance and frequency of occurrence of dominant avifauna species recorded within the PAOI during the field survey. Dominant species cumulatively account for more than 76% of the overall abundance. Only data from the standardized point counts were considered.	36
Table 7-1	SEI Summary of habitat types delineated within field assessment area of PAOI	45
Table 7-2	Guidelines for interpreting Site Ecological Importance in the context of the proposed development activities .....	48
Table 7-3	Summary of the screening tool vs. specialist assigned sensitivities .....	48

Table 8-1	Summary of unplanned events, potential impacts and mitigations .....	69
Table 8-2	The cumulative impacts considered for avifauna.....	70
Table 8-3	Cumulative Impacts to avifauna associated with the proposed project – Project in Isolation	71
Table 8-4	Cumulative Impacts to avifauna associated with the proposed project – Cumulative Effect.....	71
Table 9-1	Summary of management outcomes pertaining to impacts to avifauna and their habitats	72

### List of Figures

Figure 1-1	Proposed PAOI of the three developments.....	3
Figure 1-2	The Mooivlei 2 original PAOI and the infrastructure associated with the project	4
Figure 1-3	The Mooivlei 2 updated PAOI and the infrastructure associated with the project	5
Figure 1-4	The different categories of Species of Conservation Concern modified from the IUCN's extinction risk categories. Source: SANBI (2020).....	7
Figure 3-1	Map illustrating the field survey area and locations of standardised point counts for the proposed Solar PV PAOI .....	10
Figure 4-1	Map illustrating the ecosystem threat status associated with the PAOI.....	15
Figure 4-2	Map illustrating the ecosystem protection level associated with the PAOI.....	16
Figure 4-3	Map illustrating the locations of CBAs in the PAOI.....	17
Figure 4-4	The PAOI in relation to the protected areas .....	18
Figure 4-5	The PAOI in relation to the National Protected Area Expansion Strategy .....	19
Figure 4-6	The PAOI in relation to the nearest IBAs.....	20
Figure 4-7	Map illustrating ecosystem threat status of rivers and wetland ecosystems in relation to the PAOI.....	21
Figure 4-8	The PAOI in relation to the National Freshwater Ecosystem Priority Areas....	22
Figure 4-9	The PAOI in relation to the closest CAR route .....	23
Figure 5-1	Photographs illustrating Blue Korhaan recorded in the PAOI. Where the species were recorded is shown in Figure 5-2. ....	27
Figure 5-2	Location of the SCC during the first assessment.....	27
Figure 5-3	Some of the risk species identified; A) Whiskered Tern, B) Spur-winged Goose, C) Black Sparrowhawk and D) Blue Korhaan.....	29
Figure 5-4	The locations of the risk species in the PAOI .....	30

Figure 5-5	Some of the species recorded in the PAOI; A) White-browed Sparrow Weaver, B) Fiscal Flycatcher, C) White-backed Mousebird and D) Red-billed Teal.....	31
Figure 5-6	Column plot illustrating the proportion of each Functional Feeding Guild to the total abundance (Avifaunal trophic guilds. CGD, carnivore ground diurnal; CGN, carnivore ground nocturnal, CAN, carnivore air nocturnal, CWD, carnivore water diurnal; FFD, frugivore foliage diurnal; GGD, granivore ground diurnal; HWD, herbivore water diurnal; IAD, insectivore air diurnal; IGD, insectivore ground diurnal; IWD, insectivore water diurnal; NFD, nectivore foliage diurnal; OMD, omnivore multiple diurnal; IAN, Insectivore air nocturnal).....	32
Figure 5-7	Photographs illustrating some of the SCCs recorded in the PAOI; A) Secretarybirds, B) Black-winged Pratincole and C) Blue Korhaan.....	33
Figure 5-8	Location of the SCC during the second assessment.....	34
Figure 5-9	Some of the risk species identified; A) Egyptian Goose and B) Lesser Kestrel	35
Figure 5-10	Location of the risk species observed.....	36
Figure 5-11	Some of the species recorded in the PAOI; A) Black Winged Kite, B) Common Waxbill, C) Cardinal Woodpecker and D) Double-banded Courser .....	38
Figure 5-12	Column plot illustrating the proportion of each Functional Feeding Guild to the total abundance (Avifaunal trophic guilds. CGD, carnivore ground diurnal; CGN, carnivore ground nocturnal, CAN, carnivore air nocturnal, CWD, carnivore water diurnal; FFD, frugivore foliage diurnal; GGD, granivore ground diurnal; HWD, herbivore water diurnal; IAD, insectivore air diurnal; IGD, insectivore ground diurnal; IWD, insectivore water diurnal; NFD, nectivore foliage diurnal; OMD, omnivore multiple diurnal; IAN, Insectivore air nocturnal).....	39
Figure 5-13	Locations of the nest in the PAOI .....	40
Figure 6-1	Photograph illustrating the grassland habitat associated with the PAOI .....	41
Figure 6-2	Photograph illustrating the disturbed grassland habitat associated with the PAOI	41
Figure 6-3	Photograph illustrating the water resource habitat in the PAOI .....	42
Figure 6-4	Map illustrating the habitat types delineated within the proposed PAOI.....	43
Figure 7-1	Terrestrial Biodiversity Theme Sensitivity, National Web based Environmental Screening Tool.....	44
Figure 7-2	Fauna Theme Sensitivity, National Web based Environmental Screening Tool	45
Figure 7-3	Map illustrating the Site Ecological Importance of the proposed PAOI within an avifauna context.....	47
Figure 8-1	Photograph illustrating current negative impacts associated with the PAOI: A) Fences and B) Powerlines. ....	49
Figure 8-2	Map illustrating the additional renewable energy developments within the landscape overlaid onto the remnant vegetation types.....	70

## 1 Introduction

### 1.1 Background

The Biodiversity Company was appointed to undertake an avifauna assessment for the proposed Kroonstad Solar Photovoltaic (PV) cluster project (Figure 1-1). The proposed cluster is located in the Free State Province within the Moqhaka Local Municipality. The cluster consist of three projects namely; Mooivlei 1, Mooivlei 2 and Mooivlei 3. The field work component for these projects was conducted for the cluster, however the information in this report pertains only to Mooivlei 2. The design was updated after the initial assessment. (Figure 1-2 and Figure 1-3). A Regime 2 avifauna assessment was completed for this project, with surveys undertaken from 3-6 January 2023 and from the 6 -10 March 2023.

The approach was informed by the Environmental Impact Assessment Regulations. 2014 (GNR 326, 7 April 2017) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA). The approach has taken cognisance of the recently published Government Notices 320 (20 March 2020) in terms of NEMA, dated 20 March and 30 October 2020: “*Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorisation*” (Reporting Criteria). The National Web based Environmental Screening Tool has characterised the terrestrial theme sensitivity of the PAOI as “Very High” and the animal theme sensitivity as “Medium”.

This report, after taking into consideration the findings and recommendations provided by the specialist herein, should inform and guide the Environmental Assessment Practitioner (EAP) and regulatory authorities, enabling informed decision making, as to the ecological viability of the proposed project.

### 1.2 Project Information

The details of the proposed Solar PV Projects are presented in Table 1-1 as per Nema (2022).

**Table 1-1**      **Details of the proposed Solar PV Projects**

No	Applicant	MW output	Properties affected
1	Mooivlei Solar 1 Pty Ltd	Up to 240MW	Solar Facility on Farm Mooivlei No. 284 and the Remaining Extent of the Farm Naseby Thorns No. 288, an access road crossing Portion 1 of Farm No. 1475 and the Farm Leidzaamheid No. 213, and grid connection infrastructure on the Remining Extent of the Farm Wunningdale No. 200, approximately 11 km west of Kroonstad. The proposed Mooivlei Solar 1 will cover approximately 330 ha.
		Grid Connection 275 kV powerlines loop in loop out (LILO) between the proposed Eskom substation/switching station and the existing 275 kV powerlines	The Farm Mooivlei 284, the Farm Naseby Thorns 288 and the Farm Wunningdale 200.
2	Mooivlei Solar 2 Pty Ltd	Up to 240MW	Farm Mooivlei No. 284 and an access road crossing Portion 1 of Farm No. 1475 and the Farm Leidzaamheid No. 213, approximately 10 km west of Kroonstad. The proposed Mooivlei Solar 2 will cover approximately 312 ha.
3	Mooivlei Solar 3 Pty Ltd	Up to 330MW	Portion 1 of the Farm No. 1475 and the Farm Leidzaamheid No. 213, and grid connection infrastructure on the Farm Mooivlei No. 284, approximately 11 km south west of Kroonstad. The proposed Mooivlei Solar 3 will cover approximately 493 ha.

The proposed Solar PV Projects include the following infrastructure:

- PV modules and mounting structures which will consist of either Monofacial or Bifacial PV panels, mounted on either fixed-tilt, single-axis tracking, and/or double-axis tracking systems;
- Inverters and transformers;
- Battery Energy Storage System (BESS) area up to 5 ha;
- Operation and Maintenance buildings including a gate house and security building, control centre, offices, warehouses and workshops for storage and maintenance;
- Grid connection infrastructure. It is estimated that the maximum size of the facility substation will not exceed 1 ha. The facility substation will collect the power from the facility and transform it from medium voltage (up to 33 kV) to high voltage (132 kV). Additional 33 kV or 132 kV cabling or powerlines will connect the facility substation to the proposed Eskom substation / switching station. It is estimated that the maximum size of the Eskom substation/switching station will not exceed 14 ha. 275 kV Loop in Loop Out (LILO) powerlines will connect the proposed Eskom substation / switching station to the existing 275 kV powerlines adjacent to the site. Each facility will require inverter-stations, transformers, switchgear and internal electrical reticulation (underground cabling);
- Temporary construction laydown area up to 5 ha;
- Permanent laydown area up to 1 ha (to be located within the area demarcated for the temporary construction laydown);
- Internal roads will be up to 6 m wide, to allow access to the Solar PV modules for operations and maintenance activities; and
- Main Access Road is up to 8 m wide. The site is accessible via the R713, R34 and gravel farm roads.
- The proposed Solar PV Projects have a design life of a minimum of 25 years. The extension of the life of the plant will be considered when assessing the plant's economic viability to remain operational after its end of life.



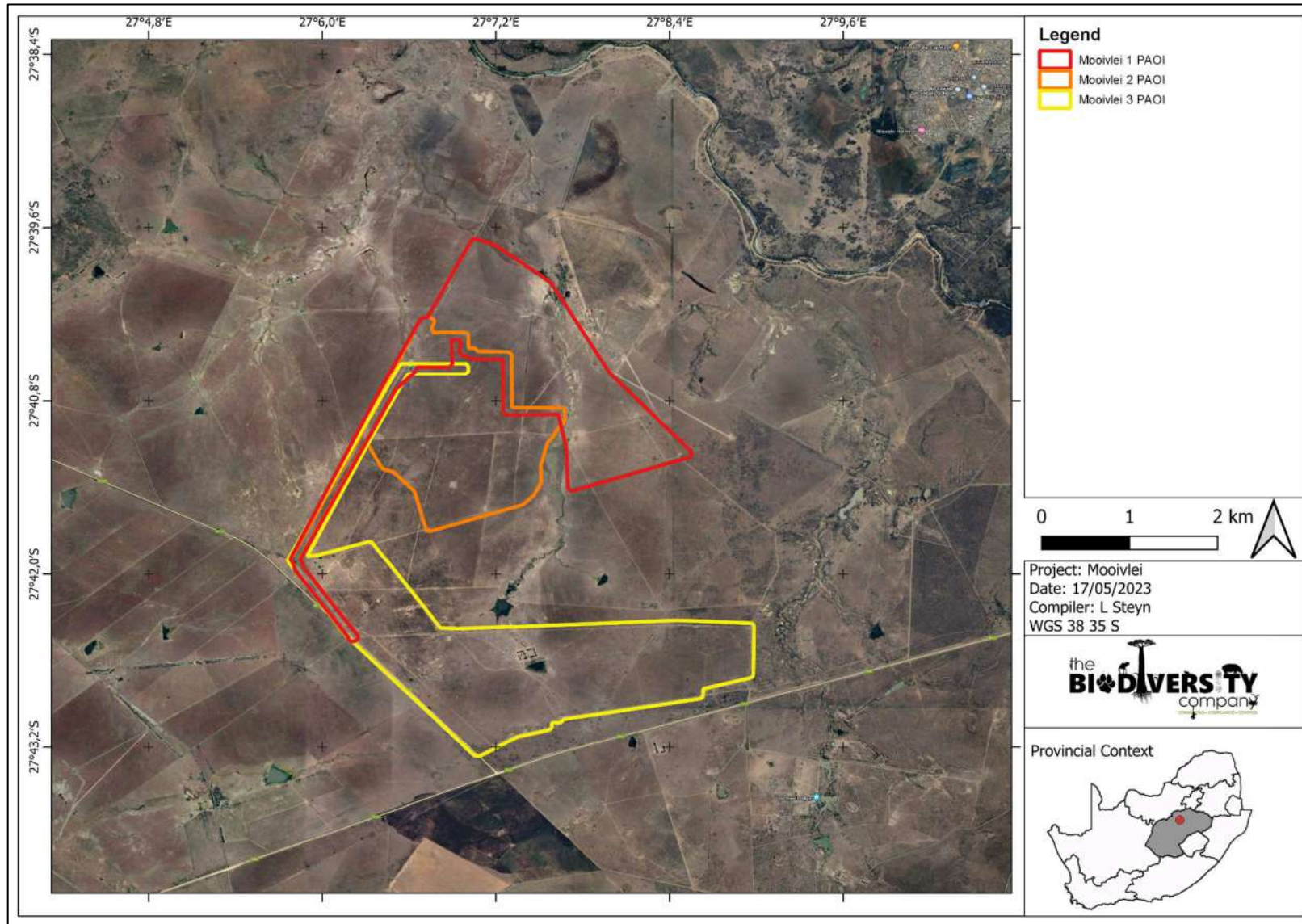


Figure 1-1 Proposed PAOI of the three developments

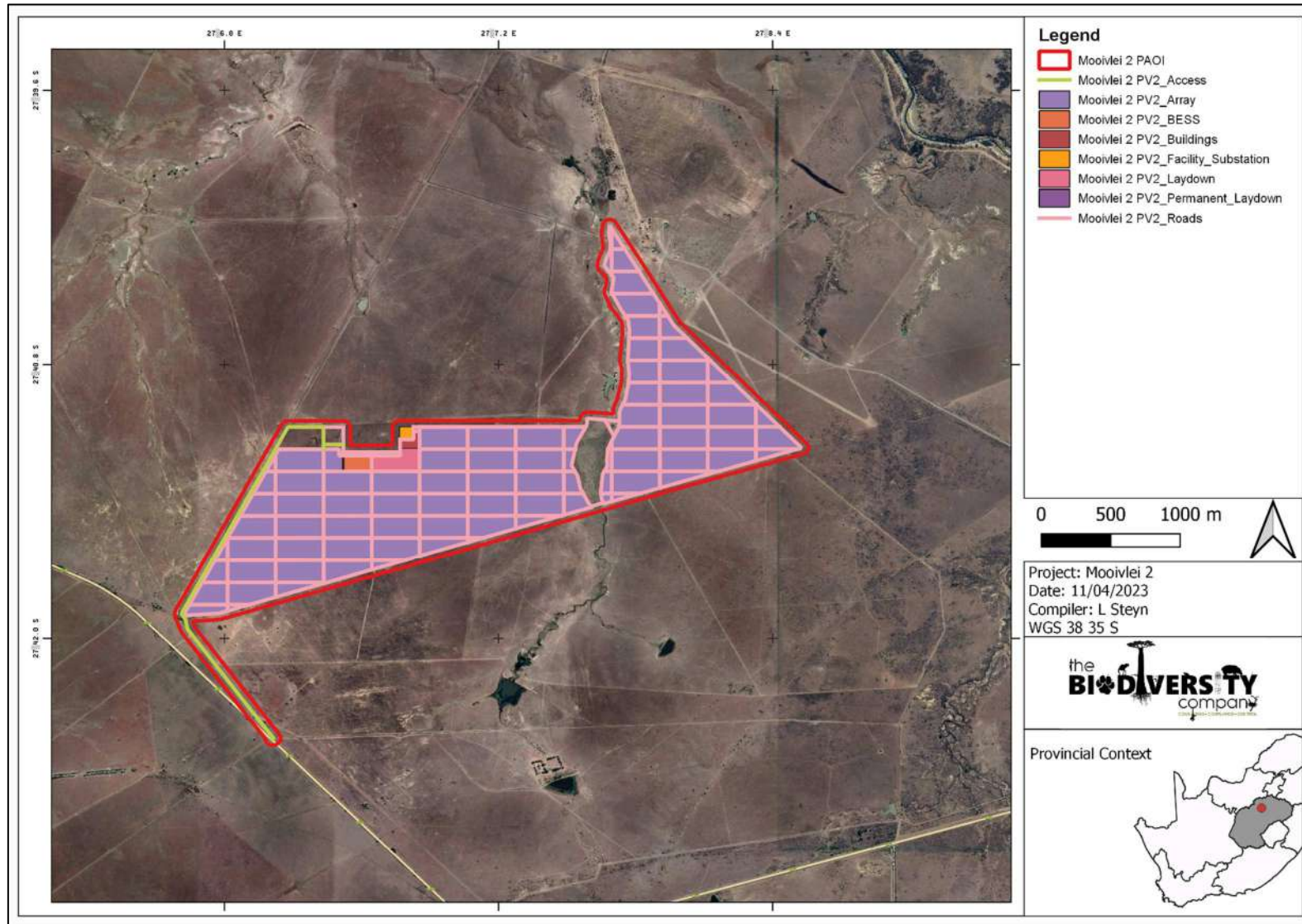
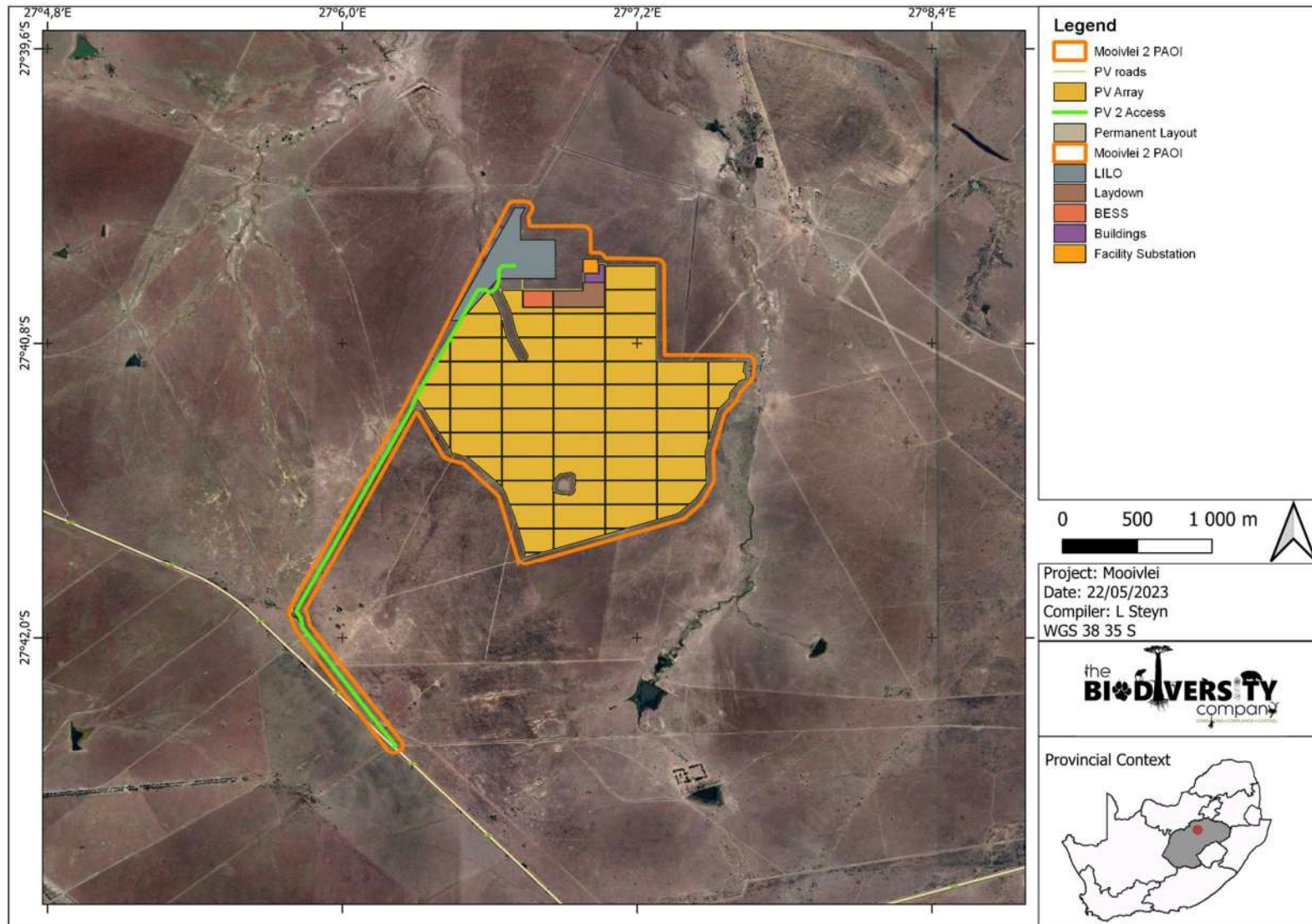





Figure 1-2 The Mooivlei 2 original PAOI and the infrastructure associated with the project





**Figure 1-3** The Moovlei 2 updated PAOI and the infrastructure associated with the project

### 1.3 Specialist Details

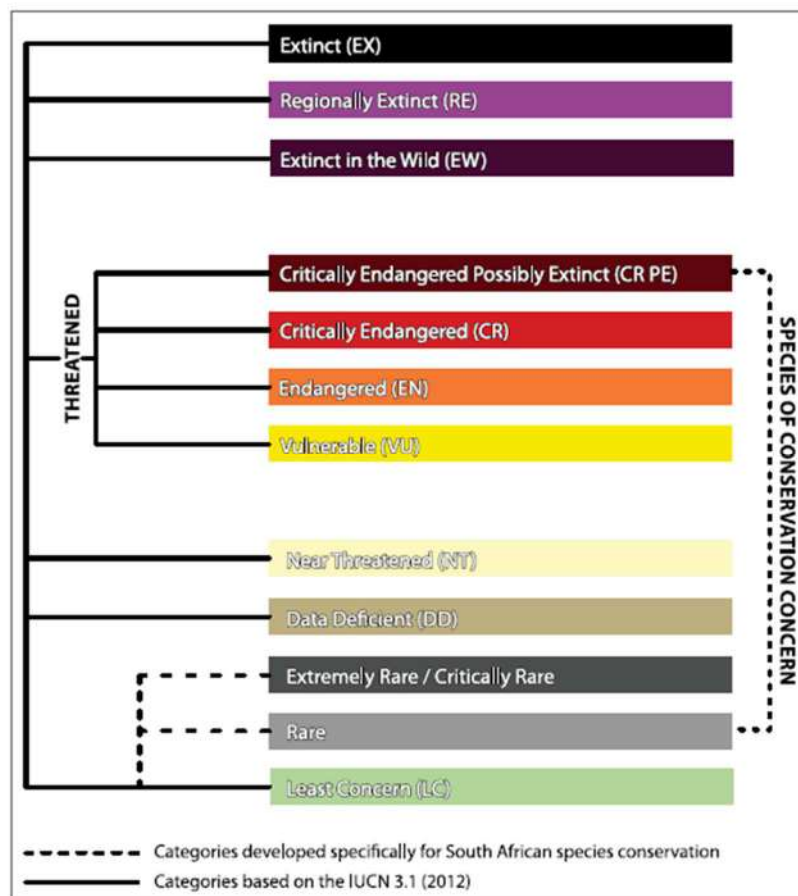
Report Name	<b>Avifauna Assessment for the proposed Mooivlei 2 Photovoltaic (PV) Facility</b>	
Reference	<b>Kroonstad PV</b>	
Submitted to		
Field Work	<b>Ernest Porter</b>	
	Ernest has gained birding experience in the Northern Cape, North West, Mpumalanga, Limpopo, KwaZulu Natal, Free State, Western Cape and also Gauteng. He is a qualified FGASA NQF2 Field Guide and a committee member of Black Eagle Project Roodekrans and The Botanical Society of South Africa (Bankenveld Branch).	
Report Writer	<b>Lindi Steyn</b>	
	Dr Lindi Steyn has completed her PhD in Biodiversity and Conservation from the University of Johannesburg. Lindi is a terrestrial ecologist with a special interest in ornithology. She has completed numerous studies ranging from Basic Assessments to Environmental Impact Assessments following IFC standards.	
Reviewer	<b>Andrew Husted</b>	
	Andrew Husted is Pr Sci Nat registered (400213/11) in the following fields of practice: Ecological Science, Environmental Science and Aquatic Science. Andrew is an Aquatic, Wetland and Biodiversity Specialist with more than 13 years' experience in the environmental consulting field.	
Declaration	The Biodiversity Company and its associates operate as independent consultants under the auspice of the South African Council for Natural Scientific Professions. We declare that we have no affiliation with or vested financial interests in the proponent, other than for work performed under the Environmental Impact Assessment Regulations, 2017. We have no conflicting interests in the undertaking of this activity and have no interests in secondary developments resulting from the authorisation of this project. We have no vested interest in the project, other than to provide a professional service within the constraints of the project (timing, time and budget) based on the principals of science.	

### 1.4 Scope of Work

The assessment was achieved according to the above-mentioned legislation and the best-practice guidelines and principles for Avifaunal Impact Assessments within the context of PVs as outlined by BirdLife South Africa (2017).

The scope of the avifaunal assessment included the following:

- Desktop assessment to identify the relevant ecologically important geographical features within the PAOI and surrounding landscape;
- Desktop assessment to compile an expected species list and possible avifauna Species of Conservation Concern (SCC) that potentially occur within the PAOI;
- Description of the baseline avifauna species and Functional Feeding Guild (FFG) composition assemblage within the PAOI;
- Delineate site sensitivity or sensitivities i.e., the Site Ecological Importance (SEI) within the context of the avifauna species assemblage of the PAOI;
- Identify the manner that the proposed development impacts the avifauna community and evaluate the level of risk of these potential impacts; and
- Provide mitigation measures to prevent or reduce the possible impacts.



**Figure 1-4** The different categories of Species of Conservation Concern modified from the IUCN’s extinction risk categories. Source: SANBI (2020).

## 2 Key Legislative Requirements

The legislation, policies and guidelines listed below in Table 2-1 are applicable to the current project. The list below, although extensive, may not be complete and other legislation, policies and guidelines may apply in addition to those listed below.

**Table 2-1** *A list of key legislative requirements relevant to biodiversity and conservation in the Free State Province*

Region	Legislation / Guideline
National	Constitution of the Republic of South Africa (Act No. 108 of 1996)
	The National Environmental Management Act (NEMA) (Act No. 107 of 1998)
	The National Environmental Management: Protected Areas Act (Act No. 57 of 2003)
	The National Environmental Management: Biodiversity Act (Act No. 10 of 2004), Threatened or Protected Species Regulations
	Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, GNR 320 of Government Gazette 43310 (March 2020)
	Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, GNR 1150 of Government Gazette 43855 (October 2020)
	The National Environmental Management: Waste Act, 2008 (Act 59 of 2008);
	The Environment Conservation Act (Act No. 73 of 1989)
	Natural Scientific Professions Act (Act No. 27 of 2003)
	National Biodiversity Framework (NBF, 2009)
	National Forest Act (Act No. 84 of 1998)
	National Veld and Forest Fire Act (101 of 1998)
	National Water Act (NWA) (Act No. 36 of 1998)
Provincial	Municipal Systems Act (Act No. 32 of 2000)
	Alien and Invasive Species Regulations and, Alien and Invasive Species List 20142020, published under NEMBA
	Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983) (CARA)
	Boputhatswana Nature Conservation Act 3 of 1973
	Free State Nature Conservation Ordinance 8 of 1969

## 3 Methods

### 3.1 Desktop Assessment

The desktop assessment was principally undertaken using a Geographic Information System (GIS) to access the latest available spatial datasets to develop digital cartographs and species lists. These datasets and their date of publishing are provided below.

#### 3.1.1 Desktop Avifaunal Assessment

The avifaunal desktop assessment comprised of the following, compiling an expected species list:

- Avifauna list, generated from the SABAP2 dataset by looking at pentads 2740\_2705; 2740\_2710; 2740\_2715; 2745\_2705; 2745\_2710; 2745\_2715; 2750\_2710; 2750\_2715; 2735\_2710; 2815\_2705; 2815\_2710.



### 3.1.2 Ecologically Important Landscape Features

Existing ecologically relevant data layers were incorporated into a GIS to establish how the proposed project might interact with any ecologically important entities. Emphasis was placed around the following spatial datasets:

- National Biodiversity Assessment 2018 (Skowno *et al*, 2019) (NBA) - The purpose of the NBA is to assess the state of South Africa's biodiversity based on best available science, with a view to understanding trends over time and informing policy and decision-making across a range of sectors. The NBA deals with all three components of biodiversity: genes, species, and ecosystems; and assesses biodiversity and ecosystems across terrestrial, freshwater, estuarine and marine environments. The two headline indicators assessed in the NBA are:
  - *Ecosystem Threat Status* – indicator of an ecosystem's wellbeing, based on the level of change in structure, function or composition. Ecosystem types are categorised as Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT) or Least Concern (LC), based on the proportion of the original extent of each ecosystem type that remains in good ecological condition.
  - *Ecosystem Protection Level* – indicator of the extent to which ecosystems are adequately protected or under-protected. Ecosystem types are categorised as Well Protected (WP), Moderately Protected (MP), Poorly Protected (PP), or Not Protected (NP), based on the proportion of the biodiversity target for each ecosystem type that is included within one or more protected areas. NP, PP or MP ecosystem types are collectively referred to as under-protected ecosystems.
- Protected areas - South Africa Protected Areas Database (SAPAD) (DEA, 2021) – The SAPAD Database contains spatial data pertinent to the conservation of South African biodiversity. It includes spatial and attribute information for both formally protected areas and areas that have less formal protection. SAPAD is updated on a continuous basis and forms the basis for the Register of Protected Areas, which is a legislative requirement under the National Environmental Management: Protected Areas Act, Act 57 of 2003.
- National Protected Areas Expansion Strategy (NPAES) (SANBI, 2016) – The NPAES provides spatial information on areas that are suitable for terrestrial ecosystem protection. These focus areas are large, intact and unfragmented and therefore, of high importance for biodiversity, climate resilience and freshwater protection.
- Conservation/Biodiversity Sector Plan:
 

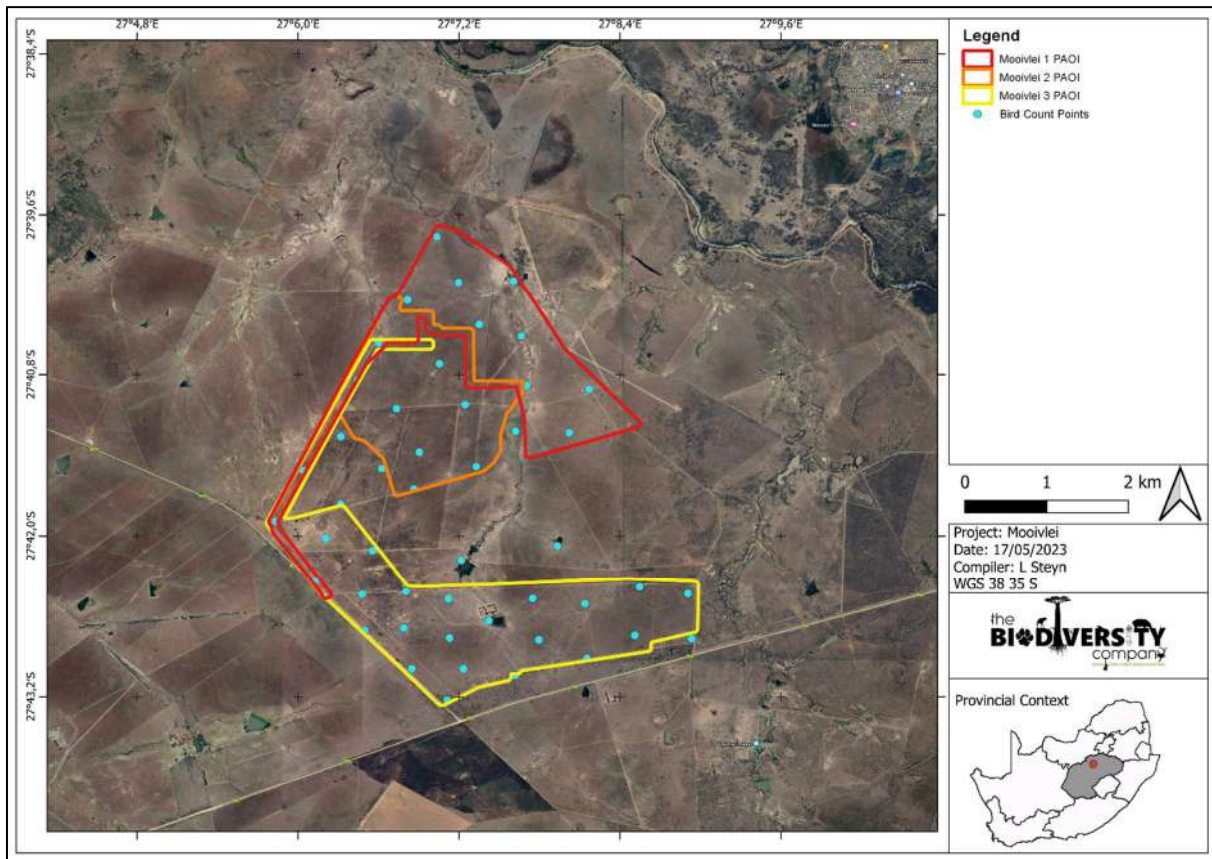
A Free State Conservation Plan map was produced as part of this plan and sites were assigned to the following CBA categories based on their biodiversity characteristics, spatial configuration and requirement for meeting targets for both biodiversity pattern and ecological processes:

  - Critical Biodiversity Area 1;
  - Critical Biodiversity Area 2;
  - Ecological Support Area 1;
  - Ecological Support Area 2;
  - Other Natural Area;
  - Protected Area; and
  - Degraded.

- Important Bird and Biodiversity Areas (IBAs) (BirdLife South Africa, 2017) – IBAs constitute a global network of over 13 500 sites, of which 112 sites are found in South Africa. IBAs are sites of global significance for bird conservation, identified through multi-stakeholder processes using globally standardised, quantitative and scientifically agreed criteria; and
- South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (Van Deventer *et al.*, 2018) – A SAIIAE was established during the NBA of 2018. It is a collection of data layers that represent the extent of river and inland wetland ecosystem types and pressures on these systems.

### 3.1.3 Field Survey

Two field surveys were undertaken, 3-6 January 2023 and 6 -10 March 2023. Sampling consisted of standardized point counts as well as random diurnal incidental surveys. Standardised point counts (Buckland *et al.*, 1993) were conducted to gather data on the species composition and relative abundance of species within the broad habitat types identified. The standardized point count technique was utilised as it was demonstrated to outperform line routes (Cumming & Henry, 2019). Each point count was run over a 10 min period. The horizontal detection limit was set at 150 m. At each point the observer would document the date, start time, and end time, habitat, numbers of each species, detection method (seen or heard), behaviour (perched or flying) and general notes on habitat and nesting suitability for conservation important species. To supplement the species inventory with cryptic and illusive species that may not be detected during the rigid point count protocol, diurnal and nocturnal incidental searches were conducted. This involved the opportunistic sampling of species between point count periods, random meandering and road cruising. Effort was made to cover all the different habitat types within the limits of time and access (Figure 3-1).



**Figure 3-1** Map illustrating the field survey area and locations of standardised point counts for the proposed Solar PV PAOI

### 3.1.4 Data Analysis

The analyses described below only used the data collected from the standardised point counts. See Appendix A for the point count raw data.

Point count data was arranged into a matrix with point count samples in rows and species in columns. The table formed the basis of the various subsequent statistical analyses. This data was first used to distinguish similarities / differences in the species composition between the two identified avifaunal habitats, the matrix was converted into a Bray-Curtis dissimilarity matrix. The data was subject to fourth root transformation to downscale the contribution of very abundant species while upscaling the influence of less abundant species. However, the effect was negligible and ultimately the raw data proved more informative. Thirdly, raw count data was converted to relative abundance values and used to establish dominant species and calculate the diversity of each habitat. The Shannon Diversity Index ( $H'$ ) was the metric used to estimate diversity. Lastly, present, and potentially occurring species were assigned to 13 major trophic guilds loosely based on the classification system developed by González-Salazar *et al.* (2014). Species were first classified by their dominant diet (carnivore, herbivore, granivore, frugivore, nectarivore, omnivore), then by the medium upon / within which they most frequently forage (ground, water, foliage, air) and lastly by their activity period (nocturnal or diurnal).

### 3.1.5 Site Ecological Importance (SEI)

The different habitat types within the assessment area were delineated and identified based on observations during the field assessment as well as available satellite imagery. These habitat types were assigned Ecological Importance (EI) categories based on their ecological integrity, conservation value, the presence of species of conservation concern and their ecosystem processes.

Site Ecological Importance (SEI) is a function of the Biodiversity Importance (BI) of the receptor (e.g., SCC, the vegetation/fauna community or habitat type present on the site) and Receptor Resilience (RR) (its resilience to impacts) as follows.

BI is a function of Conservation Importance (CI) and the Functional Integrity (FI) of the receptor as follows. The criteria for the CI and FI ratings are provided in Table 3-1 and Table 3-2, respectively.

**Table 3-1 Summary of Conservation Importance (CI) criteria**

Conservation Importance	Fulfilling Criteria
Very High	Confirmed or highly likely occurrence of CR, EN, VU or Extremely Rare or Critically Rare species that have a global EOO of < 10 km <sup>2</sup> . Any area of natural habitat of a CR ecosystem type or large area (> 0.1% of the total ecosystem type extent) of natural habitat of an EN ecosystem type. Globally significant populations of congregatory species (> 10% of global population).
High	Confirmed or highly likely occurrence of CR, EN, VU species that have a global EOO of > 10 km <sup>2</sup> . IUCN threatened species (CR, EN, VU) must be listed under any criterion other than A. If listed as threatened only under Criterion A, include if there are less than 10 locations or < 10 000 mature individuals remaining. Small area (> 0.01% but < 0.1% of the total ecosystem type extent) of natural habitat of EN ecosystem type or large area (> 0.1%) of natural habitat of VU ecosystem type. Presence of Rare species. Globally significant populations of congregatory species (> 1% but < 10% of global population).
Medium	Confirmed or highly likely occurrence of populations of NT species, threatened species (CR, EN, VU) listed under Criterion A only and which have more than 10 locations or more than 10 000 mature individuals. Any area of natural habitat of threatened ecosystem type with status of VU. Presence of range-restricted species. > 50% of receptor contains natural habitat with potential to support SCC.
Low	No confirmed or highly likely populations of SCC. No confirmed or highly likely populations of range-restricted species. < 50% of receptor contains natural habitat with limited potential to support SCC.
Very Low	No confirmed and highly unlikely populations of SCC. No confirmed and highly unlikely populations of range-restricted species. No natural habitat remaining.

**Table 3-2 Summary of Functional Integrity (FI) criteria**

Functional Integrity	Fulfilling Criteria
<b>Very High</b>	Very large (> 100 ha) intact area for any conservation status of ecosystem type or > 5 ha for CR ecosystem types. High habitat connectivity serving as functional ecological corridors, limited road network between intact habitat patches. No or minimal current negative ecological impacts with no signs of major past disturbance.
<b>High</b>	Large (> 20 ha but < 100 ha) intact area for any conservation status of ecosystem type or > 10 ha for EN ecosystem types. Good habitat connectivity with potentially functional ecological corridors and a regularly used road network between intact habitat patches. Only minor current negative ecological impacts with no signs of major past disturbance and good rehabilitation potential.
<b>Medium</b>	Medium (> 5 ha but < 20 ha) semi-intact area for any conservation status of ecosystem type or > 20 ha for VU ecosystem types. Only narrow corridors of good habitat connectivity or larger areas of poor habitat connectivity and a busy used road network between intact habitat patches. Mostly minor current negative ecological impacts with some major impacts and a few signs of minor past disturbance. Moderate rehabilitation potential.
<b>Low</b>	Small (> 1 ha but < 5 ha) area. Almost no habitat connectivity but migrations still possible across some modified or degraded natural habitat and a very busy used road network surrounds the area. Low rehabilitation potential. Several minor and major current negative ecological impacts.
<b>Very Low</b>	Very small (< 1 ha) area. No habitat connectivity except for flying species or flora with wind-dispersed seeds. Several major current negative ecological impacts.

BI can be derived from a simple matrix of CI and FI as provided in Table 3-3.

**Table 3-3 Matrix used to derive Biodiversity Importance (BI) from Functional Integrity (FI) and Conservation Importance (CI)**

Biodiversity Importance (BI)		Conservation Importance (CI)				
		Very high	High	Medium	Low	Very low
Functional Integrity (FI)	Very high	Very high	Very high	High	Medium	Low
	High	Very high	High	Medium	Medium	Low
	Medium	High	Medium	Medium	Low	Very low
	Low	Medium	Medium	Low	Low	Very low
	Very low	Medium	Low	Very low	Very low	Very low

The fulfilling criteria to evaluate RR are based on the estimated recovery time required to restore an appreciable portion of functionality to the receptor as summarised in Table 3-4.

**Table 3-4 Summary of Resource Resilience (RR) criteria**

Resilience	Fulfilling Criteria
<b>Very High</b>	Habitat that can recover rapidly (~ less than 5 years) to restore > 75% of the original species composition and functionality of the receptor functionality, or species that have a very high likelihood of remaining at a site even when a disturbance or impact is occurring, or species that have a very high likelihood of returning to a site once the disturbance or impact has been removed.
<b>High</b>	Habitat that can recover relatively quickly (~ 5–10 years) to restore > 75% of the original species composition and functionality of the receptor functionality, or species that have a high likelihood of remaining at a site even when a disturbance or impact is occurring, or species that have a high likelihood of returning to a site once the disturbance or impact has been removed.
<b>Medium</b>	Will recover slowly (~ more than 10 years) to restore > 75% of the original species composition and functionality of the receptor functionality, or species that have a moderate likelihood of remaining at a site even when a disturbance or impact is occurring, or species that have a moderate likelihood of returning to a site once the disturbance or impact has been removed.



Resilience	Fulfilling Criteria
Low	Habitat that is unlikely to be able to recover fully after a relatively long period: > 15 years required to restore ~ less than 50% of the original species composition and functionality of the receptor functionality, or species that have a low likelihood of remaining at a site even when a disturbance or impact is occurring, or species that have a low likelihood of returning to a site once the disturbance or impact has been removed.
Very Low	Habitat that is unable to recover from major impacts, or species that are unlikely to remain at a site even when a disturbance or impact is occurring, or species that are unlikely to return to a site once the disturbance or impact has been removed.

Subsequent to the determination of the BI and RR, the SEI can be ascertained using the matrix as provided in Table 3-5.

**Table 3-5 Matrix used to derive Site Ecological Importance (SEI) from Receptor Resilience (RR) and Biodiversity Importance (BI)**

Site Ecological Importance (SEI)		Biodiversity Importance (BI)				
		Very high	High	Medium	Low	Very low
Receptor Resilience (RR)	Very Low	Very high	Very high	High	Medium	Low
	Low	Very high	Very high	High	Medium	Very low
	Medium	Very high	High	Medium	Low	Very low
	High	High	Medium	Low	Very low	Very low
	Very High	Medium	Low	Very low	Very low	Very low

Interpretation of the SEI in the context of the proposed development activities is provided in Table 3-6.

**Table 3-6 Guidelines for interpreting Site Ecological Importance (SEI) in the context of the proposed development activities**

Site Ecological Importance (SEI)	Interpretation in relation to proposed development activities
Very High	Avoidance mitigation – no destructive development activities should be considered. Offset mitigation not acceptable/not possible (i.e., last remaining populations of species, last remaining good condition patches of ecosystems/unique species assemblages). Destructive impacts for species/ecosystems where persistence target remains.
High	Avoidance mitigation wherever possible. Minimisation mitigation – changes to project infrastructure design to limit the amount of habitat impacted, limited development activities of low impact acceptable. Offset mitigation may be required for high impact activities.
Medium	Minimisation and restoration mitigation – development activities of medium impact acceptable followed by appropriate restoration activities.
Low	Minimisation and restoration mitigation – development activities of medium to high impact acceptable followed by appropriate restoration activities.
Very Low	Minimisation mitigation – development activities of medium to high impact acceptable and restoration activities may not be required.

The SEI evaluated for each taxon can be combined into a single multi-taxon evaluation of SEI for the assessment area. Either a combination of the maximum SEI for each receptor should be applied, or the SEI may be evaluated only once per receptor but for all necessary taxa simultaneously. For the latter, justification of the SEI for each receptor is based on the criteria that conforms to the highest CI and FI, and the lowest RR across all taxa.

### 3.2 Assumptions and Limitations

The following assumptions and limitations are applicable for this assessment:

- The assessment area was based on the area provided by the client and any alterations to the footprint and/or missing GIS information pertaining to the assessment area would have affected the assessment;



- Fieldwork was undertaken for the cluster, whereas reporting has made consideration for the separate Solar PV projects; and
- No nocturnal assessments were conducted due to safety risks.

## 4 Results & Discussion

### 4.1 Desktop Assessment

#### 4.1.1 Ecologically Important Landscape Features

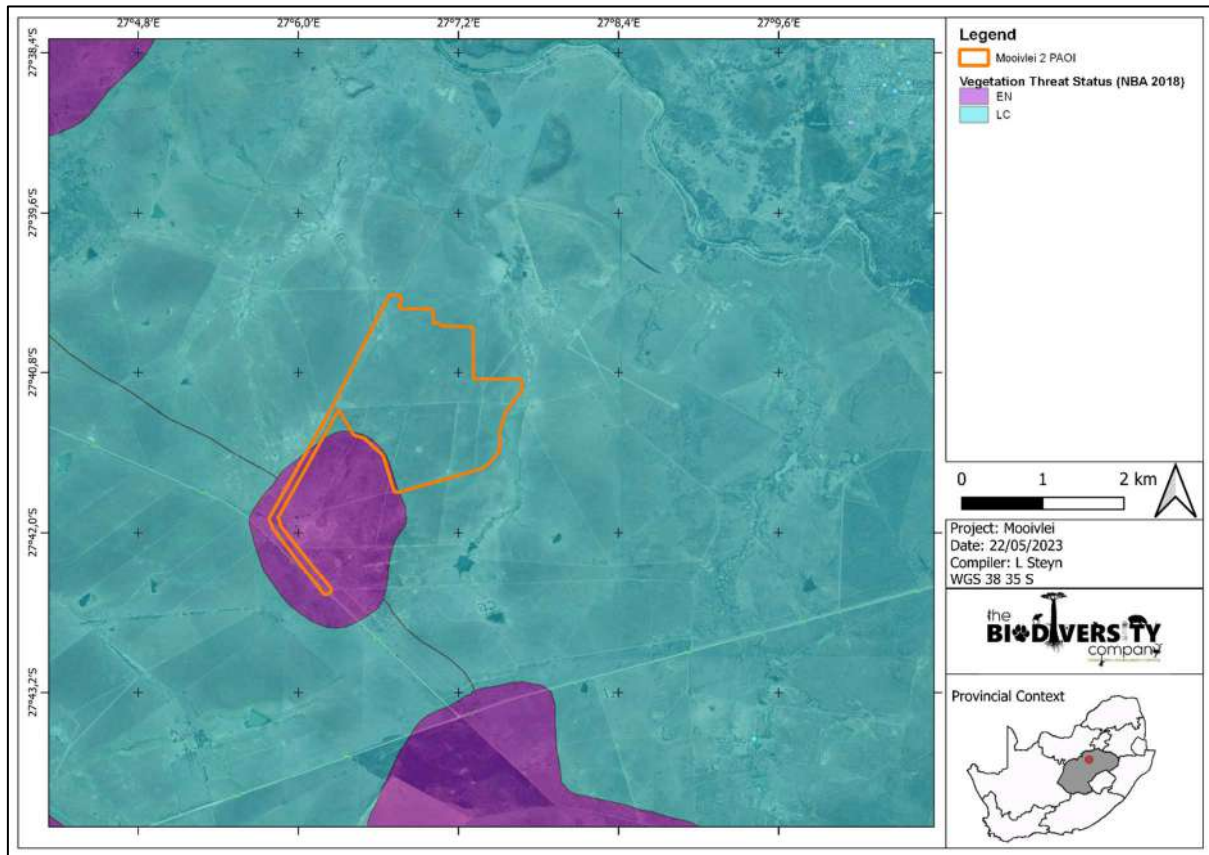
The GIS analysis pertaining to the relevance of the proposed project to ecologically important landscape features is summarised in Table 4-1.

**Table 4-1** *Summary of relevance of the proposed project to ecologically important landscape features.*

Desktop Information Considered	Description	Section
Ecosystem Threat Status	Overlaps with a Least Concern and Endangered Ecosystem.	4.1.1.1
Ecosystem Protection Level	Overlaps with a Poorly Protected and a Not Protected Ecosystem.	4.1.1.2
Protected Areas	The PAOI is approximately 3 km from the Boslaagte Private Nature Reserve	4.1.1.4
National Protected Areas Expansion Strategy	The PAOI overlap with both a priority focus area	4.1.1.5
Critical Biodiversity Area	The PAOI overlaps with CBA1, CBA2, ESA1, ESA2 and Degraded classified areas	4.1.1.3
Important Bird and Biodiversity Areas	The PAOI is located 61 km from the Willem Pretorius Game Reserve IBA.	4.1.1.6
REDZ	The PAOI is 45 km from the Klerksdorp Renewable Energy Development Zone.	-
Powerline Corridor	The PAOI does not overlap with a powerline corridor	-
South African Inventory of Inland Aquatic Ecosystems	The PAOI does not overlap with any wetlands or rivers	4.1.1.7
National Freshwater Priority Area	The PAOI does not overlap with any wetlands or rivers	4.1.1.8
Coordinated Avifaunal Road Count	The PAOI is 1.1 km from the closest CAR route	4.1.1.9
Coordinated Waterbird Count	The PAOI is 48 km from the Toronto Pan, Flamingo Pan, St Helena Mine Dam CWAC	-

##### 4.1.1.1 Ecosystem Threat Status

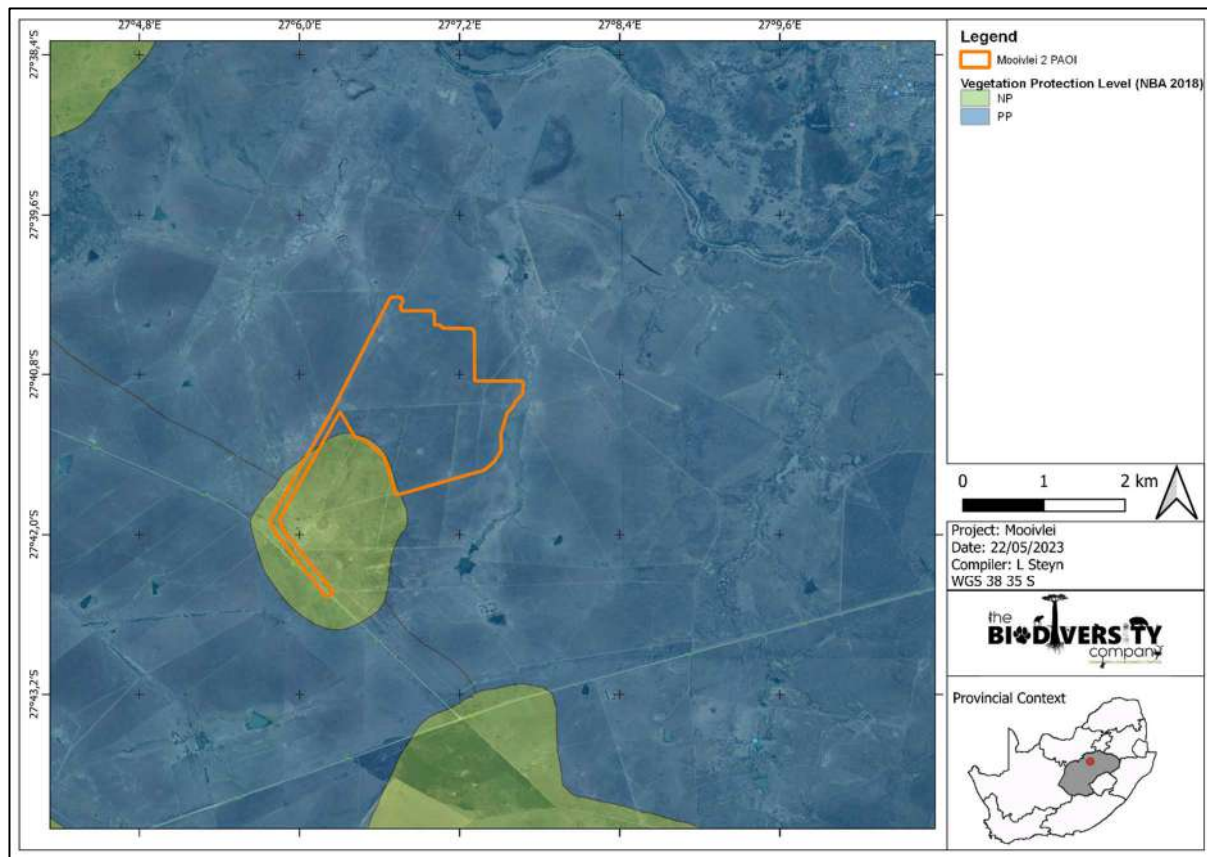
The Ecosystem Threat Status is an indicator of an ecosystem's wellbeing, based on the level of change in structure, function or composition. Ecosystem types are categorised as Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT) or Least Concern (LC), based on the proportion of the original extent of each ecosystem type that remains in good ecological condition. According to the spatial dataset the proposed PAOI overlaps with a LC and an EN ecosystem (Figure 4-1).



**Figure 4-1** Map illustrating the ecosystem threat status associated with the PAOI

#### 4.1.1.2 Ecosystem Protection Level

This is an indicator of the extent to which ecosystems are adequately protected or under-protected. Ecosystem types are categorised as Well Protected (WP), Moderately Protected (MP), Poorly Protected (PP), or Not Protected (NP), based on the proportion of the biodiversity target for each ecosystem type that is included within one or more protected areas. NP, PP or MP ecosystem types are collectively referred to as under-protected ecosystems. The proposed PAOI overlaps with a PP and a NP ecosystem (Figure 4-2).



**Figure 4-2** Map illustrating the ecosystem protection level associated with the PAOI

#### 4.1.1.3 Critical Biodiversity Areas and Ecological Support Areas

A Free State Conservation Plan map was produced as part of this plan and sites were assigned to the following CBA categories based on their biodiversity characteristics, spatial configuration and requirement for meeting targets for both biodiversity pattern and ecological processes:

- Critical Biodiversity Area 1;
- Critical Biodiversity Area 2;
- Ecological Support Area 1;
- Ecological Support Area 2;
- Other Natural Area;
- Protected Area; and
- Degraded.

Critical Biodiversity Areas (CBAs) are terrestrial and aquatic areas of the landscape that need to be maintained in a natural or near-natural state to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. Thus, if these areas are not maintained in a natural or near natural state then biodiversity targets cannot be met. Maintaining an area in a natural state can include a variety of biodiversity compatible land uses and resource uses (SANBI, 2017).

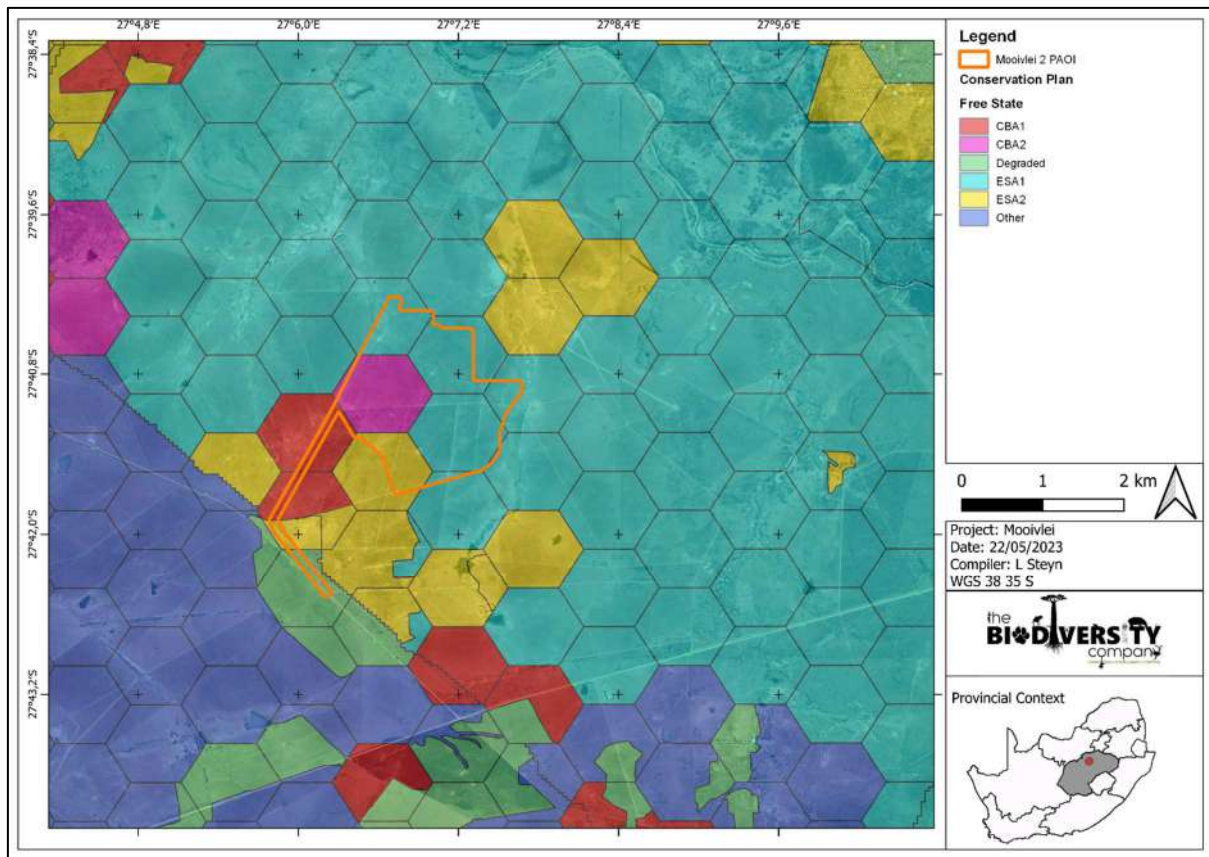
Ecological Support Areas (ESA's) are not essential for meeting biodiversity targets but play an important role in supporting the ecological functioning of Critical Biodiversity Areas and/or in delivering ecosystem

services (SANBI, 2017). Critical Biodiversity Areas and Ecological Support Areas may be terrestrial or aquatic.

Other Natural Areas (ONAs) consist of all those areas in good or fair ecological condition that fall outside the protected area network and have not been identified as CBAs or ESAs. A biodiversity sector plan or bioregional plan must not specify the desired state/management objectives for ONAs or provide land-use guidelines for ONAs (SANBI, 2017).

Degraded areas are areas in poor ecological condition that have not been identified as CBAs or ESAs. They include all irreversibly modified areas (such as urban or industrial areas and mines), and most severely modified areas (such as cultivated fields and forestry plantations) (SANBI, 2017).

According to the Free State Terrestrial CBA Plan, the proposed PAOI is situated in an area which is regarded as CBA1, CBA2, ESA1, ESA2 and Degraded (Figure 4-3).

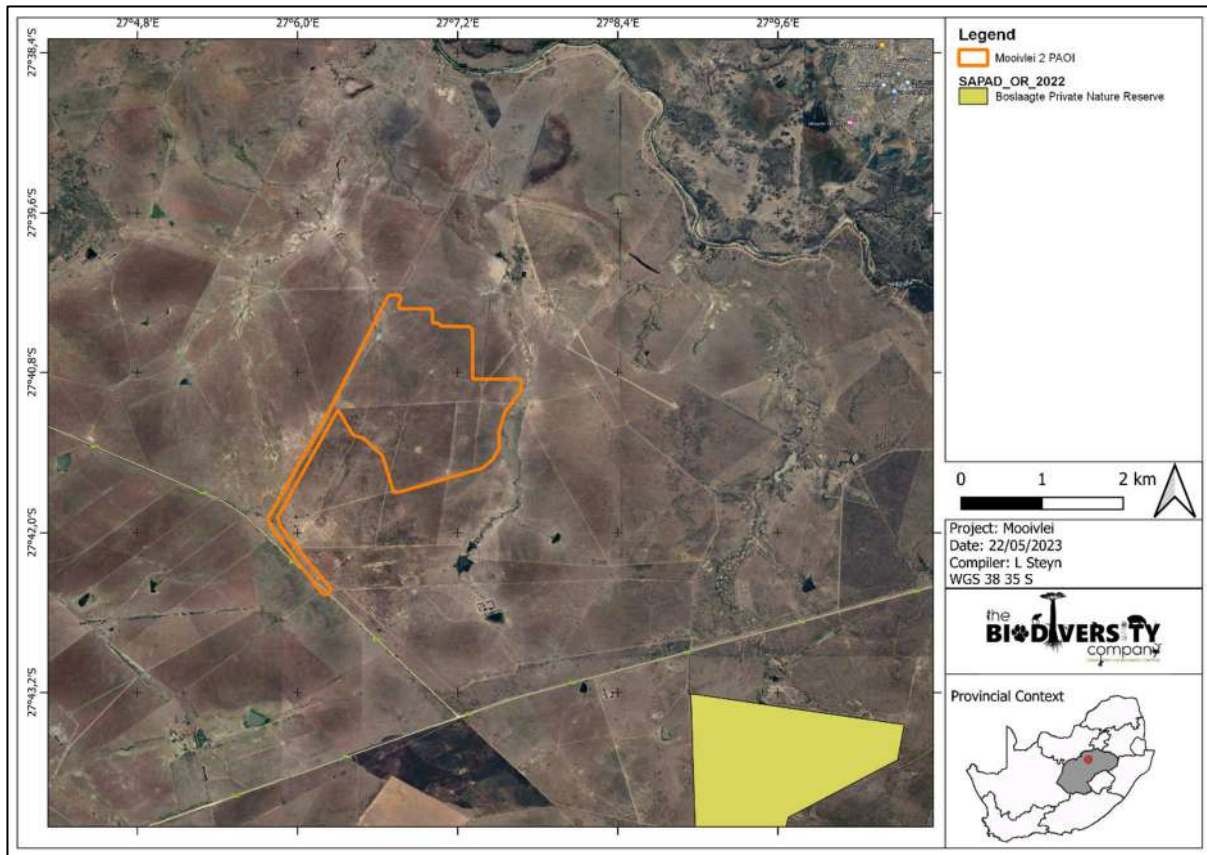


**Figure 4-3** Map illustrating the locations of CBAs in the PAOI

**4.1.1.4 Protected Areas**

According to the protected area spatial datasets from SAPAD (2022) and SACAD (2022), the PAOI is approximately 3 km from the Boslaagte Private Nature Reserve (Figure 4-4).





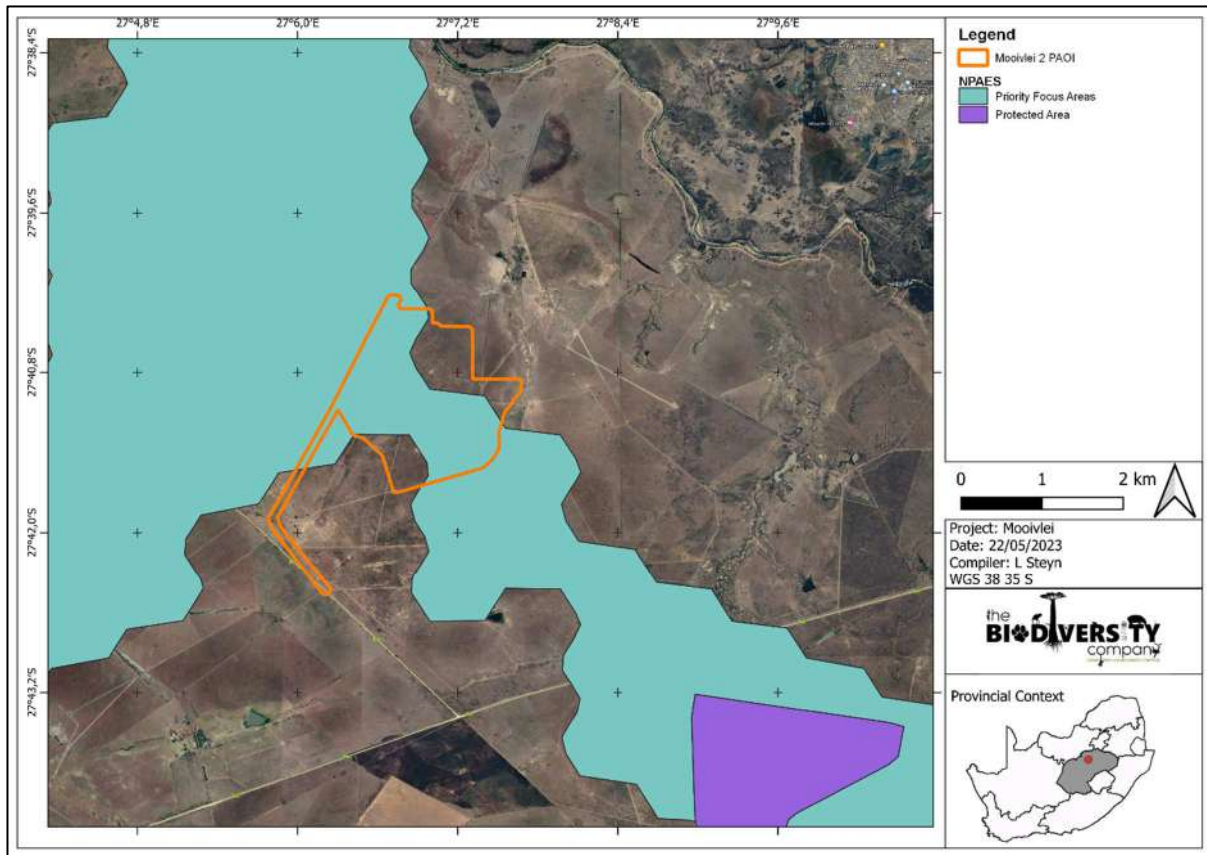
**Figure 4-4** The PAOI in relation to the protected areas

**4.1.1.5 National Protected Area Expansion Strategy**

National Protected Area Expansion Strategy 2016 (NPAES) areas were identified through a systematic biodiversity planning process. They present the best opportunities for meeting the ecosystem-specific protected area targets set in the NPAES and were designed with a strong emphasis on climate change resilience and requirements for protecting freshwater ecosystems. These areas should not be seen as future boundaries of protected areas, as in many cases only a portion of a particular focus area would be required to meet the protected area targets set in the NPAES. They are also not a replacement for fine scale planning which may identify a range of different priority sites based on local requirements, constraints and opportunities (NPAES, 2016).

The PAOI overlap with a priority focus area (Figure 4-5).



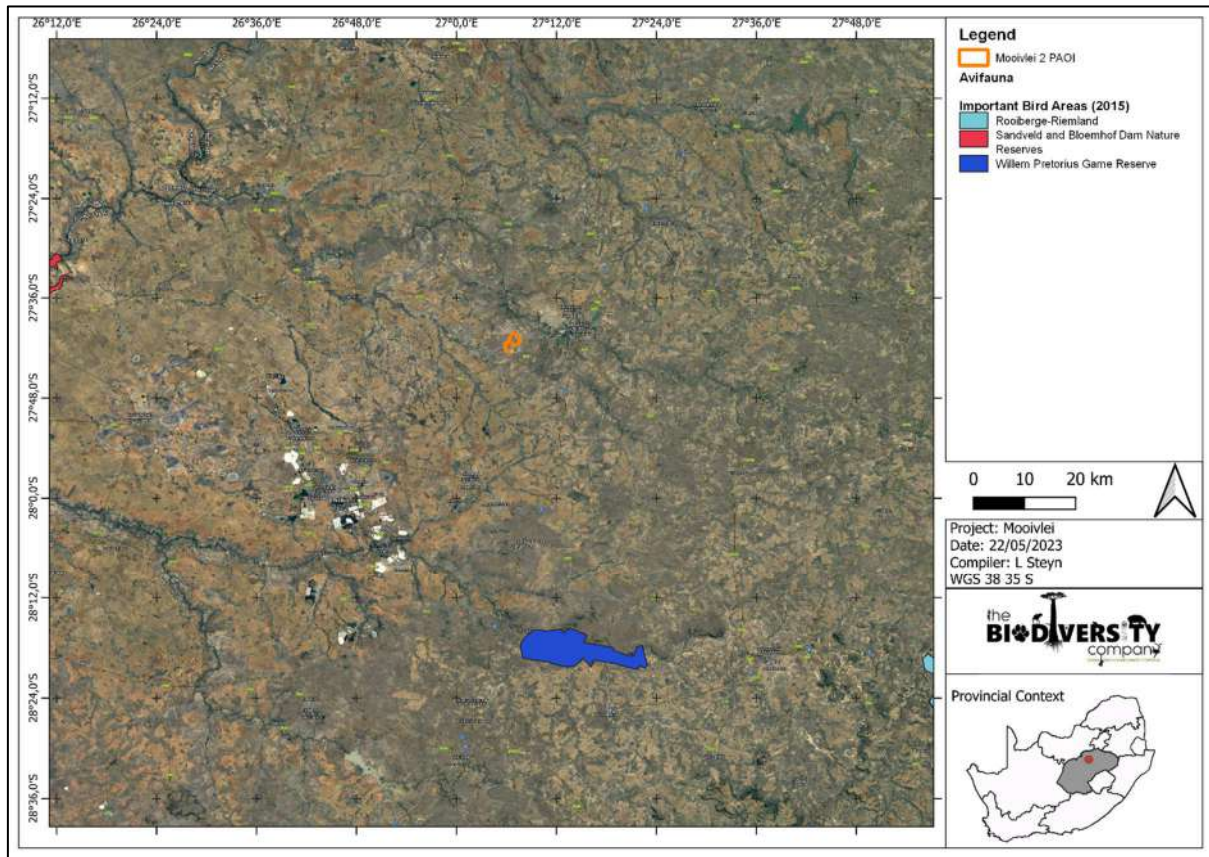


**Figure 4-5 The PAOI in relation to the National Protected Area Expansion Strategy**

**4.1.1.6 Important Bird and Biodiversity Area**

Important Bird & Biodiversity Areas (IBAs) are the sites of international significance for the conservation of the world's birds and other conservation significant species as identified by BirdLife International. These sites are also all Key Biodiversity Areas; sites that contribute significantly to the global persistence of biodiversity (Birdlife South Africa, 2017).

According to Birdlife South Africa (2017), the selection of IBAs is achieved through the application of quantitative ornithological criteria, grounded in up-to-date knowledge of the sizes and trends of bird populations. The criteria ensure that the sites selected as IBAs have true significance for the international conservation of bird populations and provide a common currency that all IBAs adhere to, thus creating consistency among, and enabling comparability between, sites at national, continental and global levels. Figure 4-6 shows that the PAOI is located 61 km from the Willem Pretorius Game Reserve IBA.

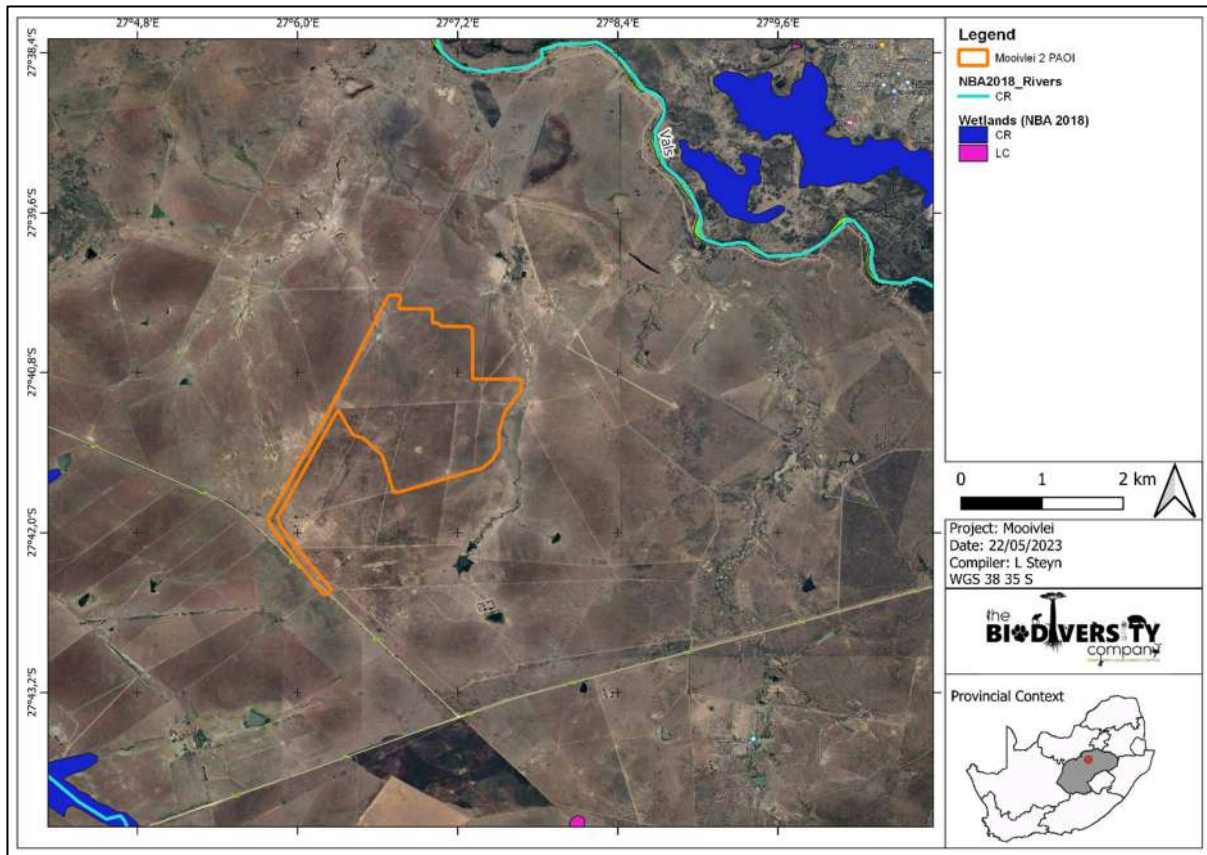


**Figure 4-6 The PAOI in relation to the nearest IBAs**

**4.1.1.7 Hydrological Setting**

The South African Inventory of Inland Aquatic Ecosystems (SAIIAE) was released with the NBA 2018. Ecosystem threat status (ETS) of river and wetland ecosystem types are based on the extent to which each river ecosystem type had been altered from its natural condition. Ecosystem types are categorised as CR, EN, VU or LT, with CR, EN and VU ecosystem types collectively referred to as ‘threatened’ (Van Deventer *et al.*, 2019; Skowno *et al.*, 2019).

The PAOI does not overlap with any NBA rivers or wetlands (Figure 4-7).

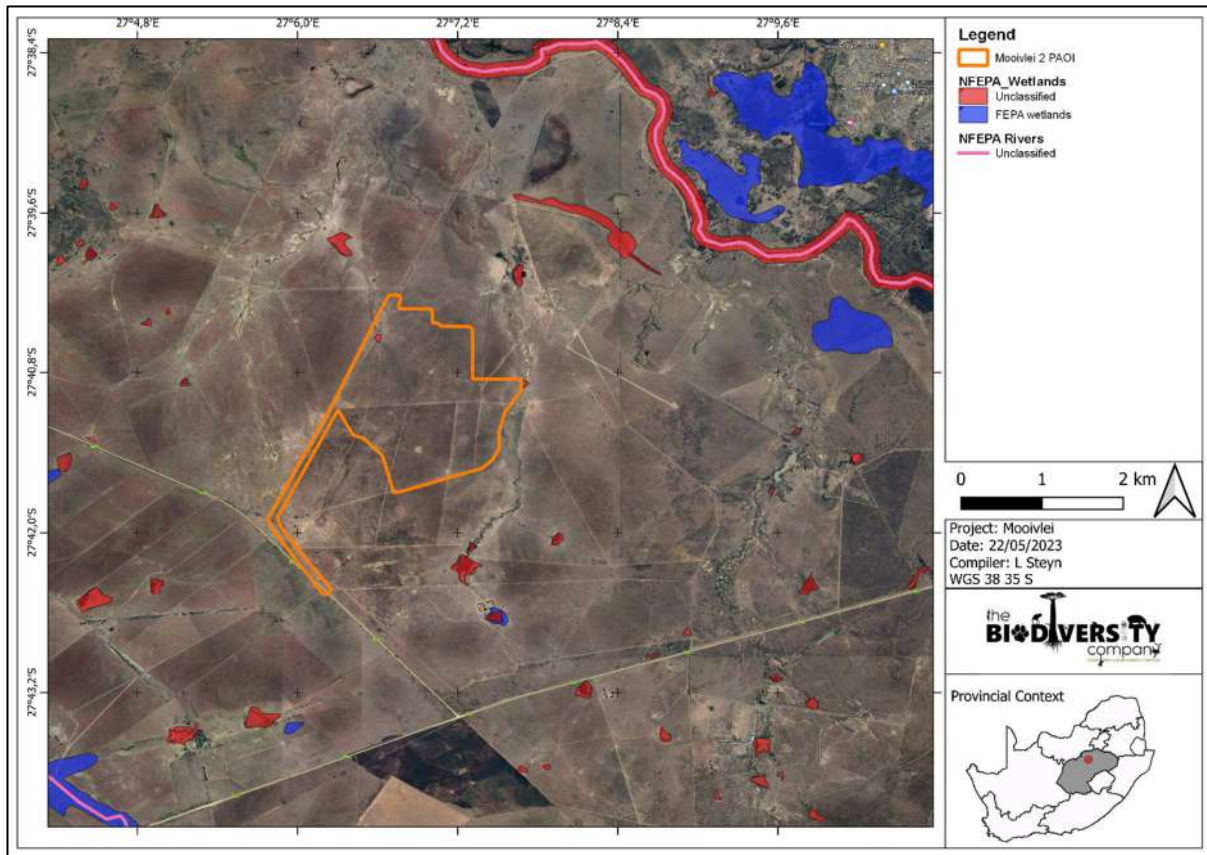


**Figure 4-7** Map illustrating ecosystem threat status of rivers and wetland ecosystems in relation to the PAOI

#### 4.1.1.8 National Freshwater Ecosystem Priority Area Status

In an attempt to better conserve aquatic ecosystems, South Africa has categorised its river systems according to set ecological criteria (i.e., ecosystem representation, water yield, connectivity, unique features, and threatened taxa) to identify Freshwater Ecosystem Priority Areas (FEPAs) (Driver *et al.*, 2011). The FEPAs are intended to be conservation support tools and envisioned to guide the effective implementation of measures to achieve the National Environment Management Biodiversity Act's (NEM:BA) biodiversity goals (Nel *et al.*, 2011). Figure 4-8 shows that the PAOI does not overlap with any wetlands but one unclassified wetland can be found on the edge of the PAOI.

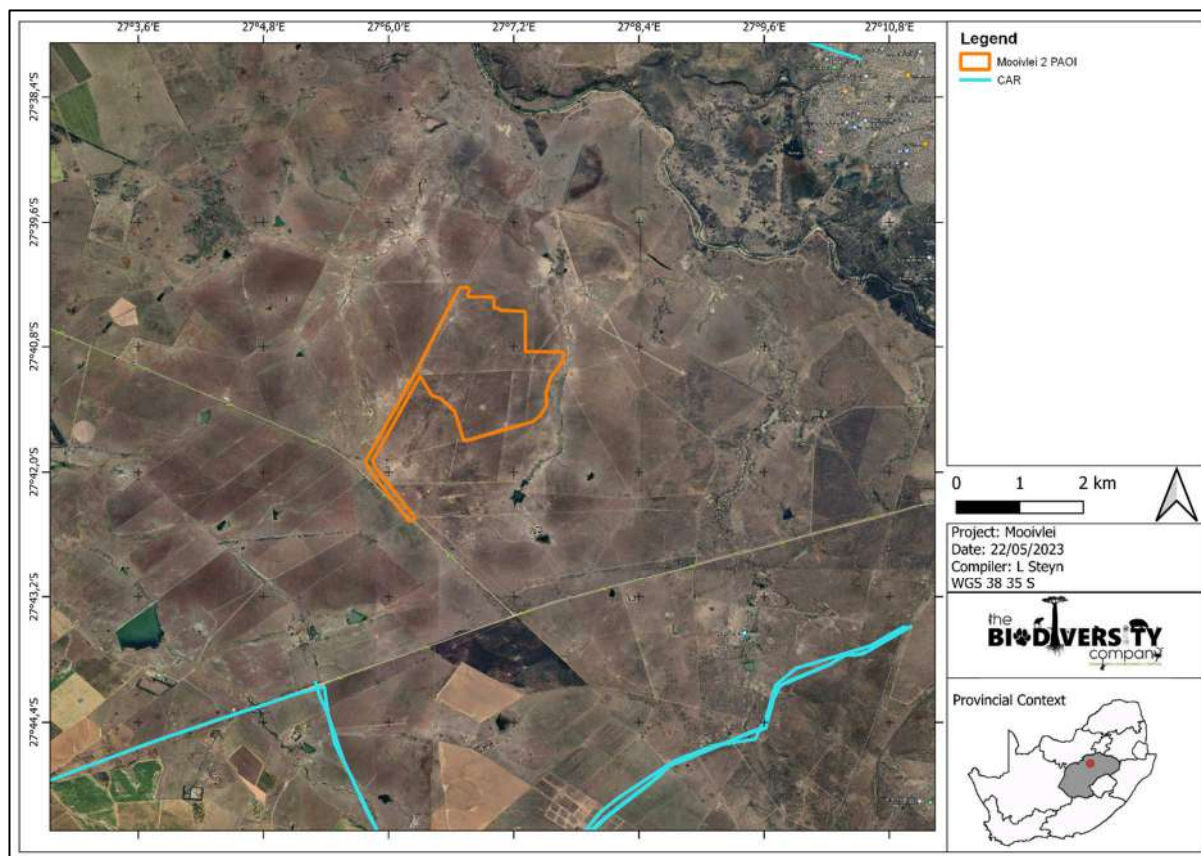




**Figure 4-8 The PAOI in relation to the National Freshwater Ecosystem Priority Areas**

**4.1.1.9 Coordinated Avifaunal Roadcount (CAR)**

The ADU/Cape bird club pioneered avifaunal roadcount of larger birds in 1993 in South Africa. Originally it was started to monitor the Blue Crane *Anthopoides paradiseus* and Denham’s/Stanley’s Bustard *Neotis denhami*. Today it has been expanded to the monitoring of 36 species of large terrestrial birds (cranes, bustards, korhaans, storks, Secretarybird and Southern Bald Ibis) along 350 fixed routes covering over 19 000 km. Twice a year, in midsummer (the last Saturday in January) and midwinter (the last Saturday in July), roadcounts are carried out using this standardised method. These counts are important for the conservation of these larger species that are under threat due to loss of habitat through changes in land use, increases in crop agriculture and human population densities, poisoning as well as man-made structures like power lines. With the prospect of wind and solar farms to increase the use of renewable energy sources monitoring of these species is most important (CAR, 2020). Figure 4-9 shows that the PAOI is 1.1 km from the closest CAR route.



**Figure 4-9 The PAOI in relation to the closest CAR route**

#### 4.1.2 Avifauna Expected

The SABAP2 Data lists 280 avifauna species that could be expected to occur within the PAOI (Appendix A). Seventeen (17) of these expected species are regarded as threatened (Table 4-2). Three (3) of the species have a low likelihood of occurrence due to the expected lack of suitable habitat in the PAOI, these species can however very likely still move over the PAOI and can still be influenced by the development.

**Table 4-2 Threatened avifauna species that are expected to occur within the PAOI.**

Species	Common Name	Conservation Status		Likelihood of Occurrence
		Regional (SANBI, 2016)	IUCN (2021)	
Abdim's Stork	<i>Ciconia abdimii</i>	NT	LC	High
African Rock Pipit	<i>Anthus crenatus</i>	NT	LC	Low
Black Harrier	<i>Circus maurus</i>	EN	EN	Moderate
Black-winged Pratincole	<i>Glareola nordmanni</i>	NT	NT	Confirmed
Blue Korhaan	<i>Eupodotis caerulescens</i>	LC	NT	Confirmed
Caspian Tern	<i>Hydropogne caspia</i>	VU	LC	High
Curlew Sandpiper	<i>Calidris ferruginea</i>	LC	NT	Moderate
European Roller	<i>Coracias garrulus</i>	NT	LC	High
Greater Flamingo	<i>Phoenicopterus roseus</i>	NT	LC	Moderate
Lanner Falcon	<i>Falco biarmicus</i>	VU	LC	High
Lesser Flamingo	<i>Phoeniconaias minor</i>	NT	NT	Moderate
Maccoa Duck	<i>Oxyura maccoa</i>	NT	EN	High



## Proposed PV Facility

Martial Eagle	<i>Polemaetus bellicosus</i>	EN	EN	Low
Red-footed Falcon	<i>Falco vespertinus</i>	NT	VU	High
Secretarybird	<i>Sagittarius serpentarius</i>	VU	EN	Confirmed
Verreaux's Eagle	<i>Aquila verreauxii</i>	VU	LC	Low
Yellow-billed Stork	<i>Mycteria ibis</i>	EN	LC	High

*Ciconia abdimii* (Abdim's Stork) is listed as NT on a local and international scale and the species is known to be found in open grassland and savanna woodland often near water but also in semi-arid areas, gathering beside pools and water-holes (IUCN, 2017). Non-breeding visitor to southern Africa, departing from its northern breeding grounds in the period from May-August, eventually arriving in southern Africa at the onset of the rainy season in the period from October-December. It is nomadic in southern Africa, moving in response to food availability. It gathers in large flocks then departs in February, March and early April. It mainly eats large insects, doing most of its foraging on pastures, irrigated land and recently ploughed fields, usually in groups which split up to cover more ground. Suitable habitat can be found in the PAOI, therefore the likelihood of occurrence is rated as high.

*Circus maurus* (Black Harrier) is endemic to southern Africa, where its core range is in the Western Cape, but also occurs in the Eastern Cape, the Northern Cape and Free State (where it is irruptive in both areas), Lesotho and Namibia (BirdLife International, 2021b). The species occupies coastal and montane fynbos, highland grasslands, Karoo subdesert scrub, open plains with low shrubs and croplands. It often breeds close to coastal and upland marshes with tall shrubs or reeds, occurring in dry steppe and grassland areas further north in the non-breeding season. Local fluctuations in breeding numbers may be related to population cycles in its prey base, such as mice whose numbers fluctuate with rainfall, especially in the more arid regions. The total population is estimated at < 1 000 individuals in South Africa, Lesotho and Eswatini (Taylor *et al*, 2015) with only around 10 mature individuals outside this region. The population is thought to have undergone a major decline of 85% in the past 100 years (17% in 20 years) due to habitat loss (BirdLife International, 2021b). Habitat is primarily lost to agriculture, and this is compounded by the uncontrolled burning of fynbos and grassland, which renders these habitats unsuitable for breeding for about five years. Additional threats include low hatching rates due to pesticide use and overgrazing. This species could occur but the habitat is not ideal for the species.

*Glareola nordmanni* (Black-winged Pratincole) is a migratory species which is listed as NT both globally and regionally. This species has a very large range, breeding mostly in Europe and Russia, before migrating to southern Africa. Overall population declines of approximately 20% for this species are suspected (IUCN, 2017). This species generally occurs near water and damp meadows, or marshes overgrown with dense grass. Due to its migratory nature, this species will only be present in South Africa for a few months during the year and will not breed locally. This species was recorded in the PAOI.

*Eupodotis caerulescens* (Blue Korhaan) is endemic to South Africa and Lesotho and occurs in grassveld usually over 1 500 m above sea level, preferring open, fairly short grassland and a mixture of grassland and karoo dwarf-shrubland within 1 km of water, with termite mounds and few or no trees (BirdLife International, 2017). The total global population is estimated to number between 12 000-15 000 individuals, equivalent to 8 000-10 000 mature individuals, with a decreasing population trend. The main threat is intensive agriculture, especially within the east of its range. This species was recorded in the PAOI.

*Sterna caspia* (Caspian Tern) is native to South Africa and are known to occur in inland freshwater systems such as large rivers, creeks, floodlands, reservoirs and sewage ponds. Habitat suitability was found to be high and thus the likelihood of occurrence is high.

*Calidris ferruginea* (Curlew Sandpiper) is migratory species which breeds on slightly elevated areas in the lowlands of the high Arctic, and may be seen in parts of South Africa during winter. During winter, the species occurs at the coast, but also inland on the muddy edges of marshes, large rivers and lakes (both

saline and freshwater), irrigated land, flooded areas, dams and salt pans (IUCN, 2017). Due to the presence of some of these habitat types within the PAOI the likelihood of occurrence of this species was rated as moderate.

*Coracias garrulous* (European Roller) is a summer migrant with the population from South-central Europe and Asia occurring throughout sub-Saharan Africa. The European Roller has a preference for bushy plains and dry savannah areas. It is globally listed as LC (BirdLife International, 2019a) but NT on a regional scale (Taylor *et al*, 2015). Threats include persecution on migration in some Mediterranean countries and numerous individuals are killed for food in Oman and India. The loss of suitable breeding habitat due to changing agricultural practices, conversion to monoculture, loss of nest sites, and use of pesticides (reducing food availability) are the main threats to the species in Europe (BirdLife International, 2019a). It is sensitive to loss of hedgerows and riparian forest in Europe which provide essential habitats for perching and nesting. Based on the suitable habitat in the PAOI the likelihood of occurrence is rated as high.

*Phoeniconaias minor* (Lesser Flamingo) is listed as NT on a global and regional scale whereas *Phoenicopterus roseus* (Greater Flamingo) is listed as NT on a regional scale only. Both species have similar habitat requirements and the species breed on large undisturbed alkaline and saline lakes, salt pans or coastal lagoons, usually far out from the shore after seasonal rains have provided the flooding necessary to isolate remote breeding sites from terrestrial predators and the soft muddy material for nest building (IUCN, 2017). Some water sources could be suitable but is not ideal habitat, therefore the likelihood of occurrence is rated as moderate for both species.

*Oxyura maccoa* (Maccoa Duck) has a large range, divided into a northern population occurring in Eritrea, Ethiopia, Kenya and Tanzania, and a southern population found in Angola, Botswana, Namibia, South Africa and Zimbabwe. During the breeding season it inhabits small temporary and permanent inland freshwater lakes, preferring those that are shallow and nutrient-rich with extensive emergent vegetation such as reeds and sedges on which it relies for nesting, although it can breed in anthropogenic systems such as farm dams and sewerage treatment plants (BirdLife International, 2021c). It exhibits a preference for habitats with a bottom of mud or silt and minimal amounts of floating vegetation, since this provides the best foraging conditions. Outside the breeding season it will wander over larger, deeper lakes and brackish lagoons. Currently the links between population trends and threats facing this species are poorly understood. Pollution is a primary concern, since the species feeds mainly on benthic invertebrates, and is therefore more vulnerable to bio-accumulation of pollutants than other duck species (BirdLife International, 2021c). Hunting and poaching, competition with alien benthic fish and habitat alteration by invasive plants are further threats. The species has a high likelihood of occurrence.

*Falco biarmicus* (Lanner Falcon) is native to South Africa and inhabits a wide variety of habitats, from lowland deserts to forested mountains (IUCN, 2017). They may occur in groups up to 20 individuals, but have also been observed solitary. Their diet is mainly composed of small birds such as pigeons and francolins. The likelihood of incidental records of this species in the project area is rated as high due to the natural veld condition and the presence of many bird species on which Lanner Falcons may predate.

*Falco vespertinus* (Red-footed Falcon) is known to breed from eastern Europe and northern Asia to north-western China, heading south in the non-breeding season to southern Angola and southern Africa. Within southern Africa it is locally uncommon to common in Botswana, northern Namibia, central Zimbabwe and the area in and around Gauteng, South Africa (Hockey *et al*, 2005). The habitat it generally prefers is open habitats with scattered trees, such as open grassy woodland, wetlands and croplands. Many of these habitats are present in the project area and thus the likelihood of occurrence is rated as high.

*Sagittarius serpentarius* (Secretarybird) is listed as VU regionally and EN on a global scale (BirdLife International, 2020). The species has a wide distribution across sub-Saharan Africa, but surveyed densities suggest that the total population size does not exceed a five-figure number. Ad-hoc records, localised surveys and anecdotal observations indicate apparent declines in many parts of the species' range, especially in South Africa where reporting rates decreased by at least 60% of quarter degree grid

cells used in Southern African Bird Atlas Projects. Threats include excessive burning of grasslands that may suppress populations of prey species, whilst the intensive grazing of livestock is also probably degrading otherwise suitable habitat. Disturbance by humans is likely to negatively affect breeding. The species is captured and traded; however, it is unknown how many deaths occur in captivity and transit. Direct hunting and nest-raiding for other uses and indiscriminate poisoning at waterholes are also further threats. A proposed conservation action is that landowners of suitable properties should join biodiversity stewardship initiatives and to manage their properties in a sustainable way for the species' populations. This species was observed in the PAOI.

*Mycteria ibis* (Yellow-billed Stork) is listed as EN on a regional scale and LC on a global scale. This species is migratory and has a large distributional range which includes much of sub-Saharan Africa. It is typically associated with freshwater ecosystems, especially wetlands and the margins of lakes and dams (IUCN, 2017). The presence of extensive water bodies within the project area creates a high possibility that this species may occur there.

## 5 Field Assessment

### 5.1 First Field Survey

#### 5.1.1 Species List of First Field Survey

During the first assessment performed in the summer 83 species were recorded during the point counts (Appendix B) and 22 during the incidental counts (Appendix C). Some species were observed both as incidental records and during the point counts. The total number of individual species accounts for approximately 36% of the total number of expected species.

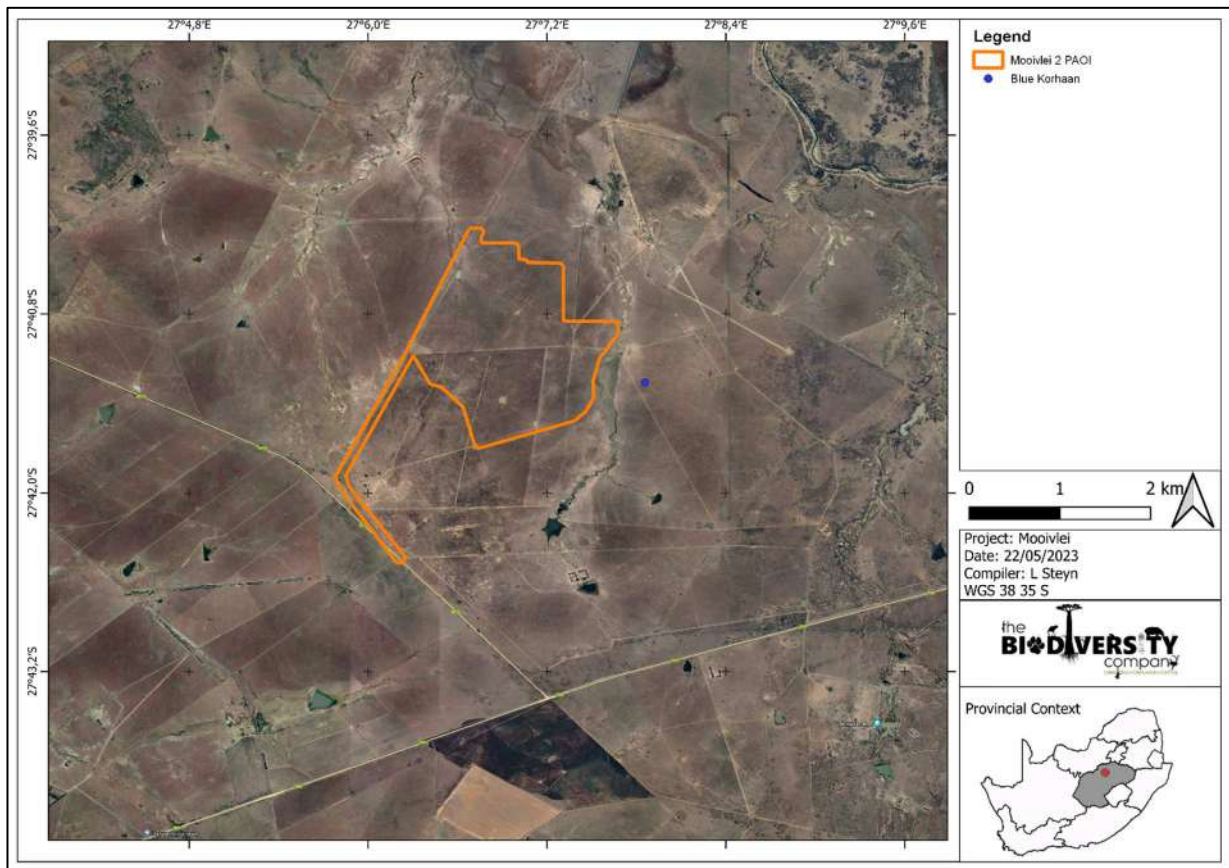
One SCC was recorded during the survey period i.e., *Eupodotis caerulescens* (Blue Korhaan) (Table 5-1 and Figure 5-1). Table 5-1 lists the species recorded, Figure 5-1 are photographic evidence of the species while Figure 5-2 shows the location of the observed species.

**Table 5-1** *Summary of the avifauna species of conservation concern recorded within the proposed PAOI during the field survey.*

Common Name	Scientific Name	Conservation Status (Regional, Global)	Relative abundance	Frequency (%)
Blue Korhaan	<i>Eupodotis caerulescens</i>	LC, NT	0,003	2,128



**Figure 5-1** Photographs illustrating Blue Korhaan recorded in the PAOI. Where the species were recorded is shown in Figure 5-2.



**Figure 5-2** Location of the SCC during the first assessment

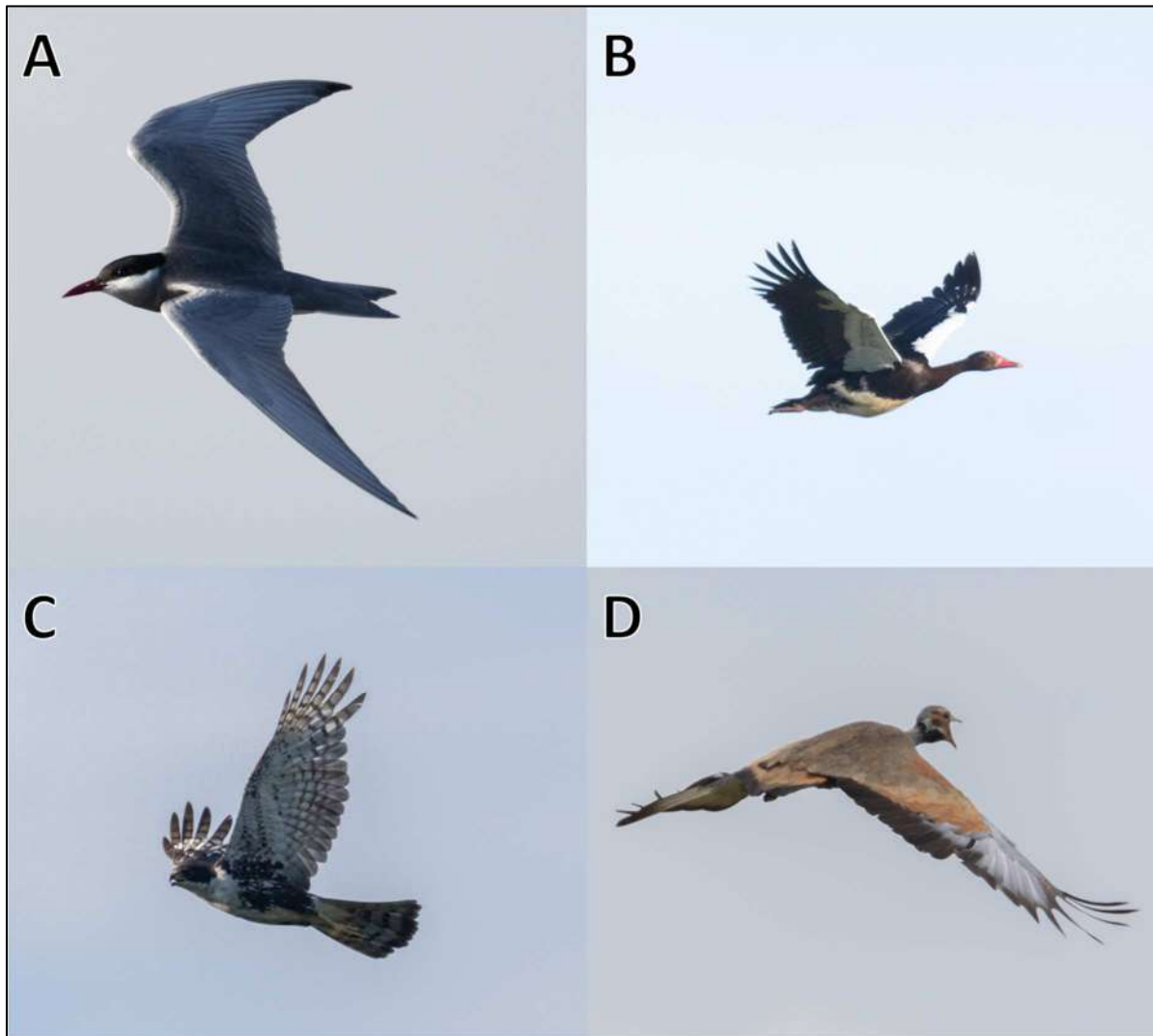
### 5.1.2 Priority Species

Priority species are susceptible to impacts from energy developments (Ralston Paton *et al.* 2017). These species are typically susceptible to collisions. This list (Ralston Paton *et al.* 2017) was developed initially for use with Wind Energy Facilities; however, the collision, electrocution and habitat loss risks are considered appropriate for renewable energy developments and so are utilised here. Also utilised here is the Eskom and EWT poster: Birds and Powerlines (Eskom and EWT, Date unknown) poster, which identifies birds most prone to collision and electrocution from powerlines. Some birds are not included in these lists, but are considered by the TBC avifauna specialists as risk species for collisions, electrocutions and habitat loss as a result of Solar PV infrastructure. All of species are referred to collectively in this report as “Risk Species” (Table 5-2). Photographs of some of the species are shown in Figure 5-3, while Figure 5-4 shows the location of these priority species.

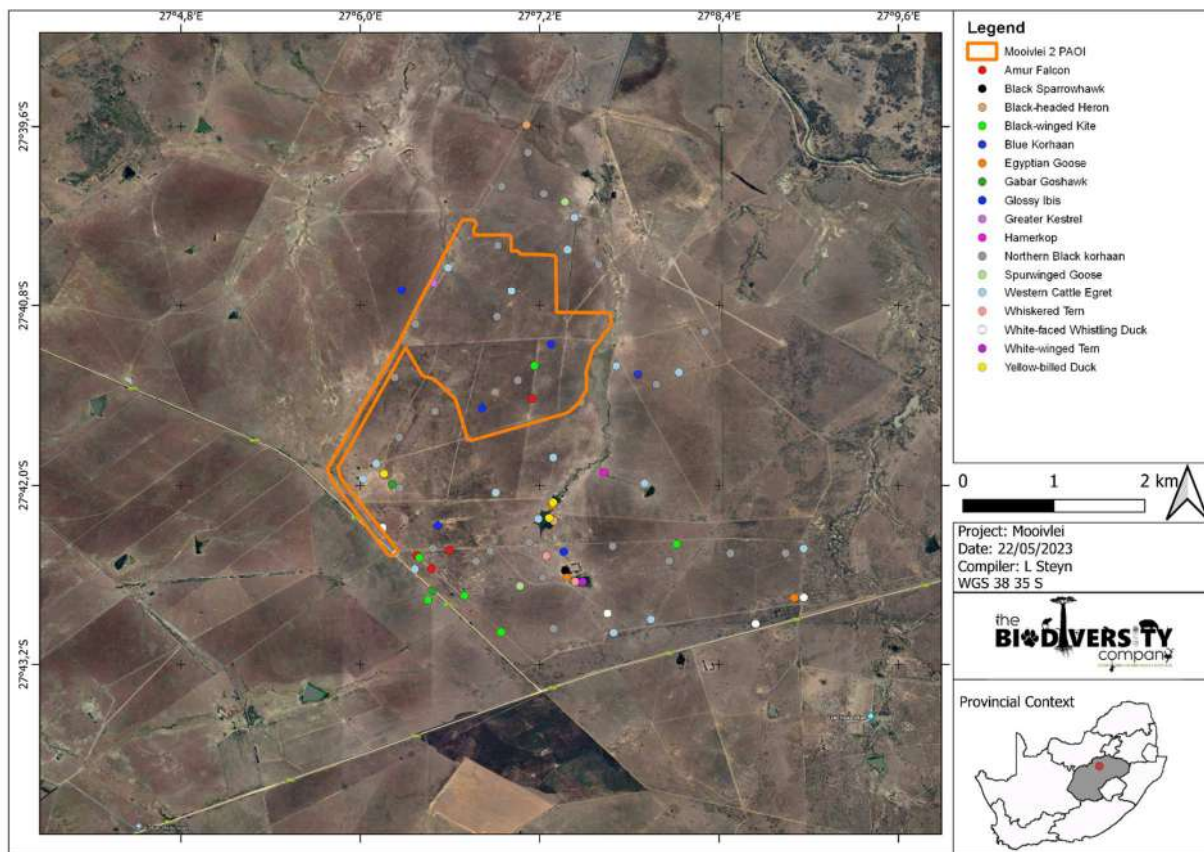
**Table 5-2 Summary of Priority Species recorded within and around the proposed PAOI**

Common Name	Scientific Name	Collisions	Electrocutions	Habitats Loss
Amur Falcon	<i>Falco amurensis</i>		x	
Black Sparrowhawk	<i>Accipiter melanoleucus</i>	x	x	
Black-Headed Heron	<i>Ardea melanocephala</i>	x	x	
Black-Winged Kite	<i>Elanus caeruleus</i>		x	
Blue Korhaan	<i>Eupodotis caerulescens</i>	x		x
Egyptian Goose	<i>Alopochen aegyptiaca</i>	x		
Gabar Goshawk	<i>Micronisus gabar</i>		x	
Glossy Ibis	<i>Plegadis falcinellus</i>	x		
Greater Kestrel	<i>Falco rupicoloides</i>		x	
Hamerkop	<i>Scopus umbretta</i>	x		
Northern Black Korhaan	<i>Afrotis afraoides</i>	x	x	x
Spur-Winged Goose	<i>Plectropterus gambensis</i>	x		
Western Cattle Egret	<i>Bubulcus ibis</i>	x		
Whiskered Tern	<i>Chlidonias hybrida</i>			x
White-Faced Whistling Duck	<i>Dendrocygna viduata</i>	x		
White-Winged Tern	<i>Chlidonias leucopterus</i>			x
Yellow-Billed Duck	<i>Anas undulata</i>	x		





**Figure 5-3** *Some of the risk species identified; A) Whiskered Tern, B) Spur-winged Goose, C) Black Sparrowhawk and D) Blue Korhaan*



**Figure 5-4** The locations of the risk species in the PAOI

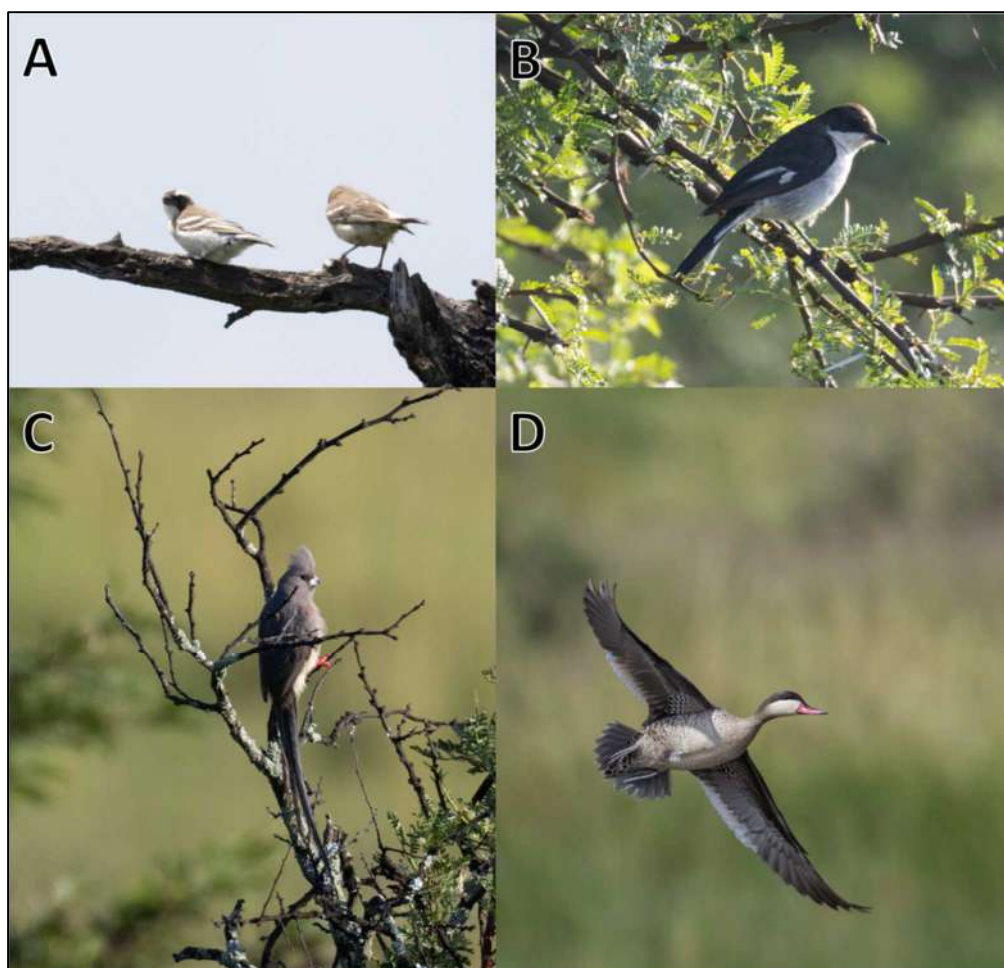
### 5.1.3 Dominant Species

Table 5-3 provides the relative abundance of the dominant species as well as the frequency with which each species appeared in the point count samples. Twenty-six of the recorded species accounted for more than 83% of the total number of individuals recorded. The species with the highest abundance found was the Barn Swallow (Table 5-3).

**Table 5-3** Relative abundance and frequency of occurrence of dominant avifauna species recorded within the PAOI during the field survey. Dominant species cumulatively account for more than 83% of the overall abundance. Only data from the standardized point counts were considered.

Common Name	Scientific Name	Relative abundance	Frequency (%)
Barn Swallow	<i>Hirundo rustica</i>	0,134	34,043
Long-tailed Widowbird	<i>Euplectes progne</i>	0,098	63,830
Red-billed Quelea	<i>Quelea quelea</i>	0,090	12,766
Cloud Cisticola	<i>Cisticola textrix</i>	0,054	78,723
Zitting Cisticola	<i>Cisticola juncidis</i>	0,041	74,468
South African Cliff Swallow	<i>Petrochelidon spilodera</i>	0,035	23,404
African Quail-finch	<i>Ortyospiza atricollis</i>	0,028	40,426
Desert Cisticola	<i>Cisticola aridulus</i>	0,025	48,936
Yellow-crowned Bishop	<i>Euplectes afer</i>	0,025	25,532
Western Cattle Egret	<i>Bubulcus ibis</i>	0,024	25,532
Northern Black Korhaan	<i>Afrotis afraoides</i>	0,023	44,681

Southern Red Bishop	<i>Euplectes orix</i>	0,022	8,511
Speckled Pigeon	<i>Columba guinea</i>	0,021	4,255
Ant-eating Chat	<i>Myrmecocichla formicivora</i>	0,021	19,149
Southern Masked Weaver	<i>Ploceus velatus</i>	0,020	21,277
Common Quail	<i>Coturnix coturnix</i>	0,019	31,915
Cape Longclaw	<i>Macronyx capensis</i>	0,018	31,915
Cape Turtle (Ring-necked) Dove	<i>Streptopelia capicola</i>	0,018	17,021
African Pipit	<i>Anthus cinnamomeus</i>	0,017	27,660
Crowned Lapwing	<i>Vanellus coronatus</i>	0,017	21,277
Spike-heeled Lark	<i>Chersomanes albofasciata</i>	0,016	14,894
White-browed Sparrow-Weaver	<i>Plocepasser mahali</i>	0,015	17,021
Helmeted Guineafowl	<i>Numida meleagris</i>	0,014	12,766
Wattled Starling	<i>Creatophora cinerea</i>	0,014	2,128
Black-chested Prinia	<i>Prinia flavicans</i>	0,012	23,404
Diederik Cuckoo	<i>Chrysococcyx caprius</i>	0,012	27,660

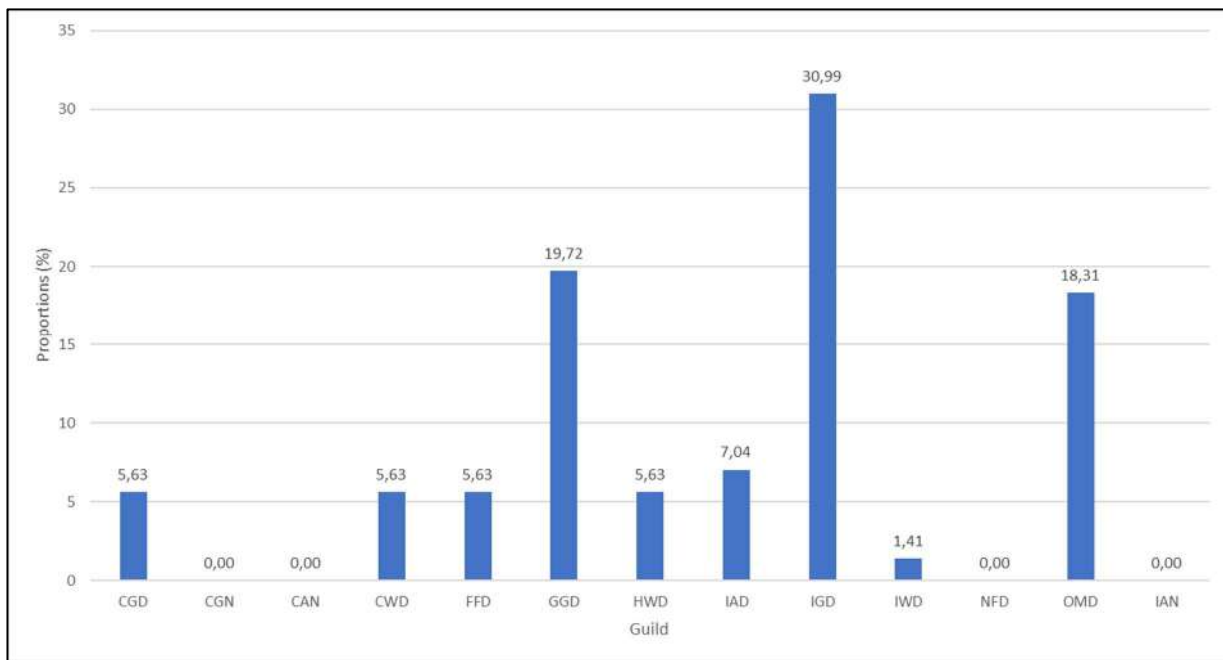


**Figure 5-5** Some of the species recorded in the PAOI; A) White-browed Sparrow Weaver, B) Fiscal Flycatcher, C) White-backed Mousebird and D) Red-billed Teal

**5.1.4 Trophic Guilds**

Trophic guilds are defined as a group of species that exploit the same class of environmental resources in a similar way (González-Salazar *et al*, 2014). The guild classification used in this assessment is as per González-Salazar *et al* (2014); they divided avifauna into 13 major groups based on their diet, habitat, and main area of activity. Although species tend to exhibit varied diet with invertivores consuming fruit and frugivores consuming insects for example, the dominant composition of the diet was considered.

The analysis of the major avifaunal guilds reveals that the species composition during the survey was dominated by insectivorous birds that feed on the ground during the day (IGD). Followed by Granivores (GGD) and Omnivores (OMD) (Figure 5-6). The species composition is spread throughout the various groups, nocturnal surveys were not performed due to safety risk and might not represent the infield composition.



**Figure 5-6** Column plot illustrating the proportion of each Functional Feeding Guild to the total abundance (Avifaunal trophic guilds. CGD, carnivore ground diurnal; CGN, carnivore ground nocturnal, CAN, carnivore air nocturnal, CWD, carnivore water diurnal; FFD, frugivore foliage diurnal; GGD, granivore ground diurnal; HWD, herbivore water diurnal; IAD, insectivore air diurnal; IGD, insectivore ground diurnal; IWD, insectivore water diurnal; NFD, nectivore foliage diurnal; OMD, omnivore multiple diurnal; IAN, Insectivore air nocturnal).

**5.2 Second Survey**

**5.2.1 Species List of Second Field Survey**

During the second assessment performed in the summer 87 species were recorded during the point counts (Appendix D) and 12 during the incidental counts (Appendix E).

Black-winged Pratincole (*Glareola nordmanni*), Blue Korhaan (*Eupodotis caerulescens*) and Secretarybirds (*Sagittarius serpentarius*) were observed during the second survey. Table 5-4 lists the species recorded, Figure 5-7 are photographic evidence of the species while Figure 5-8 shows the location of the observed species.

**Table 5-4** Summary of the avifauna species of conservation concern recorded within the proposed PAOI during the second field survey.

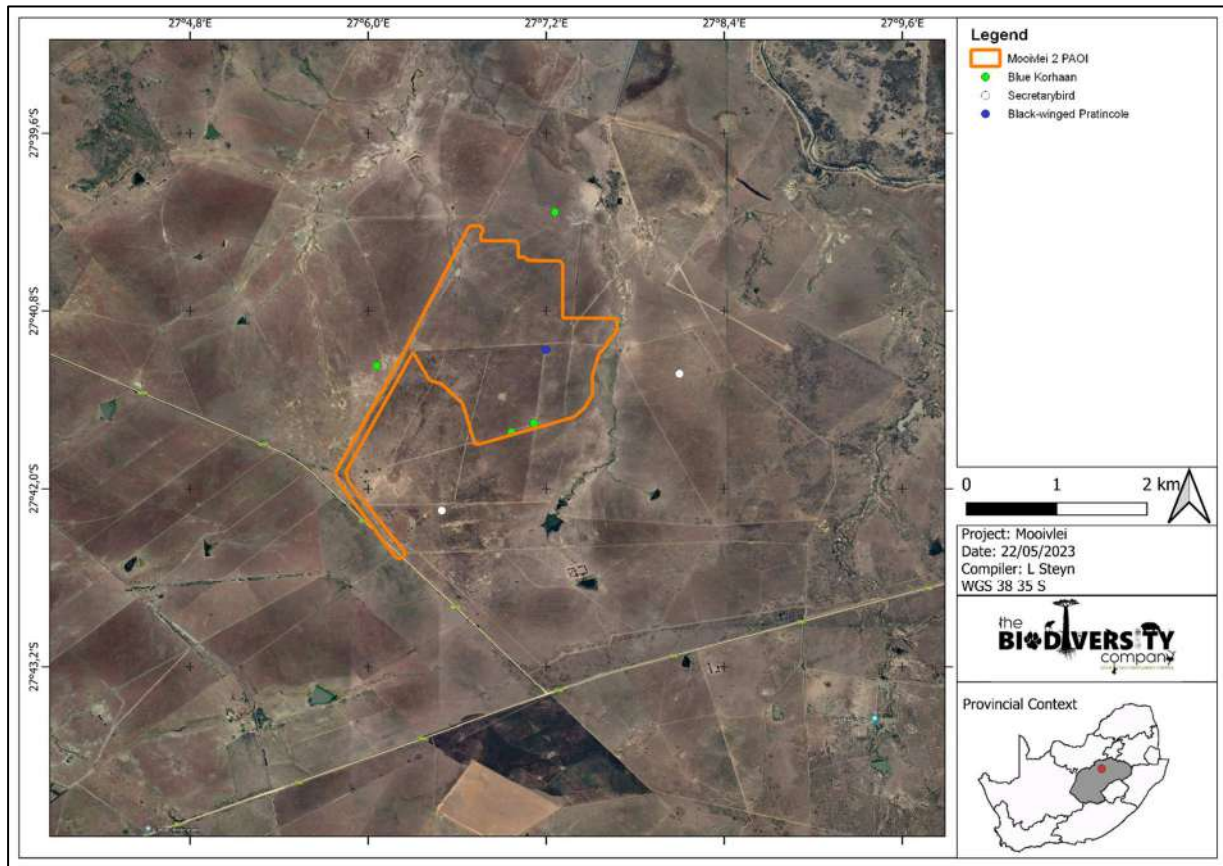


Common Name	Scientific Name	RD (Regional, Global)	Relative abundance	Frequency (%)
Black-winged Pratincole	<i>Glareola nordmanni</i>	NT, NT	0,018	2,128
Blue Korhaan	<i>Eupodotis caerulescens</i>	LC, NT	0,007	8,511
Secretarybird	<i>Sagittarius serpentarius</i>	EN, EN	0,002	4,255



**Figure 5-7** Photographs illustrating some of the SCCs recorded in the PAOI; A) Secretarybirds, B) Black-winged Pratincole and C) Blue Korhaan





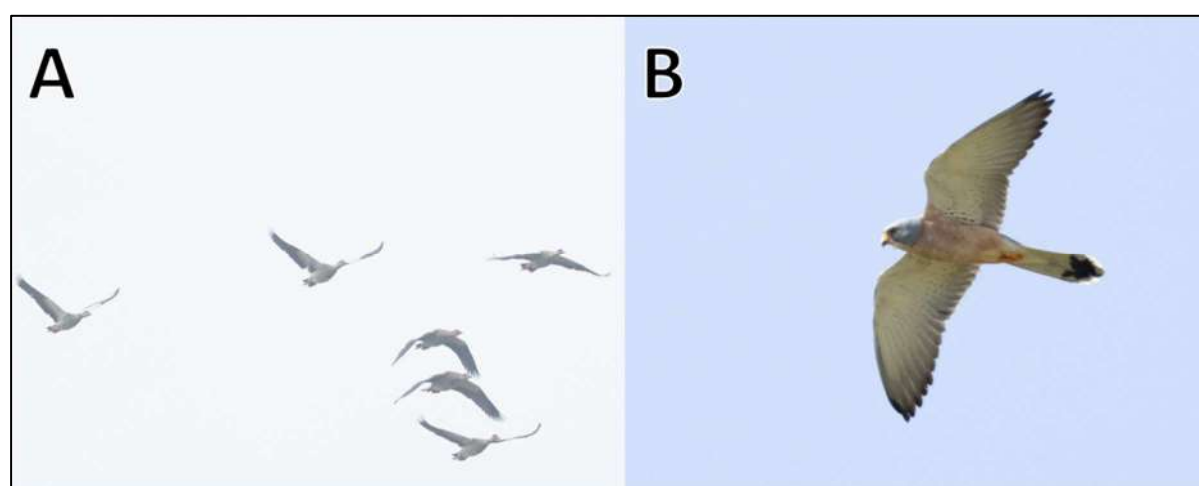
**Figure 5-8** Location of the SCC during the second assessment

### 5.2.2 Risk Species

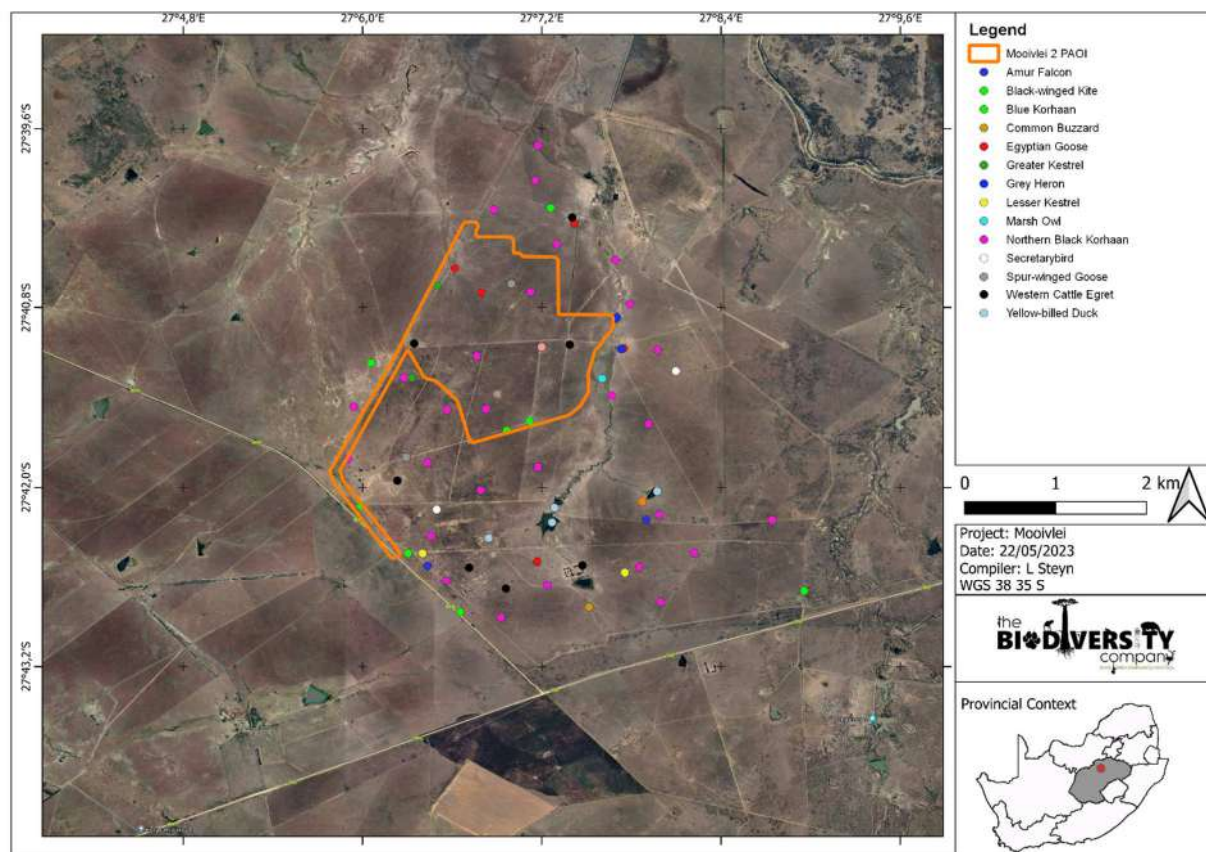
Nineteen of the species observed within the PAOI are regarded as priority species (Table 5-2). Photographs of some of the species are shown in Figure 5-3.

**Table 5-5 Summary of risk species recorded during the second survey within and around the proposed project.**

Common Name	Scientific Name	Collisions	Electrocutions	Habitats Loss
Northern Black Korhaan	<i>Afrotis afraoides</i>	x		x
Amur Falcon	<i>Falco amurensis</i>		x	
Black-winged Kite	<i>Elanus caeruleus</i>		x	
Black-winged Pratincole	<i>Glareola nordmanni</i>			x
Blue Korhaan	<i>Eupodotis caerulescens</i>	x		x
Common (Steppe) Buzzard	<i>Buteo buteo</i>	x	x	
Egyptian Goose	<i>Alopochen aegyptiaca</i>	x		
Greater Kestrel	<i>Falco rupicoloides</i>		x	
Grey Heron	<i>Ardea cinerea</i>	x	x	
Lesser Kestrel	<i>Falco naumanni</i>		x	
Marsh Owl	<i>Asio capensis</i>	x	x	x
Reed Cormorant	<i>Microcarbo africanus</i>	x		
Secretarybird	<i>Sagittarius serpentarius</i>	x	x	x
Spur-winged Goose	<i>Plectropterus gambensis</i>	x		
Western Cattle Egret	<i>Bubulcus ibis</i>		x	
Whiskered Tern	<i>Chlidonias hybrida</i>			x
White-winged Tern	<i>Chlidonias leucopterus</i>			x
Yellow-billed Duck	<i>Anas undulata</i>	x		
Yellow-billed Kite	<i>Milvus aegyptius</i>	x		



**Figure 5-9 Some of the risk species identified; A) Egyptian Goose and B) Lesser Kestrel**



**Figure 5-10** Location of the risk species observed.

### 5.2.3 Dominant Species

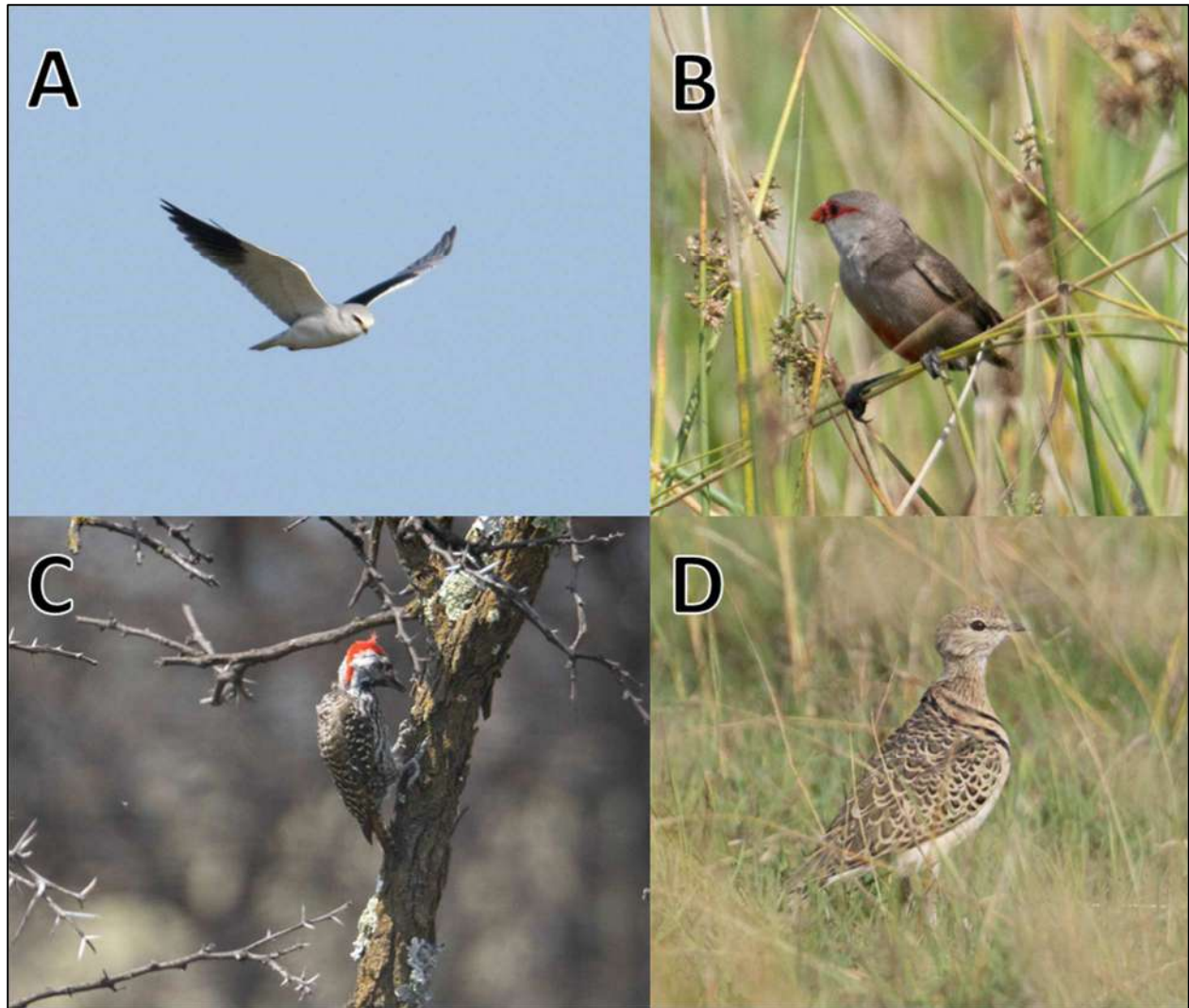
Table 5-3 provides the relative abundance of the dominant species as well as the frequency with which each species appeared in the point count samples. Twenty-five of the recorded species accounted for more than 76% of the total number of individuals recorded. The most abundant species were Western Cattle Egret with a relative abundance of 0.103 and a frequency of occurrence of 12.76%. Additional ubiquitous species comprised of Zitting Cisticola and Northern Korhaan, with a frequency of occurrence of 48.9% and 48.9%, respectively.

**Table 5-6** Relative abundance and frequency of occurrence of dominant avifauna species recorded within the PAOI during the field survey. Dominant species cumulatively account for more than 76% of the overall abundance. Only data from the standardized point counts were considered.

Common Name	Scientific Name	Relative abundance	Frequency
Western Cattle Egret	<i>Bubulcus ibis</i>	0,103	12,766
Southern Red Bishop	<i>Euplectes orix</i>	0,084	10,638
Barn Swallow	<i>Hirundo rustica</i>	0,076	25,532
South African Cliff Swallow	<i>Petrochelidon spilodera</i>	0,065	27,660
Long-tailed Widowbird	<i>Euplectes progne</i>	0,048	27,660
Helmeted Guineafowl	<i>Numida meleagris</i>	0,033	10,638
Zitting Cisticola	<i>Cisticola juncidis</i>	0,031	48,936
Cape Longclaw	<i>Macronyx capensis</i>	0,028	38,298
Yellow-billed Duck	<i>Anas undulata</i>	0,026	6,383

Northern Black Korhaan	<i>Afrotis afraoides</i>	0,023	48,936
Little Swift	<i>Apus affinis</i>	0,022	8,511
Red-billed Quelea	<i>Quelea quelea</i>	0,022	4,255
Ant-eating Chat	<i>Myrmecocichla formicivora</i>	0,021	29,787
African Pipit	<i>Anthus cinnamomeus</i>	0,020	29,787
African Quail-Finch	<i>Ortygospiza atricollis</i>	0,019	29,787
Black-winged Pratincole	<i>Glareola nordmanni</i>	0,018	2,128
Egyptian Goose	<i>Alopochen aegyptiaca</i>	0,017	10,638
Red-capped Lark	<i>Calandrella cinerea</i>	0,017	4,255
Black-chested Prinia	<i>Prinia flavicans</i>	0,015	27,660
Cape Turtle (Ring-necked) Dove	<i>Streptopelia capicola</i>	0,014	25,532
Wattled Starling	<i>Creatophora cinerea</i>	0,014	2,128
Pied Crow	<i>Corvus albus</i>	0,013	12,766
Bokmakierie	<i>Telophorus zeylonus</i>	0,012	19,149
Crowned Lapwing	<i>Vanellus coronatus</i>	0,012	14,894
White-browed Sparrow-Weaver	<i>Plocepasser mahali</i>	0,012	14,894





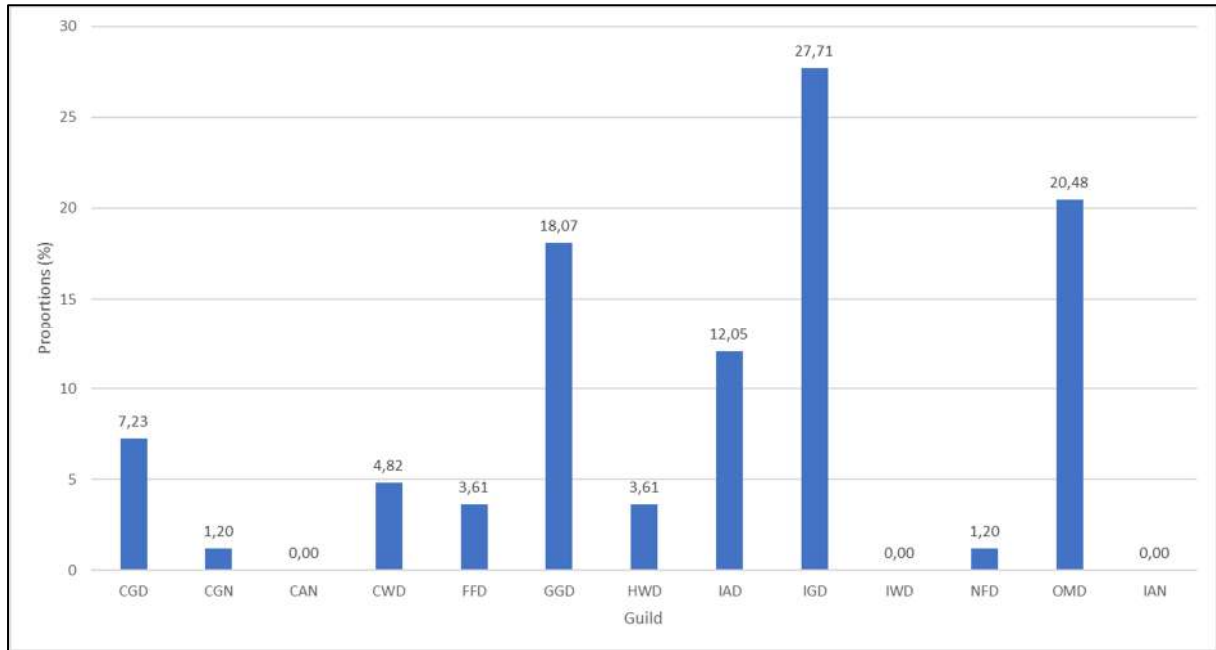
**Figure 5-11** Some of the species recorded in the PAOI; A) Black Winged Kite, B) Common Waxbill, C) Cardinal Woodpecker and D) Double-banded Courser

#### 5.2.4 Trophic Guilds

Trophic guilds are defined as a group of species that exploit the same class of environmental resources in a similar way (González-Salazar *et al*, 2014). The guild classification used in this assessment is as per González-Salazar *et al* (2014); they divided avifauna into 13 major groups based on their diet, habitat, and main area of activity. Although species tend to exhibit varied diet with insectivores consuming fruit and frugivores consuming insects for example, the dominant composition of the diet was considered.

The analysis of the major avifaunal guilds reveals that the species composition during the survey was dominated by insectivorous birds that feed on the ground during the day (IGD). Followed by Omnivores (OMD) and Granivores (GGD) (Figure 5-12).

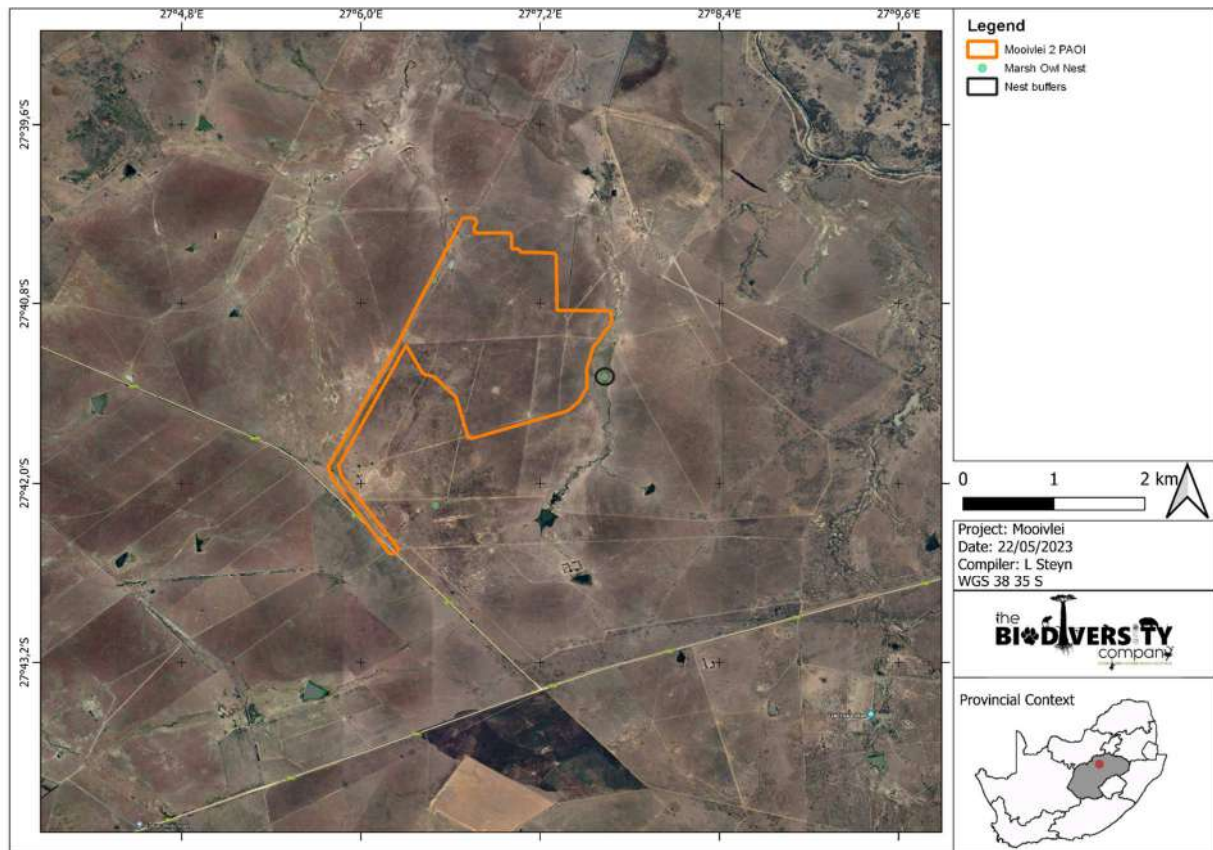




**Figure 5-12** Column plot illustrating the proportion of each Functional Feeding Guild to the total abundance (Avifaunal trophic guilds. CGD, carnivore ground diurnal; CGN, carnivore ground nocturnal, CAN, carnivore air nocturnal, CWD, carnivore water diurnal; FFD, frugivore foliage diurnal; GGD, granivore ground diurnal; HWD, herbivore water diurnal; IAD, insectivore air diurnal; IGD, insectivore ground diurnal; IWD, insectivore water diurnal; NFD, nectivore foliage diurnal; OMD, omnivore multiple diurnal; IAN, Insectivore air nocturnal).

### 5.3 Nests

A Marsh Owl nest was recorded just outside the PAOI (Figure 5-13). A 100 m buffer was placed around the priority species' nest. If the nests are in the development footprint then these nests and accompanying buffer must be regarded as no go areas for the duration of the breeding season (January- April), if the nests can be found just outside of the development areas then these nests and their buffers must be treated as long term (for the duration of the development) no go areas.



**Figure 5-13** Locations of the nest in the PAOI

## 6 Fine-Scale Habitat Use

Fine-scale habitats within the landscape are important in supporting a diverse avifauna community as they provide differing nesting, foraging and reproductive opportunities. During the field assessment three habitat units were identified from an avifauna perspective. They were Disturbed Grassland, Grassland and Water Resource. The delineations of these habitats are shown in Figure 6-4.

### Grassland

The majority of the PAOI comprised of grassland which is typically characterised by open grassland areas, some portions have been disturbed by livestock overgrazing (Figure 6-1). This habitat still has a good composition of herbs and forbs. Avifauna species found here included Ant-eating Chats, Northern Black Korhaan, and Zitting Cisticola.



**Figure 6-1** Photograph illustrating the grassland habitat associated with the PAOI

#### Disturbed Grassland

This habitat is areas associated with roads, powerline corridors, and areas where high density overgrazing has taken place (Figure 6-2). Pore patches of soil is visible in this habitat. The avifauna species composition is similar to that of the grassland as this habitat consist of small patches in between the grassland habitat. Avifauna species that were found here included Pied Crow, Cape Turtle Dove and Helmeted Guineafowl.



**Figure 6-2** Photograph illustrating the disturbed grassland habitat associated with the PAOI

#### Water resource

The water resources found in the PAOI consisted of wetlands, rivers, farm dams and pans (Figure 6-4). Avifauna species found here included Yellow-billed Ducks, White-faced Whistling Ducks, Grey Heron and Little Grebe.





**Figure 6-3**      *Photograph illustrating the water resource habitat in the PAOI*

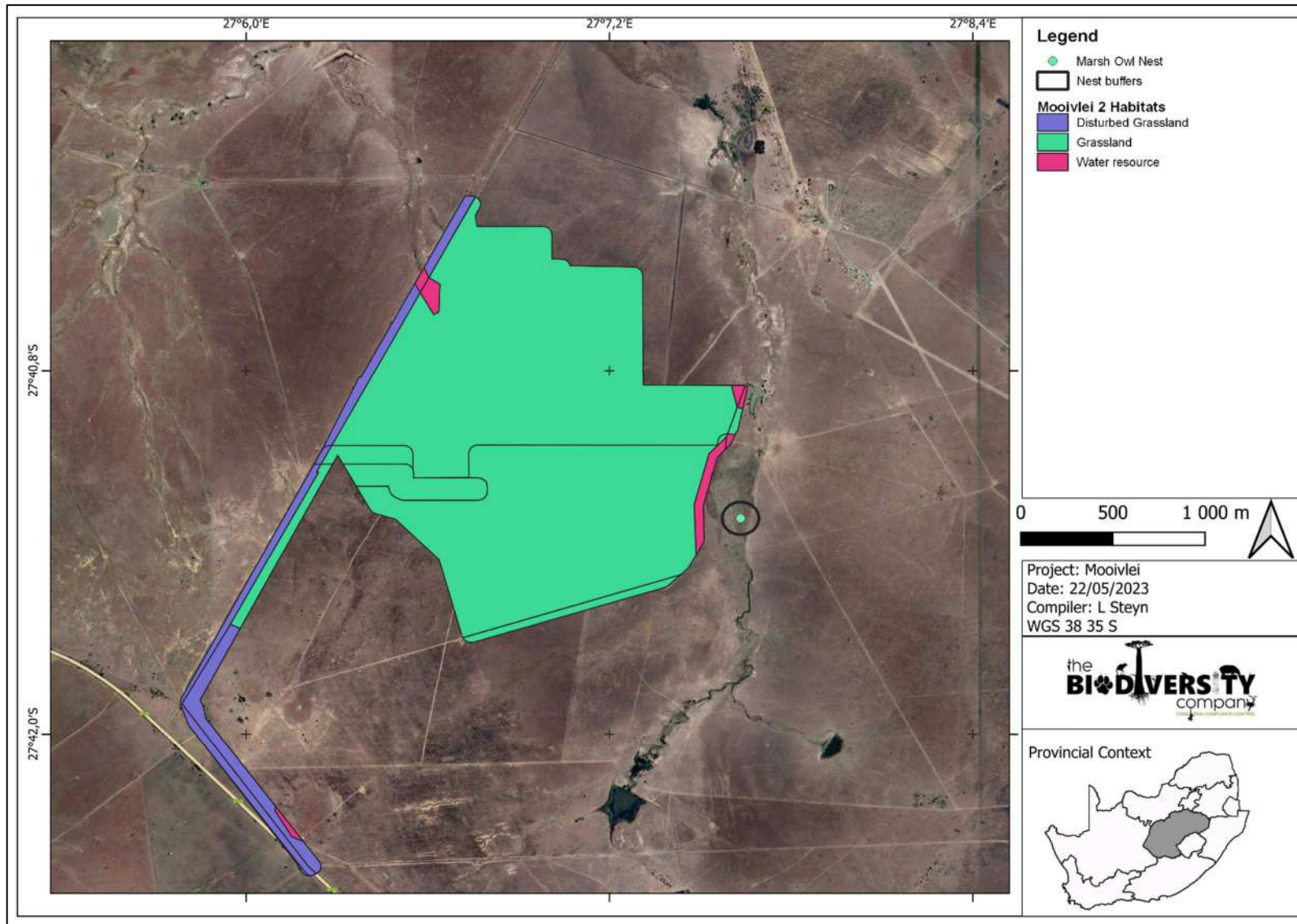


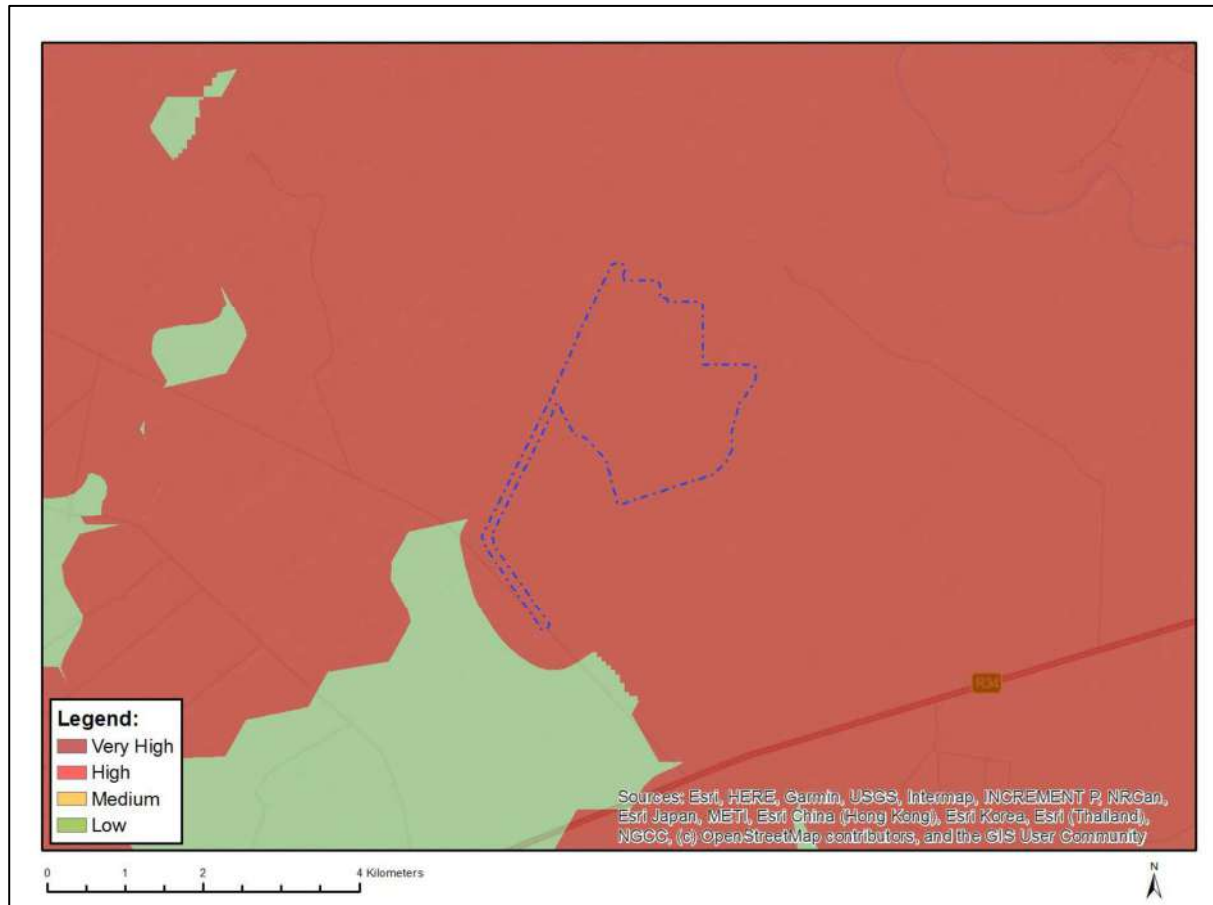
Figure 6-4 Map illustrating the habitat types delineated within the proposed PAOI



## 7 Site Ecological Importance (SEI)

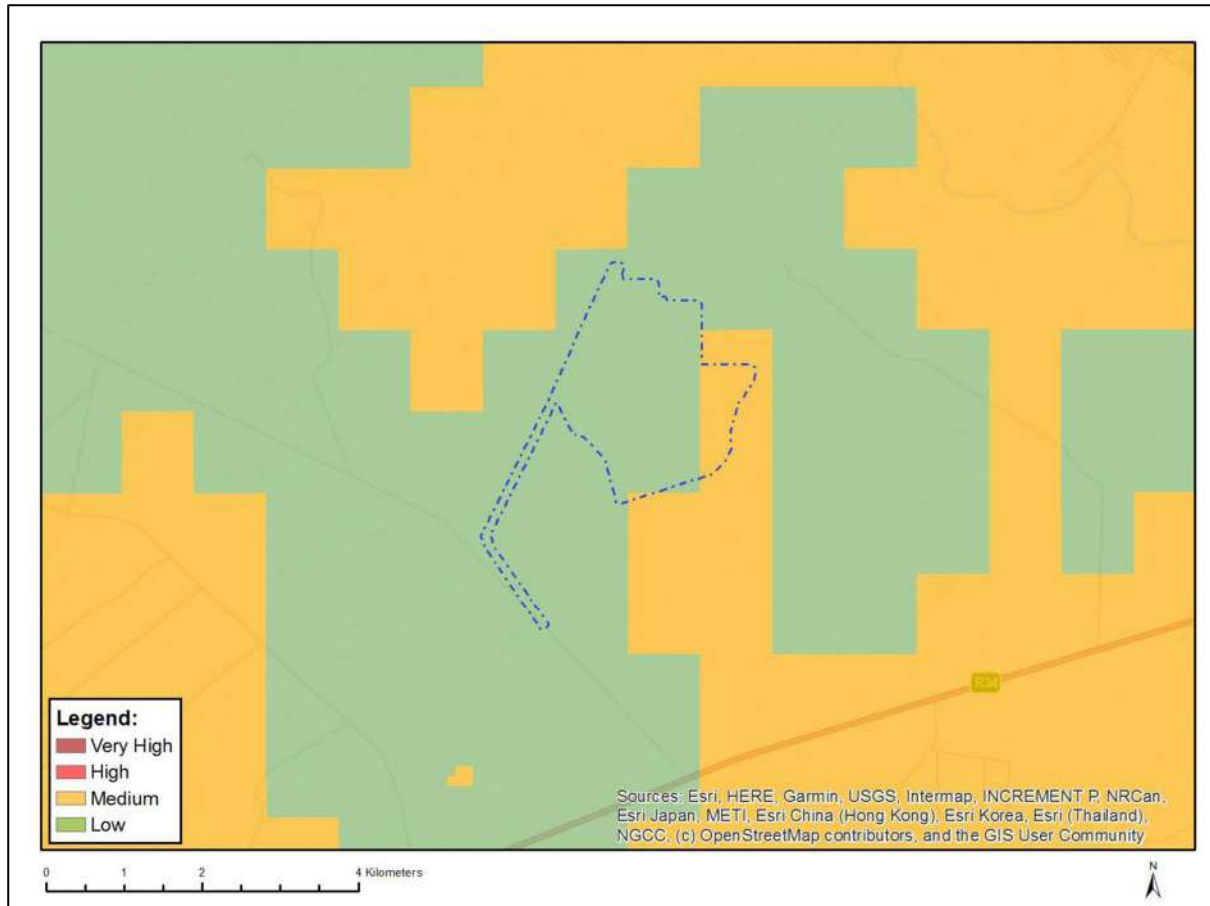
### 7.1 Environmental Screening Tool

The terrestrial biodiversity theme sensitivity as indicated by the screening tool report for the PAOI was derived to be 'Very High' (Figure 7-1). The classification is due to the CBA1, CBA2, ESA1, ESA2, NPAES, EN ecosystem and protected area status of the PAOI.



**Figure 7-1** *Terrestrial Biodiversity Theme Sensitivity, National Web based Environmental Screening Tool*

The Animal Species Theme sensitivity, as indicated in the screening report, was derived to be 'Medium' (Figure 7-2). The medium sensitivity was due to the likely presence of a mammal species.



**Figure 7-2 Fauna Theme Sensitivity, National Web based Environmental Screening Tool**

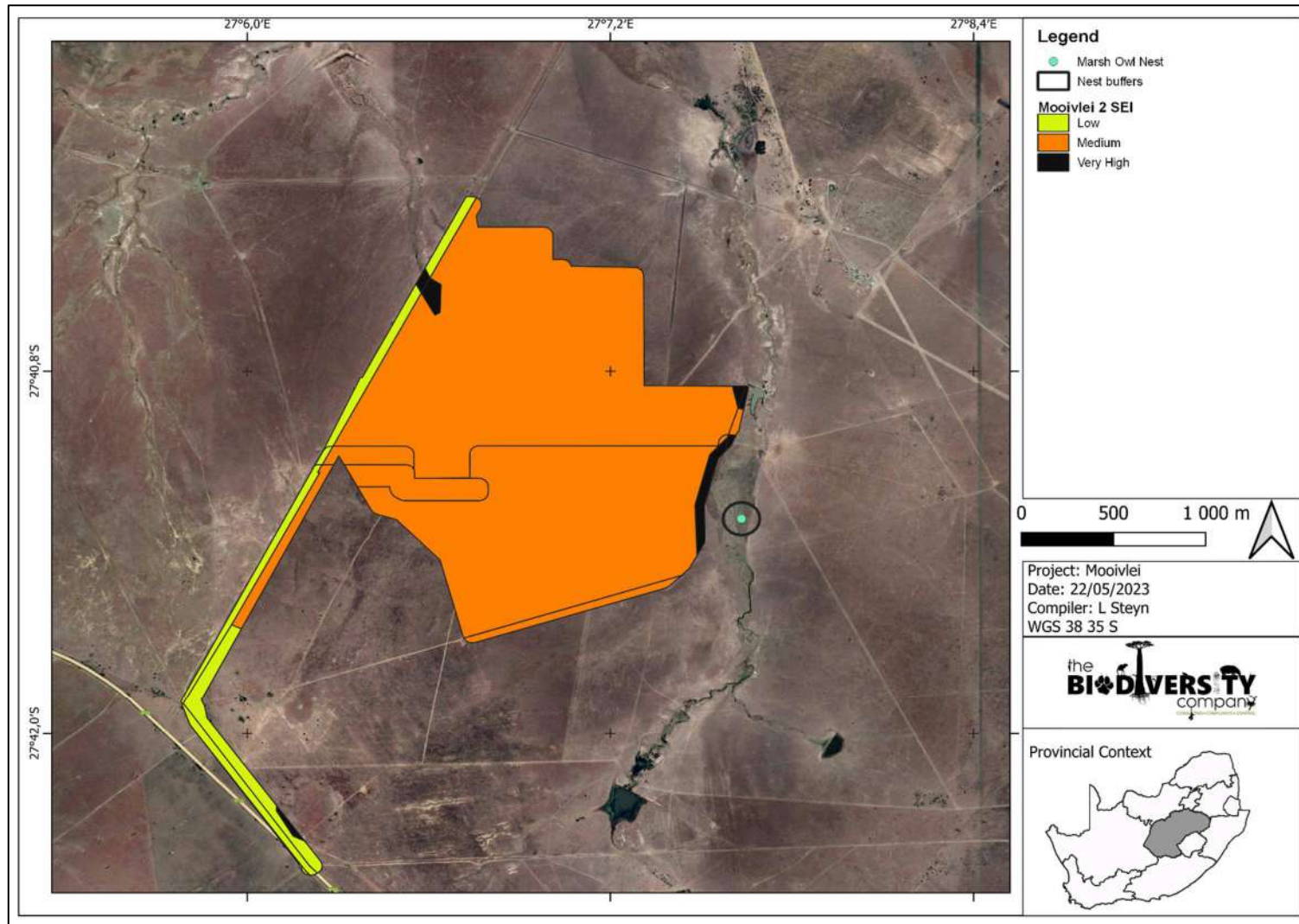
**7.2 Site Ecological Importance (SEI)**

Based on the criteria provided in Section 3.1.5 of this report, all habitats within the assessment area of the proposed project were allocated a sensitivity or SEI category (Table 7-1). The SEI of the PAOI within an avifauna context was based on both, the field results and desktop information. The SEI of the habitat types delineated are illustrated in Figure 7-3. The water resources are where the Black-winged Pratincoles were observed, while in the grasslands the Secretarybird and Blue Korhaan were found. All the habitats also have potential to support additional SCCs. The habitats that overlap with CBA classified areas have been disturbed by overgrazing to various degrees and therefore does not represent intact CBA1 and CBA 2 conditions.

**Table 7-1 SEI Summary of habitat types delineated within field assessment area of PAOI**

Habitat	Conservation Importance	Functional Integrity	Biodiversity Importance	Receptor Resilience	Site Ecological Importance
Grassland	High Confirmed or highly likely occurrence of CR, EN, VU species. Presence of Rare species	Medium Only narrow corridors of good habitat connectivity or larger areas of poor habitat connectivity	Medium	Medium Will recover slowly (~ more than 10 years) to restore > 75% of the original species composition and functionality of the receptor functionality	Medium
Disturbed Grassland	Low	Medium	Low	Medium	Low

Habitat	Conservation Importance	Functional Integrity	Biodiversity Importance	Receptor Resilience	Site Ecological Importance
	No confirmed or highly likely populations of SCC.	Only narrow corridors of good habitat connectivity or larger areas of poor habitat connectivity		Will recover slowly (~ more than 10 years) to restore > 75% of the original species composition and functionality of the receptor functionality	
Water resources	High Confirmed or highly likely occurrence of CR, EN, VU species. Presence of Rare species	High Good habitat connectivity with potentially functional ecological corridors and a regularly used road network between intact habitat patches. Only minor current negative ecological impacts with no signs of major past disturbance and good rehabilitation potential.	High	Low Habitat that is unlikely to be able to recover fully after a relatively long period: > 15 years required to restore ~ less than 50% of the original species composition and functionality	Very High



**Figure 7-3** Map illustrating the Site Ecological Importance of the proposed PAOI within an avifauna context

Interpretation of the SEI in the context of the proposed project is provided in Table 7-2.

**Table 7-2 Guidelines for interpreting Site Ecological Importance in the context of the proposed development activities**

Site Ecological Importance	Interpretation in relation to proposed development activities
Very High	Avoidance mitigation – no destructive development activities should be considered. Offset mitigation not acceptable/not possible (i.e., last remaining populations of species, last remaining good condition patches of ecosystems/unique species assemblages). Destructive impacts for species/ecosystems where persistence target remains.
Medium	Minimisation and restoration mitigation – development activities of medium impact acceptable followed by appropriate restoration activities.
Low	Minimisation and restoration mitigation – development activities of medium to high impact acceptable followed by appropriate restoration activities.

### 7.2.1 Site Sensitivity Verification

The allocated sensitivities for each of the relevant themes are either disputed or validated for the overall Project Area in Table 7-3 below. A summative explanation for each result is provided as relevant. The specialist-assigned sensitivity ratings are based largely on the SEI process followed in the previous section, and consideration is given to any observed or likely presence of SCC or protected species.

**Table 7-3 Summary of the screening tool vs. specialist assigned sensitivities**

Screening Tool Theme	Screening Tool	Specialist	Tool Validated or Disputed by Specialist - Reasoning
Animal Theme	Medium	Medium	Validated- Three SCC species were recorded, as no nests were found it can be assumed the species utilize the habitat for foraging

## 8 Impact Assessment

Potential impacts were evaluated against the data captured during the fieldwork and from a desktop perspective to identify relevance to the PAOI. The assessment of the significance of direct, indirect and cumulative impacts was undertaken. The methods used is available on request.

Bennun *et al* (2021) describes three broad types of impacts associated with solar energy development:

- Direct impacts – Impacts that result from project activities or operational decisions that can be predicted based on planned activities and knowledge of local biodiversity, such as habitat loss under the project footprint, habitat fragmentation as a result of project infrastructure and species disturbance or mortality as a result of project operations;
- Indirect impacts – Impacts induced by, or ‘by-products’ of, project activities within a project’s area of influence; and
- Cumulative impacts – Impacts that result from the successive, incremental and/or combined effects of existing, planned and/or reasonably anticipated future human activities in combination with project development impacts.

The assessment of impact significance considers pre-mitigation as well as implemented post-mitigation scenarios. Three phases were considered for the impact assessment:

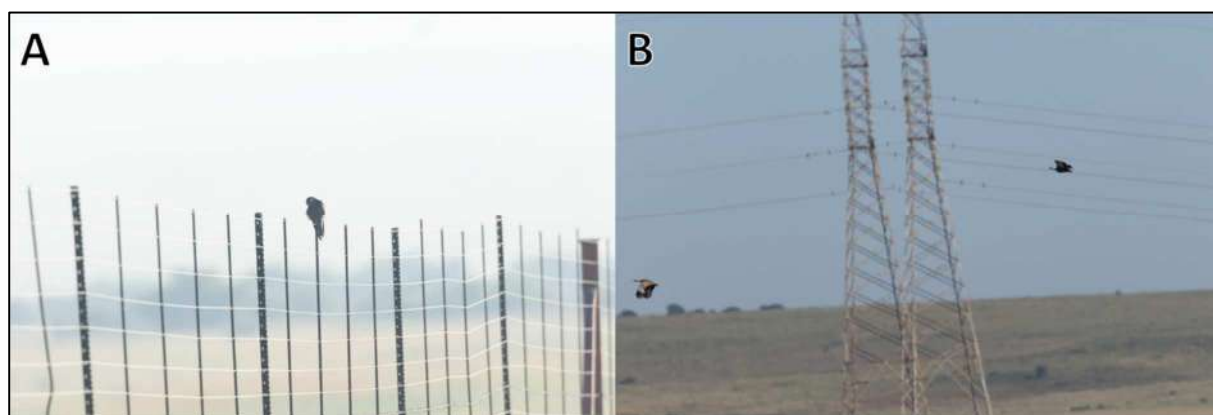
- Construction Phase;
- Operational Phase; and
- Closure/Rehabilitation Phase.



## 8.1 Present Impacts to Avifauna

In consideration that there are anthropogenic activities and influences present within the landscape, there are currently several negative impacts to biodiversity, including avifauna. These include:

- Historic land modification largely in the form of road and powerline infrastructure, and the associated land clearing and edge effects;
- Livestock grazing;
- Minor and major gravel roads (and associated vehicle traffic and the possibility of wildlife road mortalities);
- Invasive Alien Plant infestations; and
- Fences and the associated infrastructure.



**Figure 8-1** Photograph illustrating current negative impacts associated with the PAOI: A) Fences and B) Powerlines.

## 8.2 Anticipated Impacts

This section describes the potential impacts on avifauna associated with the construction and operational phases of the proposed development and is only relevant to the PV site and associated infrastructure.

During the construction phase vegetation clearing for the associated infrastructure will lead to direct habitat loss. Vegetation clearing will create a disturbance and will therefore potentially lead to the displacement of avifaunal species. The operation of construction machinery on site will generate noise pollution. Increased human presence can lead to poaching and the increase in vehicle traffic and heavy machinery will potentially lead to roadkill.

The principal impacts of the operational phase are electrocution, collisions, fencing, chemical pollution due to chemical cleaning of the PV panels and habitat loss. Solar panels have been implicated as a potential risk for bird collisions. Collisions are thought to arise when birds (particularly waterbirds) mistake the panels for waterbodies, known as the “lake effect” (Lovich & Ennen, 2011), or when migrating or dispersing birds become disorientated by the polarised light reflected by the panels. This “lake-effect” hypothesis has not been substantiated or refuted to date (Visser *et al*, 2019). It can however be said that the combination of power lines, fencing and large infrastructure will influence avifauna species. Visser *et al* (2019) performed a study at a utility-scale PV SEF in the Northern Cape and found that most of the species affected by the facility were passerine species. This is due to collisions with solar panels from underneath. During a predator attack while foraging under the panels,

individuals may alight and then collide with the panel. Larger species were said to be more influenced by the facilities when they were found foraging close by and were disturbed by predators which resulted in collisions with infrastructure.

Large passerines are particularly susceptible to electrocution because owing to their relatively large bodies, they are able to touch conductors and ground/earth wires or earthed devices simultaneously. The chances of electrocution are increased when feathers are wet, during periods of high humidity or during defecation. Prevailing wind direction also influences the rate of electrocution casualties.

Fencing of the PV site can influence birds in six ways (BirdLife South Africa, 2015):

- Snagging – occurs when a body part is impaled on one or more barbs or razor points of a fence;
- Snaring – when a bird's foot/leg becomes trapped between two overlapping wires;
- Impact injuries – birds flying into a fence, the impact may kill or injure the bird;
- Snarling – when birds try and push through a mesh or wire stands, ultimately becoming trapped (uncommon);
- Electrocution – electrified fence can kill or severely injure birds; and
- Barrier effect – fences may limit flightless birds including moulting waterfowl from resources.

Chemical pollution from PV cleaning, if not environmentally friendly will result in either acute or chronic affects. Should this chemical penetrate into the surrounding environment, it would impact populations on a larger scale and not just species found in and around the PV footprint.

### **8.3 Alternatives Considered**

The design was changed to take into account the sensitive areas as identified by the various studies, this is now considered below as Alternative 2 (Figure 1-2 and Figure 1-3).

### **8.4 Loss of Irreplaceable Resources**

The proposed development could lead to the loss of the following irreplaceable resources:

- Ecological Support Area;
- Critical Biodiversity Area; and
- Habitat and possible nesting sites for avifauna SCC.

### **8.5 Assessment of Impact Significance**

The assessment of impact significance considers pre-mitigation as well as implemented of post-mitigation scenarios. Although different species and groups will react differently to the development, the risk assessment was undertaken bearing in mind the potential impacts to the priority species listed in this report. Except for the habitat destruction, all in the impacts for the original and alternative design will be the same. These impacts were addressed simultaneously.

**8.5.1 Construction Phase**

**8.5.1.1 Habitat destruction within the project footprint**

Habitat destruction of the proposed development is inevitable. Pre-mitigation the significance of the impact is a Negative High Impact but with the implementation of mitigation measures can be reduced to a Negative Moderately High Impact. With the alternative design, the pre-mitigation impact will be high, but the post mitigation as the sensitive areas is successfully avoided will be lowered to Moderate.

Prior to mitigation (Original Design)					
Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance
5	3	4	4	5	
Permanent	Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features affected < 1000m	Great / harmful/ ecosystem structure and function largely altered	Ecology highly sensitive /important	Definite	<b>High</b>
Post mitigation					
Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance
4	2	4	4	4	
Life of operation or less than 20 years: Long Term	Development specific/ within the site boundary / < 100 ha impacted / Linear features affected < 100m	Great / harmful/ ecosystem structure and function largely altered	Ecology highly sensitive /important	Highly likely	<b>Moderately High</b>

Prior to mitigation (Alternative Design)					
Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance
5	3	4	4	5	
Permanent	Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features affected < 1000m	Great / harmful/ ecosystem structure and function largely altered	Ecology highly sensitive /important	Definite	<b>High</b>
Post mitigation					
Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance
4	2	4	3	4	
Life of operation or less than 20 years: Long Term	Development specific/ within the site boundary / < 100 ha impacted / Linear features affected < 100m	Great / harmful/ ecosystem structure and function largely altered	Significant / ecosystem structure and function moderately altered	Highly likely	<b>Moderate</b>

Mitigation Actions:

- Solar panels must be mounted on pile driven or screw foundations, such as post support spikes, rather than heavy foundations, such as trench-fill or mass concrete foundations, to reduce the negative effects on natural soil functioning, such as its filtering and buffering characteristics, while maintaining habitats for both fossorial and epigeic biodiversity (Bennun et al, 2021). If concrete foundations are used that would increase the impact of the project as there would be direct impacts to soil permeability and characteristics, thereby influencing inhabitant fauna. In addition, stormwater runoff and runoff from cleaning the panels would be increased, increasing erosion in the surrounding areas;

- Indigenous vegetation to be maintained under the solar panels to ensure biodiversity is maintained and to prevent soil erosion (Beatty et al, 2017; Sinha et al, 2018). The photographs below are sourced from these documents;



- Vegetation clearing to commence only after the necessary permits have been obtained; and
- Environmental Officer (EO) to provide supervision and oversight of vegetation clearing activities.

**8.5.1.2 Destruction, degradation and fragmentation of surrounding habitats**

Construction activities can lead to destruction of surrounding habitats. Pre-mitigation this impact has a Negative Moderately High significance, but with the implementation of mitigation measures the significance can be reduced to a Negative Low impact.

Prior to mitigation					
Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance
4	3	3	4	4	
Life of operation or less than 20 years: Long Term	Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features affected < 1000m	Significant / ecosystem structure and function moderately altered	Ecology highly sensitive /important	Highly likely	<b>Moderately High</b>
Post mitigation					
Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance



3	2	2	2	3	
One year to five years: Medium Term	Development specific/ within the site boundary / < 100 ha impacted / Linear features affected < 100m	Small / ecosystem structure and function largely unchanged	Ecology with limited sensitivity/importance	Likely	Low

Mitigation Actions:

- Pre-construction environmental induction for all construction staff on site to ensure that basic environmental principles are adhered to. This includes awareness of no littering, appropriate handling of pollution and chemical spills, avoiding fire hazards, remaining within demarcated construction areas etc.;
- All solid waste must be managed in accordance with a Solid Waste Management Plan. Recycling is encouraged;
- All construction activities and roads to be within the clearly defined and demarcated areas;
- Temporary laydown areas should be clearly demarcated and rehabilitated with indigenous vegetation subsequent to end of use;
- Appropriate dust control measures to be implemented;
- Suitable sanitary facilities to be provided for construction staff as per the guidelines in Health and Safety Act;
- Cement mixed on site must be mixed in a bunded area or on a removable surface such as thick plastic sheeting at least 50 m away from any wetlands or water resources.; and
- All hazardous materials, if any, should be stored in the appropriate manner to prevent contamination of the site. Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner.

**8.5.1.3 Displacement/emigration of avifauna community (including SCC) due to noise pollution**

Noise pollution generated from construction activities will lead to the displacement/emigration of the local avifauna community including the proximal surrounding area. This will include SCC that occur or are likely to occur within the area. Pre-mitigation this impact has a Negative Moderately High significance, but with the implementation of mitigation measures the significance can be reduced to a Negative Low impact.

Prior to mitigation					
Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance
4	3	3	4	4	
Life of operation or less than 20 years: Long Term	Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features affected < 1000m	Significant / ecosystem structure and function moderately altered	Ecology highly sensitive /important	Highly likely	<b>Moderately High</b>
Post mitigation					
Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance
3	2	2	2	3	
One year to five years: Medium Term	Development specific/ within the site boundary / < 100 ha impacted / Linear features affected < 100m	Small / ecosystem structure and function largely unchanged	Ecology with limited sensitivity/importance	Likely	<b>Low</b>

Mitigation Actions:

- No construction activity is to occur at night, as nocturnal species are highly dependent on sound and/or vocalisations for behavioural processes;
- All vehicles speed must be restricted to 20 km/h, to reduce the noise emitted by them; and
- If generators are to be used these must be soundproofed.

**8.5.1.4 Direct mortality from persecution or poaching of avifauna species and collection of eggs**

There is the possibility of construction staff poaching avifauna species and collecting eggs from the project footprint and proximal surrounding area. There is also the possibility of persecution of species that are deemed as negative in folklore. This impact was determined to have a Negative Moderately High Impact significance but can be reduced to a Negative Low Impact significance with the implementation of mitigation actions.

Prior to mitigation					
Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance
4	3	3	4	4	
Life of operation or less than 20 years: Long Term	Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features affected < 1000m	Significant / ecosystem structure and function moderately altered	Ecology highly sensitive /important	Highly likely	<b>Moderately High</b>
Post mitigation J1:Q18					
Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance
2	2	2	4	3	
One month to one year: Short Term	Development specific/ within the site boundary / < 100 ha impacted / Linear features affected < 100m	Small / ecosystem structure and function largely unchanged	Ecology highly sensitive /important	Likely	<b>Low</b>

Mitigation Actions:

- All personnel should undergo environmental awareness training that includes educating on not poaching/persecuting species and collecting eggs;
- Prior to commencing work each day, two individuals should traverse the working area in order to disturb any avifauna and so they have a chance to vacate the area; and
- Any avifauna threatened by the construction activities that does not vacate the area should be removed safely by an appropriately qualified environmental officer or removal specialist.

**8.5.1.5 Direct mortality from increased vehicle and heavy machinery traffic**

The increased vehicle and heavy machinery traffic associated with construction activities will lead to roadkill. This impact was determined to have a Negative Moderately High Impact significance but can be reduced to a Negative Low Impact significance with the implementation of mitigation actions.

Prior to mitigation					
Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance
4	3	4	4	4	
Life of operation or less than 20 years: Long Term	Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features affected < 1000m	Great / harmful/ ecosystem structure and function largely altered	Ecology highly sensitive /important	Highly likely	<b>Moderately High</b>
Post mitigation J1:Q18					
Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance
2	2	2	2	1	
One month to one year: Short Term	Development specific/ within the site boundary / < 100 ha impacted / Linear features affected < 100m	Small / ecosystem structure and function largely unchanged	Ecology with limited sensitivity/importance	Highly unlikely	<b>Absent</b>

--	--	--	--	--

Mitigation Actions:

- All personnel should undergo environmental induction with regards to awareness about speed limits and roadkill; and
- All construction vehicles should adhere to a speed limit of maximum 20 km/h to avoid collisions. Appropriate speed control measures and signs must be erected.

**8.5.2 Operational Phase**

**8.5.2.1 Collisions with infrastructure associated with the PV Facility and powerlines**

The proposed project comprises of components that pose a collision risk to avifauna species. This includes collisions with PV panels, connection infrastructure, powerlines and fences. This impact was determined to have a Negative High significance but can be reduced to a Negative Moderate significance with the implementation of appropriate mitigation measures.

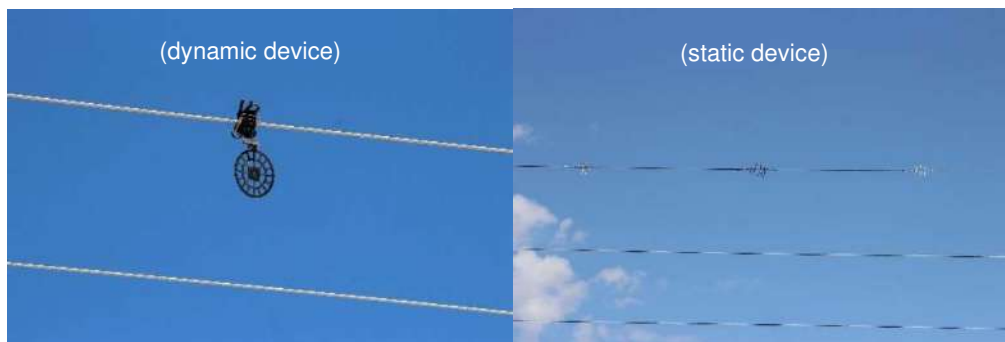
Prior to mitigation					
Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance
5	4	4	4	4	
Permanent	Regional within 5 km of the site boundary / < 2000ha impacted / Linear features affected < 3000m	Great / harmful/ ecosystem structure and function largely altered	Ecology highly sensitive /important	Highly likely	<b>High</b>
Post mitigation					
Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance
4	3	3	4	4	
Life of operation or less than 20 years: Long Term			Ecology highly sensitive /important	Highly likely	<b>Moderately High</b>



	<p>Local area/ within 1 km of the site boundary / &lt; 5000ha impacted / Linear features affected &lt; 1000m</p>	<p>Significant / ecosystem structure and function moderately altered</p>		
--	------------------------------------------------------------------------------------------------------------------	--------------------------------------------------------------------------	--	--

Mitigation Actions:

- The design of the proposed solar plant must be of a type or similar structure as endorsed by the Eskom-Endangered Wildlife Trust (EWT) Strategic Partnership on Birds and Energy, considering the mitigation guidelines recommended by Birdlife South Africa;
- Post-construction monitoring should be undertaken in accordance with the BirdLife South Africa best practice guidelines for solar energy facilities (BirdLife South Africa, 2017). If monitoring results indicate that excessive bird fatalities are occurring, then adaptive mitigations should be implemented. These should be discussed with avifaunal specialist and ECO prior to implementation and could include the retrofitting/incorporation of additional visual cues/diverters to existing PV panels/infrastructure;
- The air space used by the gridlines must be minimised by burying them;
- Overhead cables/lines across water resource areas must be fitted with industry standard bird flight diverters in order to make the lines as visible as possible to collision-susceptible species. Shaw et al (2021) demonstrated that large avifauna species mortality was reduced by 51% (95% CI: 23–68%). Recommended bird diverters such as flapping devices (dynamic device) and thickened wire spirals (static device) that increase the visibility of the lines should be fitted 5 m apart. The Inotec BFD88 bird diverter is highly recommended due to its visibility under low light conditions when most species move from roosting to feeding sites;





- Fencing mitigations:
  - Top 2 strands must be smooth wire;
  - Routinely retention loose wires;
  - Minimum distance between wires is 300 mm; and
  - Place markers on fences.

**8.5.2.2 Electrocutation due to infrastructure associated with the PV Facility**

This impact was determined to have a Negative Moderately High significance but can be reduced to a Negative Moderate significance with the implementation of appropriate mitigation measures.

Prior to mitigation					
Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance
4	3	3	4	4	
Life of operation or less than 20 years: Long Term	Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features affected < 1000m	Significant / ecosystem structure and function moderately altered	Ecology highly sensitive /important	Highly likely	<b>Moderately High</b>

Post mitigation					
Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance
4	3	3	4	2	
Life of operation or less than 20 years: Long Term	Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features affected < 1000m	Significant / ecosystem structure and function moderately altered	Ecology highly sensitive /important	Possible	<b>Moderate</b>

Mitigation Actions:

- The design of the proposed solar plant and grid lines must be of a type or similar structure as endorsed by the Eskom-EWT Strategic Partnership on Birds and Energy, considering the mitigation guidelines recommended by Birdlife South Africa;
- Insulation where energised parts and/or grounded parts are covered with materials appropriate for providing incidental contact protection to birds. It is best to use suspended insulators and vertical disconnectors, if upright insulators or horizontal disconnectors are present, these should be covered; and
- Perch discouragers can be used such as perch guards or spikes. Considerable success achieved by providing artificial bird safe perches, which are placed at a safe distance from the energised parts (Prinsen *et al*, 2012).

**8.5.2.3 Direct mortality from roadkills, persecution or poaching of avifauna species and collection of eggs**

There is the possibility of operational staff poaching avifauna species and collecting eggs from the project footprint and proximal surrounding area. There is also the possibility of persecution of species that are deemed as negative in folklore. This impact was determined to have a Negative Moderate Impact significance but can be reduced to a Negative Low Impact significance with the implementation of mitigation actions.

Prior to mitigation					
Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance

4	3	3	4	3	
Life of operation or less than 20 years: Long Term	Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features affected < 1000m	Significant / ecosystem structure and function moderately altered	Ecology highly sensitive /important	Likely	<b>Moderate</b>
<b>Post mitigation</b>					
Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance
3	2	2	2	2	
One year to five years: Medium Term	Development specific/ within the site boundary / < 100 ha impacted / Linear features affected < 100m	Small / ecosystem structure and function largely unchanged	Ecology with limited sensitivity/importance	Possible	<b>Low</b>

Mitigation Actions:

- All personnel should undergo environmental awareness training that includes educating on not poaching/persecuting avifauna species and collecting eggs.
- Signs must be put up to enforce this, should someone be caught a R1000 fine must be enforced;
- All personnel should undergo environmental induction with regards to awareness about speed limits and roadkill; and
- All vehicles should adhere to a speed limit of maximum 20 km/h to avoid collisions. Appropriate speed control measures and signs must be erected.

**8.5.2.4 Pollution of water sources and surrounding habitat due to cleaning products of the PV panels**

It is likely that the panels will be cleaned with chemicals in addition to water to ensure they function optimally. This impact was determined to have a Negative Moderate Impact significance but can be reduced to a Negative Low Impact significance with the implementation of mitigation actions.

Prior to mitigation					
Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance
4	3	3	4	3	
Life of operation or less than 20 years: Long Term	Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features affected < 1000m	Significant / ecosystem structure and function moderately altered	Ecology highly sensitive /important	Likely	<b>Moderate</b>
Post mitigation					
Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance
2	2	2	2	3	
One month to one year: Short Term	Development specific/ within the site boundary / < 100 ha impacted / Linear features affected < 100m	Small / ecosystem structure and function largely unchanged	Ecology with limited sensitivity/importance	Likely	<b>Low</b>

Mitigation Actions:

- Only environmentally friendly chemicals are to be used for cleaning of the panels.



**8.5.2.5 Heat radiation from the BESS and PV panels**

Heat radiation from the infrastructure can result in an overall increase of temperature in the surrounding area, it can also lead to veld fires. This impact was determined to have a Negative Moderate Impact significance but can be reduced to a Negative Low Impact significance with the implementation of mitigation actions.

Prior to mitigation					
Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance
4	3	3	4	3	
Life of operation or less than 20 years: Long Term	Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features affected < 1000m	Significant / ecosystem structure and function moderately altered	Ecology highly sensitive /important	Likely	<b>Moderate</b>
Post mitigation					
Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance
2	2	2	2	3	
One month to one year: Short Term	Development specific/ within the site boundary / < 100 ha impacted / Linear features affected < 100m	Small / ecosystem structure and function largely unchanged	Ecology with limited sensitivity/importance	Likely	<b>Low</b>

Mitigation Actions:

- The BESS must be enclosed in a structure with a non-reflective surface;
- A fire management plan needs to be put in place; and
- Grass must be kept under the panels to ensure that additional reflection is not taking place from the surface below the panels.

**8.5.2.6 Encroachment of Invasive Alien Plants into disturbed areas**

Invasive Alien Plants (IAPs) tend to encroach into disturbed areas and outcompete/displace indigenous vegetation. This will lead to a shift in the vegetation composition and structure, and consequently will cause a negative shift in the wellbeing of the avifauna community. This impact was determined to have a Negative Moderate significance but can be reduced to a Negative Low Impact significance with the implementation of mitigation actions.

Prior to mitigation					
Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance
4	3	3	4	3	
Life of operation or less than 20 years: Long Term	Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features affected < 1000m	Significant / ecosystem structure and function moderately altered	Ecology highly sensitive /important	Likely	<b>Moderate</b>
Post mitigation					
Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance
2	2	2	2	3	
One month to one year: Short Term	Development specific/ within the site boundary / < 100 ha	Small / ecosystem structure and function largely unchanged	Ecology with limited sensitivity/importance	Likely	<b>Low</b>

	impacted / Linear features affected < 100m				
--	--------------------------------------------	--	--	--	--

Mitigation Actions:

- An IAP Management Plan must be written and implemented for the development. The developer must contract a specialist to develop the plan and the developer is responsible for its implementation;
- Regular monitoring for IAP encroachment during the operation phase must be undertaken to ensure that no alien invasion problems have developed as result of the disturbance. This should be every 3 months during the first two years of the operation phase and every six months for the life of the project; and
- All IAP species must be removed/controlled using the appropriate techniques as indicated in the IAP management plan.

**8.5.3 Decommissioning Phase**

**8.5.3.1 Direct mortality due to earthworks, vehicle collisions and persecution**

Decommissioning activity will likely lead to direct mortality of avifauna due to earthworks, vehicle collisions and persecution. This impact was determined to have a Negative Moderate significance but can be reduced to a Negative Low Impact significance with the implementation of mitigation actions.

Prior to mitigation					
Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance
4	3	3	4	3	
Life of operation or less than 20 years: Long Term	Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features affected < 1000m	Significant / ecosystem structure and function moderately altered	Ecology highly sensitive /important	Likely	<b>Moderate</b>
Post mitigation					
Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance

2	2	3	4	3	
One month to one year: Short Term	Development specific/ within the site boundary / < 100 ha impacted / Linear features affected < 100m	Significant / ecosystem structure and function moderately altered	Ecology highly sensitive /important	Likely	Low

Mitigation Actions:

- All personnel should undergo environmental awareness training including educating about not harming or collecting species;
- Prior to commencing work each day, two individuals should traverse the working area in order to disturb any fauna and so they have a chance to vacate;
- Any fauna threatened by the construction activities should be removed safely by an appropriately qualified environmental officer or removal specialist;
- All construction vehicles should adhere to a speed limit of maximum 20 km/h to avoid collisions. Appropriate speed control measures and signs must be erected;
- All hazardous materials, if any, should be stored in the appropriate manner to prevent contamination of the site. Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner;
- Any excavations should not be left open for extended periods of time as avifauna may fall in and become trapped in them. Excavations should only be dug when they are required and should be used and filled shortly thereafter;
- All infrastructure must be removed if the facility is decommissioned, this includes the powerlines; and
- The PAOI must be rehabilitated, and a management plan must be in place to ensure that it is done successfully.

**8.5.3.2 Continued habitat degradation due to Invasive Alien Plant encroachment and erosion**

Disturbance created during decommissioning will leave the development area vulnerable to erosion and alien plant invasion for several years. Pre-mitigation this impact has a Negative Moderately-High significance, but with the implementation of mitigation measures the significance can be reduced to a Negative Low impact.

Prior to mitigation

Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance
4	3	3	4	4	
Life of operation or less than 20 years: Long Term	Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features affected < 1000m	Significant / ecosystem structure and function moderately altered	Ecology highly sensitive /important	Highly likely	<b>Moderately High</b>
Post mitigation					
Duration of Impact	Spatial Scope	Severity of Impact	Sensitivity of Receiving Environment	Probability of Impact	Significance
2	2	2	4	3	
One month to one year: Short Term	Development specific/ within the site boundary / < 100 ha impacted / Linear features affected < 100m	Small / ecosystem structure and function largely unchanged	Ecology highly sensitive /important	Likely	<b>Low</b>

Mitigation Actions:

- Rehabilitation in accordance with the Rehabilitation Plan for the development must be undertaken in areas disturbed during the decommissioning phase;
- Monitoring of the rehabilitated area must be undertaken at quarterly intervals for 3 years after the decommissioning phase;
- All erosion problems observed should be rectified as soon as possible, using the appropriate erosion control structures and revegetation techniques; and
- There should be follow-up rehabilitation and revegetation of any remaining bare areas with indigenous flora.



## 8.6 Unplanned Events

The planned activities will have anticipated impacts as discussed above; however, unplanned events may occur on any project, and these could lead to potential impacts which will require appropriate management.

Table 8-1 is a summary of the findings of an unplanned event assessment conducted from an avifaunal perspective. Note that not all potential unplanned events may be captured herein, and this process must therefore be managed throughout all phases and according to events that take place or have a high likelihood of taking place.

**Table 8-1 Summary of unplanned events, potential impacts and mitigations**

Unplanned Event	Potential Impact	Mitigation
Spills into the surrounding environment	Contamination of habitat as well as water resources associated with a spillage.	A spill response kit must be available at all times. The incident must be reported on, and if necessary, a biodiversity specialist must investigate the extent of the impact and provide rehabilitation recommendations.
Fire	Uncontrolled/unmanaged fire that spreads to the surrounding natural savannah.	An appropriate fire management plan needs to be compiled and implemented.
Erosion caused by water runoff from the surface	Erosion on the side of the roads and cleared areas.	A storm water management plan must be compiled and implemented.

## 8.7 Cumulative Impacts

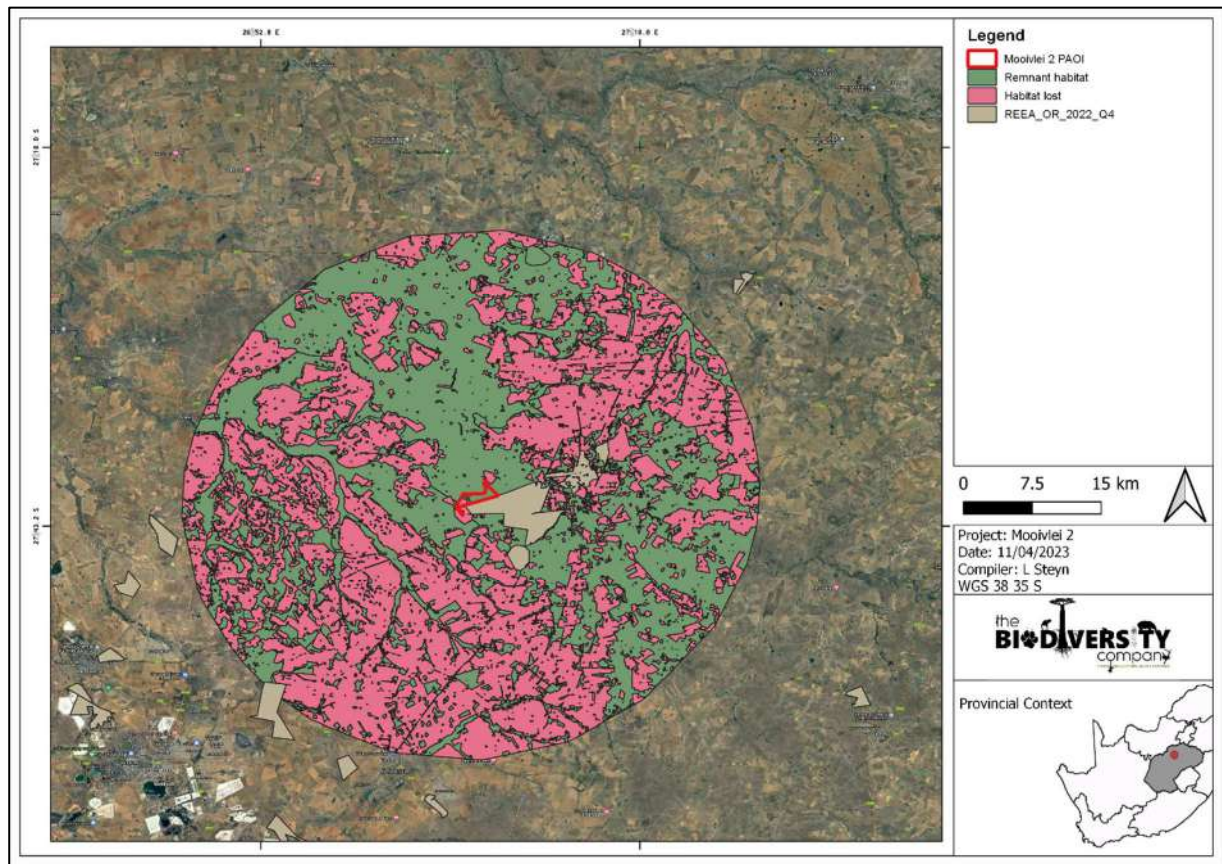
Cumulative impacts are assessed within the context of the extent of the proposed PAOI, other developments and activities in the area (existing and proposed) and general habitat loss and disturbance resulting from any other anthropogenic activities in the area. The impacts of projects are often assessed by comparing the post-project situation to a pre-existing baseline. Where projects can be considered in isolation this provides a good method of assessing a project's impact. However, in areas where baselines have already been affected, or where future development will continue to add to the impacts in an area or region, it is appropriate to consider the cumulative effects of development or disturbance activities. This is similar to the concept of shifting baselines, which describes how the environmental baseline at a specific point in time may actually represent a significant change from the original state of the system. This section describes the potential cumulative impacts of the project on the local and regional avifauna community.

Localised cumulative impacts include those from operations that are close enough to potentially cause additive effects on the local environment or any sensitive receivers (such as nearby large road networks, other solar PV facilities, and power infrastructure). Relevant activities and impacts include dust deposition, noise and vibration, loss of corridors or habitat, disruption of waterways, groundwater drawdown, groundwater and surface water depletion, and transport activities. Long-term cumulative impacts associated with the site development activities can lead to the loss of endemic and threatened species, including natural habitat and vegetation types, and these impacts can even lead to the degradation of conserved areas such as the adjacent game parks and reserves.

A total area of 30 km surrounding the PAOI were used to assess the total habitat loss in the area and subsequently the cumulative impact. To determine the intact remnant habitat the NBA (2018) remnant spatial data was utilised. The future renewable energy projects were also considered by utilising the REEA Q4 (2022) spatial dataset. In order to remove any duplication, only the areas that overlap with the remanence areas were considered. The total cumulative loss was found to be 45.5% (Table 8-2), a visual representation of this is shown in Figure 8-2.

**Table 8-2**      *The cumulative impacts considered for avifauna*

Total Area of 30 km <sup>2</sup>	Intact Remnant Habitat	REEA area that does not overlap with disturbed areas	Total Disturbed/Transformed habitat	Percentage area lost
317515.64 Ha	150388 Ha	5906.919 Ha	144481.1 Ha	45.5%



**Figure 8-2**      *Map illustrating the additional renewable energy developments within the landscape overlaid onto the remnant vegetation types*

The proposed Solar PV facility in isolation has a Negative Low impact significance (Table 8-3). In consideration of the aforementioned information, the cumulative impact was determined to be of a Negative Medium significance (Table 8-4).

**Table 8-3 Cumulative Impacts to avifauna associated with the proposed project – Project in Isolation**

Impact	Project in Isolation							Significance
	Extent	Probability	Duration	Reversibility	Irreplaceability	Cumulative Effect	Magnitude/ Intensity	
	1	4	2	2	3	2	2	
Loss of habitat	Site: The impact will only affect the site.	Definite: Impact will certainly occur (Greater than a 75% chance of occurrence).	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).	Partly reversible: The impact is partly reversible but more intense mitigation measures are required.	Significant loss of resources: The impact will result in significant loss of resources.	Low cumulative impact: The impact would result in insignificant cumulative effects.	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).	Negative Low Impact

**Table 8-4 Cumulative Impacts to avifauna associated with the proposed project – Cumulative Effect**

Impact	Cumulative Effect							Significance
	Extent	Probability	Duration	Reversibility	Irreplaceability	Cumulative Effect	Magnitude/ Intensity	
	3	4	3	3	3	4	2	
Loss of habitat, and disruption of surrounding ecological corridors.	Province/region: Will affect the entire province or region.	Definite: Impact will certainly occur (Greater than a 75% chance of occurrence).	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).	Barely reversible: The impact is unlikely to be reversed even with intense mitigation measures.	Significant loss of resources: The impact will result in significant loss of resources.	High cumulative impact: The impact would result in significant cumulative effects	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).	Negative Medium Impact

## 9 Avifauna Impact Management Actions

The purpose of the Biodiversity Impact Management Actions of is to present the mitigations in such a way that they can be incorporated into the Environmental Management Programme (EMPr), allowing for more successful implementation and auditing of the mitigations and monitoring guidelines.

Table 9-1 presents the recommended mitigation measures and the respective timeframes, targets, and performance indicators pertaining to the avifaunal component.

**Table 9-1 Summary of management outcomes pertaining to impacts to avifauna and their habitats**

Impact Management Actions	Implementation		Monitoring	
	Phase	Responsible Party	Aspect	Frequency
<b>Management outcome: Habitats</b>				
The areas to be developed must be specifically demarcated to prevent movement into surrounding environments.	Life of operation	Project Manager Environmental Officer	Development footprint	Ongoing
Areas of indigenous vegetation, even secondary communities outside of the direct project footprint, should under no circumstances be fragmented or disturbed further.	Life of operation	Project Manager Environmental Officer	Areas of indigenous vegetation	Ongoing
Solar panels must be mounted on pile driven or screw foundations, such as post support spikes, rather than heavy foundations, such as trench-fill or mass concrete foundations, to reduce the negative effects on natural soil functioning, such as its filtering and buffering characteristics, while maintaining habitats for both below and above-ground biodiversity.	Life of operation	Project Manager	Solar panels must be mounted on pile driven or screw foundations, such as post support spikes, rather than heavy foundations, such as trench-fill or mass concrete foundations, to reduce the negative effects on natural soil functioning, such as its filtering and buffering characteristics, while maintaining habitats for both below and above-ground biodiversity	Life of operation
Indigenous vegetation to be maintained under the solar panels to ensure biodiversity is maintained and to prevent soil erosion (Beatty et al, 2017; Sinha et al, 2018).	Life of operation	Project Manager	Indigenous vegetation to be maintained under the solar panels to ensure biodiversity is maintained and to prevent soil erosion (Beatty et al, 2017; Sinha et al, 2018).	Life of operation
Areas that are denuded during construction need to be re-vegetated with indigenous vegetation to prevent erosion. This will also reduce the likelihood of encroachment by alien invasive plant species. Topsoil must also be utilised, and any disturbed area must be re-vegetated with plant and grass species which are indigenous to this vegetation type.	Decommissioning /Rehabilitation	Project Manager	Areas that are denuded during construction need to be re-vegetated with indigenous vegetation to prevent erosion. This will also reduce the likelihood of encroachment by alien invasive plant species. Topsoil must also be utilised, and any disturbed	Decommissioning /Rehabilitation

Impact Management Actions	Implementation		Monitoring	
	Phase	Responsible Party	Aspect	Frequency
<p>A hydrocarbon spill management plan must be put in place to ensure that should there be any chemical spill out or over that it does not run into the surrounding areas. The Contractor shall be in possession of an emergency spill kit that must always be complete and available on site. Drip trays or any form of oil absorbent material must be placed underneath vehicles/machinery and equipment when not in use. No servicing of equipment on site unless necessary. All contaminated soil / yard stone shall be treated in situ or removed and be placed in containers. Appropriately contain any generator diesel storage tanks, machinery spills (e.g., accidental spills of hydrocarbons oils, diesel etc.) in such a way as to prevent them leaking and entering the environment.</p> <p>No cement/concrete may be mixed on site and must be brought in off site to ensure the water sources does not get polluted and that successful rehabilitation of the construction areas can take place.</p> <p>Leaking equipment and vehicles must be repaired immediately or be removed from PAOI to facilitate repair.</p> <p>A fire management plan needs to be compiled to restrict the impact of fire.</p>	Life of operation	Environmental Officer Contractor	Spill events, Vehicles dripping.	Ongoing
	Planning and Construction	Project Manager Environmental Officer Contractor Engineer	Water pollution and restricted rehabilitation	During phase
	Life of operation	Environmental Officer Contractor	Leaks and spills	Ongoing
	Life of operation	Environmental Officer Contractor	Fire Management	During Phase
<b>Management outcome: Avifauna</b>				

area must be re-vegetated with plant and grass species which are indigenous to this vegetation type.

Impact Management Actions	Implementation		Monitoring	
	Phase	Responsible Party	Aspect	Frequency
All personnel must undergo environmental induction with regards to avifauna and in particular awareness about not harming, collecting, or hunting terrestrial species, and owls, which are often persecuted out of superstition. Signs must be put up to enforce this.	Life of operation	Environmental Officer	Evidence of trapping etc	Ongoing
The duration of the construction should be kept to a minimum to avoid disturbing avifauna.	Construction/Operational Phase	Project Manager Environmental Officer	Construction/Closure Phase	Ongoing
Outside lighting must be designed and limited to minimize impacts on fauna. All outside lighting should be directed away from highly sensitive areas. Fluorescent and mercury vapor	Construction/Operational Phase	Project Manager Environmental Officer Design Engineer	Light pollution and period of light.	Ongoing



Impact Management Actions	Implementation		Monitoring	
	Phase	Responsible Party	Aspect	Frequency
lighting should be avoided, and sodium vapor (red/green) lights should be used wherever possible.				
All construction and maintenance motor vehicle operators should undergo an environmental induction that includes instruction on the need to comply with speed limit (20 km/h), to respect all forms of wildlife. Speed limits must be enforced to ensure that road killings and erosion is limited.	Life of Operation	Health and Safety Officer	Compliance to the training.	Ongoing
All project activities must be undertaken with appropriate noise mitigation measures to avoid disturbance to avifauna population in the region	Construction/Operational Phase	Project Manager Environmental Officer	Noise	Ongoing
Powerlines must be fitted with bird diverters in the high sensitivity areas	Planning and Construction	Project Manager Environmental Officer Contractor Engineer	Presence of electrocuted birds or bird strikes	During Phase
All areas to be developed must be walked through prior to any activity to ensure no nests or avifauna species are found in the area. Should any Species of Conservation Concern be found and not move out of the area, or their nest be found in the area a suitably qualified specialist must be consulted to advise on the correct actions to be taken.	Construction	Environmental Officer	Presence of avifauna species and nests	During Phase
The design of the proposed PV and grid lines must be of a type or similar structure as endorsed by the Eskom-EWT Strategic Partnership on Birds and Energy, considering the mitigation guidelines recommended by Birdlife South Africa (Jenkins <i>et al.</i> , 2015).	Planning and Construction	Project Manager Environmental Officer Contractor Engineer	Presence of electrocuted birds or bird strikes	During Phase
Infrastructure must be consolidated where possible in order to minimise the amount of ground and air space used.	Planning and Construction	Project Manager Environmental Officer Contractor Engineer	Presence of bird collisions	During phase
All the parts of the infrastructure must be nest proofed and anti-perch devices placed on areas that can lead to electrocution	Planning and Construction	Environmental Officer Contractor Engineer	Presence of electrocuted birds	During phase
Use environmentally friendly cleaning and dust suppressant products	Construction and Operation	Environmental Officer Contractor Engineer	Chemicals used	During phase
Fencing mitigations: <ul style="list-style-type: none"> <li>• Top 2 strands must be smooth wire;</li> <li>• Routinely retention loose wires;</li> <li>• Minimum 300 mm between wires; and</li> </ul>	Life of Operation	Project Manager Environmental Officer Contractor Design Engineer	Presence of birds stuck /dead in fences Monitor fences for slack wires	During phase

Impact Management Actions	Implementation		Monitoring	
	Phase	Responsible Party	Aspect	Frequency
<ul style="list-style-type: none"> <li>Place markers on fences.</li> </ul>				
As far as possible power cables within the PAOI should be thoroughly insulated and preferably buried.	Construction and Operation	Project Manager Environmental Officer Design Engineer	Exposed cables	During phase
Any exposed parts must be covered (insulated) to reduce electrocution risk	Planning and construction	Environmental Officer & Contractor, Engineer	Presence of electrocuted birds	During phase
The BESS must be enclosed in a structure with a non-reflective surface	Construction and Operation	Project Manager Environmental Officer Design Engineer	Reflective surfaces on BESS	During phase
Non-polarising white strips can be fitted along the edges of the panels to reduce reflection and therefore similarity to water and deter birds and insects (Horvath <i>et al</i> , 2010).	Operational	Project Manager Environmental Officer Design Engineer	<p>Presence of dead birds in the project site. Monitoring must be undertaken in accordance with the BirdLife South Africa best practice guidelines for solar energy facilities (BirdLife South Africa, 2017).</p> <p>The precise location of any dead birds found should be recorded and mapped (using GPS). All carcasses should be photographed as found then placed in a plastic bag, labelled as to the location and date, and preserved (refrigerated or frozen) until identified. Feather spots (e.g., a group of feathers attached to skin) and body parts should also be collected.</p>	During phase. The monitoring frequency is based on the collision rate.
All infrastructure, must be removed if the facility is decommissioned.	Closure/Rehabilitation	Project Manager Environmental Officer	Infrastructure removal	During Process

## 10 Conclusion and Impact Statement

### 10.1 Conclusion

The aim of this Avifauna Impact Assessment was to provide information to guide the risk of the proposed Solar PV facility to the avifauna community likely affected by its development.

During the assessment three SCCs were observed, the Blue Korhaan (*Eupodotis caerulescens*; LC (Regional), NT (Global)) ; Secretarybird (*Sagittarius serpentarius*; VU, EN) and Black-winged Pratincole (*Glareola nordmanni*; NT, NT). Seventeen and nineteen priority species respectively were recorded in the first and second survey. These species are at risk of either habitat loss, collisions or electrocutions. If the mitigations and recommendations are implemented these risks can be reduced to moderate. Nests of a Marsh Owl was found during the second survey. A 100 m buffer was placed around the nest. If the nest is in the development footprint then it must be regarded as a no go buffer for the duration of the breeding season (January- April), if the nests can be found just outside of the development areas then nest and its buffer must be treated as long term (for the lifetime of the development) no go areas. Three habitats were delineated in the assessment namely, Grassland, Disturbed grassland and Water Resources. All these habitats support a number of avifauna species with the grasslands being the most species rich. The Water Resources were given a very high SEI rating based on the SCCs that are dependent on this habitat for both water and habitation. The water resources found in this study was also in good condition and therefore their functional integrity were rated as high, contributing to the overall Very high rating. The habitats that overlap with CBA classified areas have been disturbed by overgrazing to various degrees and therefore does not represent intact CBA1 and CBA 2 conditions and can be considered for development. The overall impact of the project is regarded as acceptable should the mitigations and recommendations be implemented. The alternative design is the preferred layout.

### 10.2 Impact Statement

The main expected impacts of the proposed PV facility and associated infrastructure will include the following:

- Habitat loss and fragmentation;
- Electrocutions; and
- Collisions.

Mitigation measures as described in this report can be implemented to reduce the significance of the risk to an acceptable residual risk level. Considering the above-mentioned information it is the opinion of the specialist that the project may be favourably considered, on condition that all the mitigation, monitoring and recommendations provided in this report and other specialist reports are implemented.

## 11 References

- BirdLife International. 2021. The IUCN Red List of Threatened Species 2021
- Birdlife South Africa (2022). Important Bird and Biodiversity Areas. <https://www.birdlife.org.za/what-we-do/important-bird-and-biodiversity-areas/>
- BirdLife South Africa. 2015. Fences & birds, minimising unintended impacts. <https://www.birdlife.org.za/what-we-do/landscape-conservation/what-we-do/birds-and-fences/>
- BirdLife South Africa. 2017. Birds and Solar Energy Best Practice Guidelines. <https://www.birdlife.org.za/wp-content/uploads/2020/03/BLSA-Guidelines-Solar-and-Energy.pdf>
- Buckland, S., Anderson, D., Burnham, K.P. and Laake, J. 1993. Distance Sampling: Estimating Abundance of Biological Populations. 440 pgs., Chapman and Hall, London
- Coordinated Avifaunal Roadcounts (CAR) (2020). <http://car.birdmap.africa/index.php>
- Cumming, G.S. & Henry, D.A.W. 2019. Point counts outperform line transects when sampling birds along routes in South African protected areas. *African Zoology*, 54(4): 187-198. doi: 10.1080/15627020.2019.1658540.
- Del Hoyo, J., Collar, N.J., Christie, D.A., Elliott, A., Fishpool, L.D.C., Boesman, P. & Kirwan, G.M. (1996). *HBW and BirdLife International Illustrated Checklist of the Birds of the World. Volume 2: Passerines*. Lynx Editions and BirdLife International, Barcelona, Spain and Cambridge, UK.
- Department of Forestry, Fisheries and the Environment (DFFE). 2021a. SACAD (South Africa Conservation Areas Database) and SAPAD (South Africa Protected Areas Database). <http://egis.environment.gov.za>.
- Department of Forestry, Fisheries and the Environment (DFFE). 2021b. National Protected Areas Expansion Strategy. <http://egis.environment.gov.za>.
- Department of Forestry, Fisheries and the Environment (DFFE). 2021c. Renewable Energy EIA Application Database. <http://egis.environment.gov.za>.
- Taylor, M.R., Peacock, F. & Wanless, R.M. (Eds). 2015. The 2015 Eskom Red Data Book of birds of South Africa, Lesotho and Swaziland. BirdLife South Africa, Johannesburg.
- Hockey, P.A.R., Dean, W.R.J. & Ryan, P.G. (Eds). (2005). *Roberts – Birds of Southern Africa*, VIIth ed. The Trustees of the John Voelcker Bird Book Fund, Cape Town.
- Horvath, G., Blaho, M., Egri A., Kriska, G., Seres, I. & Robertson, B. 2010. Reducing the Maladaptive Attractiveness of Solar Panels to Polarotactic Insects *Conservation biology* 24 (6) 1644-1653
- IUCN. (2021). The IUCN Red List of Threatened Species. [www.iucnredlist.org](http://www.iucnredlist.org)
- Jenkins, A.R., van Rooyen, C.S., Smallie, J.J., Harrison, J.A., Diamond, M., Smit-Robinson, H.A. & Ralston, S. 2015. *Birds and Wind-Energy Best-Practice Guidelines*. Birds and Wind-Energy Best-Practice Guidelines.
- Lovich, J.E. & Ennen, J.R. 2011. Wildlife conservation and solar energy development in the desert southwest, United States. *BioScience* 61:982-992.
- Prinsen, H.A.M., Smallie, J.J., Boere, G.C. & Pires, N. (Compilers). 2012. *Guidelines on How to Avoid or Mitigate Impact of Electricity Power Grids on Migratory Birds in the African-Eurasian Region*. AEWA Conservation Guidelines No. 14, CMS Technical Series No. 29, AEWA Technical Series No. 50, CMS Raptors MOU Technical Series No. 3, Bonn, Germany.

Ralston Paton, S., Smallie J., Pearson A., & Ramalho, R. 2017. Wind energy's impacts on birds in South Africa: A preliminary review of the results of operational monitoring at the first wind farms of the Renewable Energy Independent Power Producer Procurement Programme in South Africa. BirdLife South Africa Occasional Report Series No. 2. BirdLife South Africa, Johannesburg, South Africa

Shaw, J.M., Reid, T.A., Gibbons, B.K., Pretorius, M., Jenkins, A.R., Visagie, R., Michael, M.D. & Ryan, P.G. 2021. A large-scale experiment demonstrates that line marking reduces power line collision mortality for large terrestrial birds, but not bustards, in the Karoo, South Africa. *Ornithological Applications*, 123: 1-10.

Skowno, A.L., Raimondo, D.C., Poole, C.J., Fizzotti, B. & Slingsby, J.A. (eds.). 2019. South African National Biodiversity Assessment 2018 Technical Report Volume 1: Terrestrial Realm. South African National Biodiversity Institute, Pretoria.

South African National Biodiversity Institute (SANBI). 2016. Lexicon of Biodiversity Planning in South Africa. Beta Version, June 2016. South African National Biodiversity Institute, Pretoria. 72 pp.

South African National Biodiversity Institute (SANBI). 2017. Technical guidelines for CBA Maps: Guidelines for developing a map of Critical Biodiversity Areas & Ecological Support Areas using systematic biodiversity planning. Driver, A., Holness, S. & Daniels, F. (Eds). 1st Edition. South African National Biodiversity Institute, Pretoria.

South African National Biodiversity Institute (SANBI). 2020. Species Environmental Assessment Guideline. Guidelines for the implementation of the Terrestrial Fauna and Terrestrial Flora Species Protocols for environmental impact assessments in South Africa. South African National Biodiversity Institute, Pretoria.

Van Deventer, H., Smith-Adao, L., Mbona, N., Petersen, C., Skowno, A., Collins, N.B., Grenfell, M., Job, N., Lötter, M., Ollis, D., Scherman, P., Sieben, E. & Snaddon, K. 2018. South African National Biodiversity Assessment 2018: Technical Report. Volume 2a: South African Inventory of Inland Aquatic Ecosystems (SAIIAE). Version 3, final released on 3 October 2019. Council for Scientific and Industrial Research (CSIR) and South African National Biodiversity Institute (SANBI): Pretoria, South Africa.

Visser, Elke & Perold, V. & Ralston-Paton, S. & Cardenal, A. C. & Ryan, P.G., 2019. "Assessing the impacts of a utility-scale photovoltaic solar energy facility on birds in the Northern Cape, South Africa," *Renewable Energy*, Elsevier, vol. 133(C), pages 1285-1294.



## 12 Appendix Items

### 12.1 Appendix A: Summary of Expected species

Common Name	Scientific Name	RD (Regional, Global)
Abdim's Stork	<i>Ciconia abdimii</i>	NT, LC
Acacia Pied Barbet	<i>Tricholaema leucomelas</i>	
African Black Duck	<i>Anas sparsa</i>	
African Black Swift	<i>Apus barbatus</i>	
African Darter	<i>Anhinga rufa</i>	
African Fish Eagle	<i>Haliaeetus vocifer</i>	
African Harrier-Hawk	<i>Polyboroides typus</i>	
African Hoopoe	<i>Upupa africana</i>	
African Openbill	<i>Anastomus lamelligerus</i>	
African Palm Swift	<i>Cypsiurus parvus</i>	
African Paradise Flycatcher	<i>Terpsiphone viridis</i>	
African Pipit	<i>Anthus cinnamomeus</i>	
African Quail-finch	<i>Ortygospiza atricollis</i>	
African Red-eyed Bulbul	<i>Pycnonotus nigricans</i>	
African Reed Warbler	<i>Acrocephalus baeticatus</i>	
African Rock Pipit	<i>Anthus crenatus</i>	NT, LC
African Sacred Ibis	<i>Threskiornis aethiopicus</i>	
African Snipe	<i>Gallinago nigripennis</i>	
African Spoonbill	<i>Platalea alba</i>	
African Stonechat	<i>Saxicola torquatus</i>	
African Wattled Lapwing	<i>Vanellus senegallus</i>	
Alpine Swift	<i>Tachymarpis melba</i>	
Amethyst Sunbird	<i>Chalcomitra amethystina</i>	
Amur Falcon	<i>Falco amurensis</i>	
Ant-eating Chat	<i>Myrmecocichla formicivora</i>	
Ashy Tit	<i>Melaniparus cinerascens</i>	
Banded Martin	<i>Riparia cincta</i>	
Barn Swallow	<i>Hirundo rustica</i>	
Barred Wren-Warbler	<i>Calamonastes fasciolatus</i>	
Black Crane	<i>Zapornia flavirostra</i>	
Black Cuckoo	<i>Cuculus clamosus</i>	
Black Harrier	<i>Circus maurus</i>	EN, EN
Black Sparrowhawk	<i>Accipiter melanoleucus</i>	
Black-chested Prinia	<i>Prinia flavicans</i>	
Black-chested Snake Eagle	<i>Circaetus pectoralis</i>	
Black-collared Barbet	<i>Lybius torquatus</i>	

Black-crowned Night Heron	<i>Nycticorax nycticorax</i>	
Black-faced Waxbill	<i>Brunhilda erythronotos</i>	
Black-headed Heron	<i>Ardea melanocephala</i>	
Black-necked Grebe	<i>Podiceps nigricollis</i>	
Blacksmith Lapwing	<i>Vanellus armatus</i>	
Black-throated Canary	<i>Crithagra atrogularis</i>	
Black-winged Kite	<i>Elanus caeruleus</i>	
Black-winged Pratincole	<i>Glareola nordmanni</i>	NT, NT
Black-winged Stilt	<i>Himantopus himantopus</i>	
Blue Korhaan	<i>Eupodotis caerulescens</i>	LC, NT
Blue Waxbill	<i>Uraeginthus angolensis</i>	
Bokmakierie	<i>Telophorus zeylonus</i>	
Booted Eagle	<i>Hieraaetus pennatus</i>	
Bronze-winged Courser	<i>Rhinoptilus chalcopterus</i>	
Brown Snake Eagle	<i>Circaetus cinereus</i>	
Brown-crowned Tchagra	<i>Tchagra australis</i>	
Brown-hooded Kingfisher	<i>Halcyon albiventris</i>	
Brown-throated Martin	<i>Riparia paludicola</i>	
Brubru	<i>Nilaus afer</i>	
Buffy Pipit	<i>Anthus vaalensis</i>	
Burchell's Coucal	<i>Centropus burchellii</i>	
Cape Bunting	<i>Emberiza capensis</i>	
Cape Canary	<i>Serinus canicollis</i>	
Cape Glossy (Cape) Starling	<i>Lamprotornis nitens</i>	
Cape Longclaw	<i>Macronyx capensis</i>	
Cape Penduline-tit	<i>Anthoscopus minutus</i>	
Cape Robin-chat	<i>Cossypha caffra</i>	
Cape Shoveler	<i>Spatula smithii</i>	
Cape Sparrow	<i>Passer melanurus</i>	
Cape Teal	<i>Anas capensis</i>	
Cape Turtle (Ring-necked) Dove	<i>Streptopelia capicola</i>	
Cape Wagtail	<i>Motacilla capensis</i>	
Cape Weaver	<i>Ploceus capensis</i>	
Cape White-eye	<i>Zosterops virens</i>	
Capped Wheatear	<i>Oenanthe pileata</i>	
Cardinal Woodpecker	<i>Dendropicops fuscescens</i>	
Caspian Tern	<i>Hydropogone caspia</i>	VU, LC
Chestnut-backed Sparrow-lark	<i>Eremopterix leucotis</i>	
Chestnut-vented Tit-Babbler (Warbler)	<i>Curruca subcoerulea</i>	

Cinnamon-breasted Bunting	<i>Emberiza tahapisi</i>	
Cloud Cisticola	<i>Cisticola textrix</i>	
Common (Kurrichane) Buttonquail	<i>Turnix sylvaticus</i>	
Common (Steppe) Buzzard	<i>Buteo buteo</i>	
Common Cuckoo	<i>Cuculus canorus</i>	
Common Greenshank	<i>Tringa nebularia</i>	
Common House Martin	<i>Delichon urbicum</i>	
Common Moorhen	<i>Gallinula chloropus</i>	
Common Myna	<i>Acridotheres tristis</i>	
Common Ostrich	<i>Struthio camelus</i>	
Common Quail	<i>Coturnix coturnix</i>	
Common Ringed Plover	<i>Charadrius hiaticula</i>	
Common Sandpiper	<i>Actitis hypoleucos</i>	
Common Scimitarbill	<i>Rhinopomastus cyanomelas</i>	
Common Starling	<i>Sturnus vulgaris</i>	
Common Swift	<i>Apus apus</i>	
Common Waxbill	<i>Estrilda astrild</i>	
Common Whitethroat	<i>Curruca communis</i>	
Crested Barbet	<i>Trachyphonus vaillantii</i>	
Crimson-breasted Shrike	<i>Laniarius atrococcineus</i>	
Crowned Lapwing	<i>Vanellus coronatus</i>	
Curlew Sandpiper	<i>Calidris ferruginea</i>	LC, NT
Desert Cisticola	<i>Cisticola aridulus</i>	
Diederik Cuckoo	<i>Chrysococcyx caprius</i>	
Double-banded Courser	<i>Rhinoptilus africanus</i>	
Dwarf Bittern	<i>Ixobrychus sturmii</i>	
Eastern Clapper Lark	<i>Mirafraga fasciolata</i>	
Eastern Long-billed Lark	<i>Certhilauda semitorquata</i>	
Egyptian Goose	<i>Alopochen aegyptiaca</i>	
Eurasian Golden Oriole	<i>Oriolus oriolus</i>	
European Bee-eater	<i>Merops apiaster</i>	
European Honey Buzzard	<i>Pernis apivorus</i>	
European Roller	<i>Coracias garrulus</i>	NT, LC
Fairy Flycatcher	<i>Stenostira scita</i>	
Familiar Chat	<i>Oenanthe familiaris</i>	
Fiscal Flycatcher	<i>Melaenornis silens</i>	
Fork-tailed Drongo	<i>Dicrurus adsimilis</i>	
Fulvous Whistling Duck	<i>Dendrocygna bicolor</i>	
Gabar Goshawk	<i>Micronisus gabar</i>	

Garden Warbler	<i>Sylvia borin</i>	
Giant Kingfisher	<i>Megaceryle maxima</i>	
Glossy Ibis	<i>Plegadis falcinellus</i>	
Golden-breasted Bunting	<i>Emberiza flaviventris</i>	
Goliath Heron	<i>Ardea goliath</i>	
Great Crested Grebe	<i>Podiceps cristatus</i>	
Great Egret	<i>Ardea alba</i>	
Great Reed Warbler	<i>Acrocephalus arundinaceus</i>	
Greater Flamingo	<i>Phoenicopterus roseus</i>	NT, LC
Greater Honeyguide	<i>Indicator indicator</i>	
Greater Kestrel	<i>Falco rupicoloides</i>	
Greater Striped Swallow	<i>Cecropis cucullata</i>	
Green Wood-hoopoe	<i>Phoeniculus purpureus</i>	
Green-winged Pytilia	<i>Pytilia melba</i>	
Grey Heron	<i>Ardea cinerea</i>	
Grey-headed Gull	<i>Chroicocephalus cirrocephalus</i>	
Hadeda (Hadada) Ibis	<i>Bostrychia hagedash</i>	
Hamerkop	<i>Scopus umbretta</i>	
Helmeted Guineafowl	<i>Numida meleagris</i>	
Horus Swift	<i>Apus horus</i>	
House Sparrow	<i>Passer domesticus</i>	
Icterine Warbler	<i>Hippolais icterina</i>	
Jackal Buzzard	<i>Buteo rufofuscus</i>	
Jacobin Cuckoo	<i>Clamator jacobinus</i>	
Jameson's Firefinch	<i>Lagonosticta rhodopareia</i>	
Kalahari Scrub Robin	<i>Cercotrichas paena</i>	
Karoo Prinia	<i>Prinia maculosa</i>	
Karoo Scrub Robin	<i>Cercotrichas coryphoeus</i>	
Karoo Thrush	<i>Turdus smithi</i>	
Kittlitz's Plover	<i>Charadrius pecuarius</i>	
Klaas's Cuckoo	<i>Chrysococcyx klaas</i>	
Knob-billed Duck	<i>Sarkidiornis melanotos</i>	
Lanner Falcon	<i>Falco biarmicus</i>	VU, LC
Lark-like Bunting	<i>Emberiza impetuani</i>	
Laughing Dove	<i>Spilopelia senegalensis</i>	
Lesser Black-backed Gull	<i>Larus fuscus</i>	
Lesser Flamingo	<i>Phoeniconaias minor</i>	NT, NT
Lesser Grey Shrike	<i>Lanius minor</i>	
Lesser Honeyguide	<i>Indicator minor</i>	

Lesser Kestrel	<i>Falco naumanni</i>	
Lesser Swamp Warbler	<i>Acrocephalus gracilirostris</i>	
Levaillant's Cisticola	<i>Cisticola tinniens</i>	
Lilac-breasted Roller	<i>Coracias caudatus</i>	
Little Bee-eater	<i>Merops pusillus</i>	
Little Egret	<i>Egretta garzetta</i>	
Little Grebe	<i>Tachybaptus ruficollis</i>	
Little Stint	<i>Calidris minuta</i>	
Little Swift	<i>Apus affinis</i>	
Long-billed crombec	<i>Sylvietta rufescens</i>	
Long-tailed Paradise Whydah	<i>Vidua paradisaea</i>	
Long-tailed Widowbird	<i>Euplectes progne</i>	
Maccoa Duck	<i>Oxyura maccoa</i>	NT, EN
Magpie Shrike	<i>Urolestes melanoleucus</i>	
Malachite Kingfisher	<i>Corythornis cristatus</i>	
Malachite Sunbird	<i>Nectarinia famosa</i>	
Marsh Owl	<i>Asio capensis</i>	
Marsh Sandpiper	<i>Tringa stagnatilis</i>	
Marsh Warbler	<i>Acrocephalus palustris</i>	
Martial Eagle	<i>Polemaetus bellicosus</i>	EN, EN
Melodious Lark	<i>Mirafraga cheniana</i>	
Mocking Cliff Chat	<i>Thamnolaea cinnamomeiventris</i>	
Mountain Wheatear	<i>Myrmecocichla monticola</i>	
Namaqua Dove	<i>Oena capensis</i>	
Namaqua Sandgrouse	<i>Pterocles namaqua</i>	
Natal Spurfowl	<i>Pternistis natalensis</i>	
Neddicky	<i>Cisticola fulvicapilla</i>	
Nicholson's Pipit	<i>Anthus nicholsoni</i>	
Northern Black Korhaan	<i>Afrotis afraoides</i>	
Orange River Francolin	<i>Scleroptila gutturalis</i>	
Orange River White-eye	<i>Zosterops pallidus</i>	
Pale Chanting Goshawk	<i>Melierax canorus</i>	
Pearl-breasted Swallow	<i>Hirundo dimidiata</i>	
Pied Avocet	<i>Recurvirostra avosetta</i>	
Pied Crow	<i>Corvus albus</i>	
Pied Kingfisher	<i>Ceryle rudis</i>	
Pied Starling	<i>Lamprotornis bicolor</i>	
Pink-billed Lark	<i>Spizocorys conirostris</i>	
Pin-tailed Whydah	<i>Vidua macroura</i>	



Plain-backed Pipit	<i>Anthus leucophrys</i>	
Pirit Batis	<i>Batis pirit</i>	
Purple Heron	<i>Ardea purpurea</i>	
Rattling Cisticola	<i>Cisticola chiniana</i>	
Red-backed Shrike	<i>Lanius collurio</i>	
Red-billed Firefinch	<i>Lagonosticta senegala</i>	
Red-billed Quelea	<i>Quelea quelea</i>	
Red-billed Teal	<i>Anas erythrorhyncha</i>	
Red-breasted Swallow	<i>Cecropis semirufa</i>	
Red-capped Lark	<i>Calandrella cinerea</i>	
Red-chested Cuckoo	<i>Cuculus solitarius</i>	
Red-collared Widowbird	<i>Euplectes ardens</i>	
Red-eyed Dove	<i>Streptopelia semitorquata</i>	
Red-faced Mousebird	<i>Urocolius indicus</i>	
Red-footed Falcon	<i>Falco vespertinus</i>	NT, VU
Red-headed Finch	<i>Amadina erythrocephala</i>	
Red-knobbed coot	<i>Fulica cristata</i>	
Red-throated Wryneck	<i>Jynx ruficollis</i>	
Red-winged Starling	<i>Onychognathus morio</i>	
Reed Cormorant	<i>Microcarbo africanus</i>	
Rock Dove	<i>Columba livia</i>	
Rock Kestrel	<i>Falco rupicolus</i>	
Rock Martin	<i>Ptyonoprogne fuligula</i>	
Ruff	<i>Calidris pugnax</i>	
Rufous-cheeked Nightjar	<i>Caprimulgus rufigena</i>	
Rufous-eared Warbler	<i>Malcorus pectoralis</i>	
Rufous-naped Lark	<i>Mirafrā africana</i>	
Sabota Lark	<i>Calendulauda sabota</i>	
Scaly-feathered Finch (Weaver)	<i>Sporopipes squamifrons</i>	
Secretarybird	<i>Sagittarius serpentarius</i>	VU, EN
Shaft-tailed Whydah	<i>Vidua regia</i>	
Sickle-winged Chat	<i>Emarginata sinuata</i>	
South African Cliff Swallow	<i>Petrochelidon spilodera</i>	
South African Shelduck	<i>Tadorna cana</i>	
South African Shelduck	<i>Tadorna cana</i>	
Southern (Common) Fiscal	<i>Lanius collaris</i>	
Southern Boubou	<i>Laniarius ferrugineus</i>	
Southern Grey-headed Sparrow	<i>Passer diffusus</i>	
Southern Masked Weaver	<i>Ploceus velatus</i>	

Southern Pochard	<i>Netta erythrophthalma</i>	
Southern Red Bishop	<i>Euplectes orix</i>	
Speckled Mousebird	<i>Colius striatus</i>	
Speckled Pigeon	<i>Columba guinea</i>	
Spike-heeled Lark	<i>Chersomanes albobasata</i>	
Spotted Eagle-Owl	<i>Bubo africanus</i>	
Spotted flycatcher	<i>Muscicapa striata</i>	
Spotted Thick-knee	<i>Burhinus capensis</i>	
Spur-winged Goose	<i>Plectropterus gambensis</i>	
Squacco Heron	<i>Ardeola ralloides</i>	
Streaky-headed Seedeater	<i>Crithagra gularis</i>	
Swainson's Spurfowl	<i>Pternistis swainsonii</i>	
Swallow-tailed Bee-eater	<i>Merops hirundineus</i>	
Three-banded Plover	<i>Charadrius tricollaris</i>	
Verreaux's Eagle	<i>Aquila verreauxii</i>	VU, LC
Village Indigobird	<i>Vidua chalybeata</i>	
Violet-backed Starling	<i>Cinnyricinclus leucogaster</i>	
Violet-eared Waxbill	<i>Granatina granatina</i>	
Wailing Cisticola	<i>Cisticola lais</i>	
Wattled Starling	<i>Creatophora cinerea</i>	
Western Barn Owl	<i>Tyto alba</i>	
Western Cattle Egret	<i>Bubulcus ibis</i>	
Western Osprey	<i>Pandion haliaetus</i>	
Whiskered Tern	<i>Chlidonias hybrida</i>	
White Stork	<i>Ciconia ciconia</i>	
White-backed Duck	<i>Thalassornis leuconotus</i>	
White-backed Mousebird	<i>Colius colius</i>	
White-bellied Sunbird	<i>Cinnyris talatala</i>	
White-breasted Cormorant	<i>Phalacrocorax lucidus</i>	
White-browed Sparrow-Weaver	<i>Plocepasser mahali</i>	
White-faced Whistling Duck	<i>Dendrocygna viduata</i>	
White-fronted Bee-eater	<i>Merops bullockoides</i>	
White-rumped Swift	<i>Apus caffer</i>	
White-throated Canary	<i>Crithagra albogularis</i>	
White-throated Swallow	<i>Hirundo albigularis</i>	
White-winged Tern	<i>Chlidonias leucopterus</i>	
White-winged Widowbird	<i>Euplectes albonotatus</i>	
Willow Warbler	<i>Phylloscopus trochilus</i>	
Wing-snapping Cisticola	<i>Cisticola ayresii</i>	

Wood Sandpiper	<i>Tringa glareola</i>	
Yellow Canary	<i>Crithagra flaviventris</i>	
Yellow-bellied Eremomela	<i>Eremomela icteropygialis</i>	
Yellow-billed (Intermediate) Egret	<i>Ardea intermedia</i>	
Yellow-billed Duck	<i>Anas undulata</i>	
Yellow-billed Kite	<i>Milvus aegyptius</i>	
Yellow-billed Stork	<i>Mycteria ibis</i>	EN, LC
Yellow-crowned Bishop	<i>Euplectes afer</i>	
Yellow-fronted Canary	<i>Crithagra mozambica</i>	
Zitting Cisticola	<i>Cisticola juncidis</i>	

## 12.2 Appendix A: Point count data of the first assessment

Common Name	Scientific Name	RD (Regional, Global)	Endemism in South Africa (E)	Guild code	Relative abundance	Frequency
Acacia Pied Barbet	<i>Tricholaema leucomelas</i>			OMD	0,002	4,255
African Pipit	<i>Anthus cinnamomeus</i>			IGD	0,017	27,660
African Quail-finch	<i>Ortygospiza atricollis</i>			GGD	0,028	40,426
African Stonechat	<i>Saxicola torquatus</i>			IGD	0,004	4,255
Ant-eating Chat	<i>Myrmecocichla formicivora</i>			IGD	0,021	19,149
Barn Swallow	<i>Hirundo rustica</i>			IAD	0,134	34,043
Black-chested Prinia	<i>Prinia flavicans</i>			IGD	0,012	23,404
Black-headed Heron	<i>Ardea melanocephala</i>			CGD	0,002	4,255
Blacksmith Lapwing	<i>Vanellus armatus</i>			IGD	0,004	4,255
Black-winged Kite	<i>Elanus caeruleus</i>			CGD	0,003	6,383
Blue Korhaan	<i>Eupodotis caerulescens</i>	LC, NT	SLS	OMD	0,003	2,128
Bokmakierie	<i>Telophorus zeylonus</i>			OMD	0,007	14,894
Cape Longclaw	<i>Macronyx capensis</i>			IGD	0,018	31,915
Cape Sparrow	<i>Passer melanurus</i>			GGD	0,002	2,128
Cape Turtle (Ring-necked) Dove	<i>Streptopelia capicola</i>			GGD	0,018	17,021
Cape Wagtail	<i>Motacilla capensis</i>			IGD	0,002	2,128
Chestnut-vented Tit-Babbler (Warbler)	<i>Curruca subcoerulea</i>			IGD	0,002	4,255
Cloud Cisticola	<i>Cisticola textrix</i>		NE	IGD	0,054	78,723
Common Quail	<i>Coturnix coturnix</i>			OMD	0,019	31,915
Crowned Lapwing	<i>Vanellus coronatus</i>			IGD	0,017	21,277
Desert Cisticola	<i>Cisticola aridulus</i>			IGD	0,025	48,936
Diederik Cuckoo	<i>Chrysococcyx caprius</i>			IGD	0,012	27,660
Double-banded Courser	<i>Rhinoptilus africanus</i>			IGD	0,003	4,255
Eastern Clapper Lark	<i>Mirafra fasciolata</i>			IGD	0,004	8,511
Egyptian Goose	<i>Alopochen aegyptiaca</i>			HWD	0,002	4,255
European Bee-eater	<i>Merops apiaster</i>			IAD	0,003	2,128
Fiscal Flycatcher	<i>Melaenornis silens</i>		NE	OMD	0,001	2,128
Gabar Goshawk	<i>Micronisus gabar</i>			CGD	0,002	4,255
Glossy Ibis	<i>Plegadis falcinellus</i>			IWD	0,010	10,638
Greater Kestrel	<i>Falco rupicoloides</i>			CGD	0,002	2,128
Hadedda (Hadada) Ibis	<i>Bostrychia hagedash</i>			OMD	0,002	4,255
Hamerkop	<i>Scopus umbretta</i>			CWD	0,001	2,128
Helmeted Guineafowl	<i>Numida meleagris</i>			OMD	0,014	12,766

Laughing Dove	<i>Spilopelia senegalensis</i>			GGD	0,003	4,255
Levaillant's Cisticola	<i>Cisticola tinniens</i>			IGD	0,010	12,766
Little Grebe	<i>Tachybaptus ruficollis</i>			CWD	0,002	4,255
Little Swift	<i>Apus affinis</i>			IAD	0,007	8,511
Long-tailed Widowbird	<i>Euplectes progne</i>			GGD	0,098	63,830
Namaqua Dove	<i>Oena capensis</i>			GGD	0,001	2,128
Northern Black Korhaan	<i>Afrotis afraoides</i>			IGD	0,023	44,681
Orange River Francolin	<i>Scleroptila gutturalis</i>			GGD	0,001	2,128
Pied Crow	<i>Corvus albus</i>			OMD	0,009	12,766
Pink-billed Lark	<i>Spizocorys conirostris</i>			GGD	0,007	6,383
Pin-tailed Whydah	<i>Vidua macroura</i>			GGD	0,004	6,383
Red-billed Quelea	<i>Quelea quelea</i>			GGD	0,090	12,766
Red-billed Teal	<i>Anas erythrorhyncha</i>			OMD	0,001	2,128
Red-faced Mousebird	<i>Urocolius indicus</i>			FFD	0,002	2,128
Red-knobbed Coot	<i>Fulica cristata</i>			HWD	0,009	6,383
Red-throated Wryneck	<i>Jynx ruficollis</i>			IGD	0,001	2,128
Rufous-naped Lark	<i>Mirafra africana</i>			IGD	0,010	23,404
South African Cliff Swallow	<i>Petrochelidon spilodera</i>		BNE	IAD	0,035	23,404
Southern (Common) Fiscal	<i>Lanius collaris</i>			IAD	0,010	19,149
Southern Masked Weaver	<i>Ploceus velatus</i>			GGD	0,020	21,277
Southern Red Bishop	<i>Euplectes orix</i>			GGD	0,022	8,511
Speckled Mousebird	<i>Colius striatus</i>			FFD	0,001	2,128
Speckled Pigeon	<i>Columba guinea</i>			FFD	0,021	4,255
Spike-heeled Lark	<i>Chersomanes albobasata</i>			IGD	0,016	14,894
Spotted Thick-knee	<i>Burhinus capensis</i>			IGD	0,002	2,128
Spur-winged Goose	<i>Plectropterus gambensis</i>			OMD	0,002	4,255
Swainson's Spurfowl	<i>Pternistis swainsonii</i>			OMD	0,005	10,638
Wattled Starling	<i>Creatophora cinerea</i>			OMD	0,014	2,128
Western Cattle Egret	<i>Bubulcus ibis</i>			IGD	0,024	25,532
Whiskered Tern	<i>Chlidonias hybrida</i>			CWD	0,005	6,383
White-backed Mousebird	<i>Colius colius</i>			FFD	0,006	6,383
White-browed Sparrow-Weaver	<i>Plocepasser mahali</i>			OMD	0,015	17,021
White-faced Whistling Duck	<i>Dendrocygna viduata</i>			HWD	0,002	2,128
White-winged Tern	<i>Chlidonias leucopterus</i>			CWD	0,001	2,128
Yellow Canary	<i>Crithagra flaviventris</i>			GGD	0,007	4,255
Yellow-billed Duck	<i>Anas undulata</i>			HWD	0,001	2,128



Yellow-crowned Bishop	<i>Euplectes afer</i>	GGD	0,025	25,532
Zitting Cisticola	<i>Cisticola juncidis</i>	IGD	0,041	74,468

### 12.3 Appendix C: Incidental records during the first assessment

Common Name	Scientific Name
African Palm Swift	<i>Cypsiurus parvus</i>
African Pipit	<i>Anthus cinnamomeus</i>
African Red-eyed Bulbul	<i>Pycnonotus nigricans</i>
Ant-eating Chat	<i>Myrmecocichla formicivora</i>
Barn Swallow	<i>Hirundo rustica</i>
Cape Turtle (Ring-necked) Dove	<i>Streptopelia capicola</i>
Common Waxbill	<i>Estrilda astrild</i>
Double-banded Courser	<i>Rhinoptilus africanus</i>
Hadeda (Hadada) Ibis	<i>Bostrychia hagedash</i>
Helmeted Guineafowl	<i>Numida meleagris</i>
Karoo Thrush	<i>Turdus smithi</i>
Little Swift	<i>Apus affinis</i>
Pied Crow	<i>Corvus albus</i>
Pink-billed Lark	<i>Spizocorys conirostris</i>
Rattling Cisticola	<i>Cisticola chiniana</i>
Red-capped Lark	<i>Calandrella cinerea</i>
Red-chested Cuckoo	<i>Cuculus solitarius</i>
Southern (Common) Fiscal	<i>Lanius collaris</i>
Spike-heeled Lark	<i>Chersomanes albofasciata</i>
Spotted Thick-knee	<i>Burhinus capensis</i>
Swainson's Spurfowl	<i>Pternistis swainsonii</i>
White-browed Sparrow-Weaver	<i>Plocepasser mahali</i>

### 12.4 Appendix D: Point count data of the second assessment

Common Name	Scientific Name	RD (Regional, Global)	Endemism in South Africa (E)	Guild code	Relative abundance	Frequency
Acacia Pied Barbet	<i>Tricholaema leucomelas</i>			OMD	0,003	6,383
African Palm Swift	<i>Cypsiurus parvus</i>			IAD	0,003	4,255
African Pipit	<i>Anthus cinnamomeus</i>			IGD	0,020	29,787
African Quail-Finch	<i>Ortygospiza atricollis</i>			GGD	0,019	29,787
African Red-eyed Bulbul	<i>Pycnonotus nigricans</i>			OMD	0,001	2,128
African Stonechat	<i>Saxicola torquatus</i>			IGD	0,001	2,128
Ant-eating Chat	<i>Myrmecocichla formicivora</i>			IGD	0,021	29,787

Barn Swallow	<i>Hirundo rustica</i>			IAD	0,076	25,532
Black-chested Prinia	<i>Prinia flavicans</i>			IGD	0,015	27,660
Blacksmith Lapwing	<i>Vanellus armatus</i>			IGD	0,006	8,511
Black-winged Kite	<i>Elanus caeruleus</i>			CGD	0,005	8,511
Black-winged Pratincole	<i>Glareola nordmanni</i>	NT, NT		IAD	0,018	2,128
Blue Korhaan	<i>Eupodotis caerulescens</i>	LC, NT	SLS	OMD	0,007	8,511
Bokmakierie	<i>Telophorus zeylonus</i>			OMD	0,012	19,149
Brown-crowned Tchagra	<i>Tchagra australis</i>			OMD	0,001	2,128
Cape Crow	<i>Corvus capensis</i>			OMD	0,001	2,128
Cape Longclaw	<i>Macronyx capensis</i>			IGD	0,028	38,298
Cape Sparrow	<i>Passer melanurus</i>			GGD	0,011	12,766
Cape Turtle (Ring-necked) Dove	<i>Streptopelia capicola</i>			GGD	0,014	25,532
Cape Wagtail	<i>Motacilla capensis</i>			IGD	0,005	10,638
Cape White-eye	<i>Zosterops virens</i>		NE	OMD	0,001	2,128
Cardinal Woodpecker	<i>Dendropicos fuscescens</i>			IGD	0,001	2,128
Chestnut-vented Tit-Babbler (Warbler)	<i>Curruca subcoerulea</i>			IGD	0,005	8,511
Cloud Cisticola	<i>Cisticola textrix</i>		NE	IGD	0,009	17,021
Common (Steppe) Buzzard	<i>Buteo buteo</i>			CGD	0,001	2,128
Common Quail	<i>Coturnix coturnix</i>			OMD	0,011	17,021
Common Swift	<i>Apus apus</i>			IAD	0,004	2,128
Common Waxbill	<i>Estrilda astrild</i>			GGD	0,005	2,128
Crowned Lapwing	<i>Vanellus coronatus</i>			IGD	0,012	14,894
Desert Cisticola	<i>Cisticola aridulus</i>			IGD	0,005	10,638
Double-banded Courser	<i>Rhinoptilus africanus</i>			IGD	0,002	2,128
Eastern Clapper Lark	<i>Mirafra fasciolata</i>			IGD	0,001	2,128
Egyptian Goose	<i>Alopochen aegyptiaca</i>			HWD	0,017	10,638
Fiscal Flycatcher	<i>Melaenornis silens</i>		NE	OMD	0,001	2,128
Greater Kestrel	<i>Falco rupicoloides</i>			CGD	0,002	4,255
Greater Striped Swallow	<i>Cecropis cucullata</i>			IAD	0,007	2,128
Grey Heron	<i>Ardea cinerea</i>			CWD	0,001	2,128
Hadedda (Hadada) Ibis	<i>Bostrychia hagedash</i>			OMD	0,001	2,128
Helmeted Guineafowl	<i>Numida meleagris</i>			OMD	0,033	10,638
Laughing Dove	<i>Spilopelia senegalensis</i>			GGD	0,003	2,128
Lesser Kestrel	<i>Falco naumanni</i>			CGD	0,001	2,128
Lesser Swamp Warbler	<i>Acrocephalus gracilirostris</i>			IGD	0,001	2,128
Levaillant's Cisticola	<i>Cisticola tinniens</i>			IGD	0,011	17,021

Little Swift	<i>Apus affinis</i>			IAD	0,022	8,511
Long-tailed Widowbird	<i>Euplectes progne</i>			GGD	0,048	27,660
Marsh Owl	<i>Asio capensis</i>			CGN	0,002	2,128
Namaqua Dove	<i>Oena capensis</i>			GGD	0,001	2,128
Neddicky	<i>Cisticola fulvicapilla</i>			IGD	0,004	2,128
Northern Black Korhaan	<i>Afrotis afraoides</i>			IGD	0,023	48,936
Orange River Francolin	<i>Scleroptila gutturalis</i>			GGD	0,005	6,383
Pied Crow	<i>Corvus albus</i>			OMD	0,013	12,766
Pink-billed Lark	<i>Spizocorys conirostris</i>			GGD	0,007	6,383
Pin-tailed Whydah	<i>Vidua macroura</i>			GGD	0,001	2,128
Red-backed Shrike	<i>Lanius collurio</i>			IGD	0,001	2,128
Red-billed Quelea	<i>Quelea quelea</i>			GGD	0,022	4,255
Red-billed Teal	<i>Anas erythrorhyncha</i>			OMD	0,001	2,128
Red-capped Lark	<i>Calandrella cinerea</i>			GGD	0,017	4,255
Red-faced Mousebird	<i>Urocolius indicus</i>			FFD	0,010	8,511
Red-knobbed Coot	<i>Fulica cristata</i>			HWD	0,007	8,511
Reed Cormorant	<i>Microcarbo africanus</i>			CWD	0,003	6,383
Rufous-naped Lark	<i>Mirafra africana</i>			IGD	0,007	14,894
Secretarybird	<i>Sagittarius serpentarius</i>	VU, EN		CGD	0,002	4,255
Shaft-tailed Whydah	<i>Vidua regia</i>			GGD	0,003	2,128
South African Cliff Swallow	<i>Petrochelidon spilodera</i>		BNE	IAD	0,065	27,660
Southern (Common) Fiscal	<i>Lanius collaris</i>			IAD	0,009	19,149
Southern Masked Weaver	<i>Ploceus velatus</i>			GGD	0,002	4,255
Southern Red Bishop	<i>Euplectes orix</i>			GGD	0,084	10,638
Speckled Mousebird	<i>Colius striatus</i>			FFD	0,001	2,128
Spike-heeled Lark	<i>Chersomanes albofasciata</i>			IGD	0,011	10,638
Spotted Flycatcher	<i>Muscicapa striata</i>			IAD	0,001	2,128
Spur-winged Goose	<i>Plectropterus gambensis</i>			OMD	0,005	4,255
Swainson's Spurfowl	<i>Pternistis swainsonii</i>			OMD	0,007	14,894
Wattled Starling	<i>Creatophora cinerea</i>			OMD	0,014	2,128
Western Cattle Egret	<i>Bubulcus ibis</i>			IGD	0,103	12,766
Whiskered Tern	<i>Chlidonias hybrida</i>			CWD	0,005	4,255
White-backed Mousebird	<i>Colius colius</i>			FFD	0,010	6,383
White-bellied Sunbird	<i>Cinnyris talatala</i>			NFD	0,001	2,128
White-browed Sparrow-Weaver	<i>Plocepasser mahali</i>			OMD	0,012	14,894
White-rumped Swift	<i>Apus caffer</i>			IAD	0,011	8,511

White-winged Tern	<i>Chlidonias leucopterus</i>	CWD	0,004	4,255
Yellow-billed Duck	<i>Anas undulata</i>	HWD	0,026	6,383
Yellow-billed Kite	<i>Milvus aegyptius</i>	CGD	0,001	2,128
Zitting Cisticola	<i>Cisticola juncidis</i>	IGD	0,031	48,936

## 12.5 Appendix E: Incidental records during the second survey

Common Name	Scientific Name
African Pipit	<i>Anthus cinnamomeus</i>
Cape Sparrow	<i>Passer melanurus</i>
Common Quail	<i>Coturnix coturnix</i>
Greater Striped Swallow	<i>Cecropis cucullata</i>
Hadeda (Hadada) Ibis	<i>Bostrychia hagedash</i>
Karoo Thrush	<i>Turdus smithi</i>
Red-capped Lark	<i>Calandrella cinerea</i>
Southern Grey-headed Sparrow	<i>Passer diffusus</i>
Southern Red Bishop	<i>Euplectes orix</i>
Speckled Pigeon	<i>Columba guinea</i>
White-browed Sparrow-Weaver	<i>Plocepasser mahali</i>

## 12.6 Appendix F: Specialist Declaration of Independence

I, Lindi Steyn, declare that:

- 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 form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.



Lindi Steyn

Biodiversity Specialist

The Biodiversity Company

April 2023



## **APPENDIX E4: Agricultural Compliance Statement**

---



# AGRICULTURAL ASSESSMENT: COMPLIANCE STATEMENT

Mooivlei Solar 2: Kroonstad PV Cluster - Free State Province

**Compiled for:**

Nemai Consulting

**Compiled by**

Dr Andries Gouws Index

April 2023

# DECLARATION

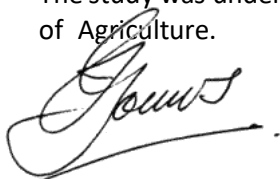
The observations, conclusions and recommendations made in this report are based on the best available data and on best scientific and professional knowledge of the directors of INDEX (Pty) Ltd. The report is based on GIS programming and utilises satellite tracking to map survey points. Survey points are normally accurate to within 3 metres; which must be considered in the use of the information.

The directors of INDEX (Pty) Ltd exercises due care and diligence in rendering services and preparing documents. However, the company accepts no liability, and the client, by receiving this document, indemnifies INDEX (Pty) Ltd and its directors and employees, by the use of the information contained in this document, against any action, claim, demand, loss, liability, cost, damage and expense arising from or in connection with services rendered.

The property and copyright of this report shall remain vested in INDEX (Pty) Ltd. The client that commissioned the report may use the information as it may think fit; but only for the land for which it was commissioned.

General declaration:

- INDEX acted as the independent specialist in this application;
- Performed 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;
- There were no circumstances that may compromise INDEX's objectivity in performing such work;
- INDEX have expertise in conducting the specialist report relevant to this application, including knowledge of NEMA and its regulations and any guidelines that have relevance to the proposed activity;
- Have not and will not engage in conflicting interests in the undertaking of the activity.
- The study was undertaken by Dr Andries Gouws. He is a registered member of SACNASP in the category of Agriculture.



April 2023

# CONTENTS

1	SPECIALIST DECLARATION .....	6
2	BACKGROUND .....	8
3	TERMS OF REFERENCE.....	9
4	PROPOSED DEVELOPMENT .....	9
5	METHODS AND PROCEDURES .....	11
6	ECOLOGICAL SENSITIVITY .....	11
6.1	Sensitivity Screening Tool findings.....	11
6.2	Findings of the Site sensitivity investigation .....	13
7	SITE EVALUATION.....	14
7.1	Present land uses .....	14
7.2	Climate .....	15
7.3	Water .....	15
7.4	Vegetation .....	15
7.5	Soil and Land capability.....	15
8	IMPACT ASSESSMENT.....	18
8.1	Loss of high potential land .....	18
8.2	Loss of agricultural production .....	18
8.3	Loss of Agricultural infrastructure.....	19
8.4	Loss of soil due to erosion.....	19
9	CONCLUSIONS AND RECOMMENDATIONS .....	19
10	ADDENDA.....	21
10.1	Sources of information .....	21
10.2	Gross margins.....	22
10.3	SACNASP certificate.....	23
10.4	Curriculum Vitae (CV).....	24
10.5	Observations .....	26

# SUMMARY

The site is located just southwest of Kroonstad in Free State Province.

The Department of Forestry, Fisheries and Environment published Notice 320 in 2020 that describes the minimum criteria when applying for environmental authorisation, which was followed for this investigation.

## SENSITIVITY SCREENING TOOL

Two alternatives were evaluated.

- 1) The sensitivity tool correctly indicates no cultivated land. This is correct. All cultivated areas are outside of the project area.
- 2) The sensitivity screening tool indicates that the majority of the land has a high sensitivity. In our professional view this grading is incorrect and that it is only moderately sensitive. Nevertheless, Alternative 2 has no land that the tool describes as high sensitivity.

## SITE INVESTIGATION

The outcome of the site sensitivity verification found the following:

1. The survey agrees with the screening tool that there is no cultivated land on the proposed Mooivlei Solar 2 (MV2) site. It is used for livestock grazing.
2. The environmental sensitivity according to the tool is indicated as moderately sensitive. This was confirmed by the site investigation. Using the same guidelines as DALRRD, the land has low/moderate arable potential. This is because of the shallow and highly erodible nature of the soils.

In line with the provisions of the Protocol, a compliance statement is required for the EIA report.

## LOSS OF HIGH POTENTIAL LAND

No high potential or sensitive soils were found; therefore, there will not be a loss of high potential land if MV2 is implemented. The impact is low, temporary and totally reversable.

## LOSS OF AGRICULTURAL PRODUCTION

The site is used for game farming. These animals can be moved to another part of the farm without any impact on farming income.

The grazing opportunity that the farm provides cannot be replaced or mitigated on a national level.

- The impact is low on a regional or national scale.
- The loss is temporary and will be for the medium term.
- There will be no loss of labour opportunities. The labourer that tends the game can be employed elsewhere on the farm.

## LOSS OF AGRICULTURAL INFRASTRUCTURE

There is no farming infrastructure on the site.

## LOSS OF SOIL DUE TO EROSION

The soil is very erodible because of the strongly developed structure in the subsoil.

Runoff from hard surfaces should be dealt with by a Stormwater Management Plan (SWMP). This is an engineering function and is normally addressed as part of the project design.

## RECOMMENDATION

No key issues or triggers were identified that should be addressed in the EIA report.

The conclusion is that there will be no permanent loss of high potential land and only limited loss of



agricultural production from game.

There were no gaps found in knowledge in the investigation. The recommendations made in this report are based on the findings during the investigation.

The PV site development takes place on medium/low potential land that has a medium sensitivity related to agriculture.

It is the author's opinion that there is no reason to prevent the project from being implemented.

Further, any measures or projects that can help to relieve the country's electricity problems should be encouraged.

# 1 SPECIALIST DECLARATION

## COMPLIANCE STATEMENT

Main findings of the study are as follows:

### SENSITIVITY SCREENING TOOL

- Field crop boundary. The sensitivity tool indicates no cultivated land on MV2.
- Land sensitivity to agriculture. The tool indicates the sensitivity of the site as moderately high on Alternative 1, but medium on Alternative 2.

### SITE INVESTIGATION

The outcome of the site sensitivity verification found the following:

1. The survey agrees with the screening tool that there is no cultivated land on the proposed MV2 site. It is used for game farming.
2. The environmental sensitivity according to the tool is indicated as moderately sensitive. This was confirmed by the site investigation. Small isolated portions have high sensitivity. This is incorrect. There is only medium sensitive land on Alternative 2. Using the same guidelines as DALRRD, the land has low/moderate arable potential. This is because of the shallow and highly erodible nature of the soils.

In line with the provisions of the Protocol, a compliance statement is required for the EIA report.

### THE AUTHOR OF THE REPORT CONFIRMS THE FOLLOWING:

3.3.1. Details and relevant experience as well as the SACNASP registration number of the soil scientist/agricultural specialist/s preparing the assessment including a curriculum vita;	Dr Andries Gouws is a soil scientist and is registered with SACNASP. Refer to Section 10.
3.3.2. A signed statement of independence by the specialist;	Refer to the preamble of the report.
3.3.3. A map showing the proposed development footprint (including supporting infrastructure), overlaid on the agricultural sensitivity map generated by the national environmental screening tool;	The entire MV2 site will be developed. See Figure 3 for the development footprint. Although the screening tool indicate highly sensitive land, the detailed assessment found that the climatic conditions and crop yield are such that profitable crop farming is not possible.
3.3.4. Calculations of the physical development footprint area for each land parcel as well as the total physical development footprint area of the proposed development including supporting infrastructure;	Total survey area was confined to the land of 385ha (Alternative 1) and 378ha for Alternative 2, this is what will be under photovoltaic (PV) and support infrastructure. The total farms are more than 2 000ha.
3.3.5. Confirmation that the development footprint is in line with the allowable development limits contained in Table 1 above;	No detail at this stage

<p>3.3.6. confirmation from the specialist that all reasonable measures have been taken through micro-siting to avoid or minimise fragmentation and disturbance of agricultural activities;</p>	<p>385ha will be developed. The PV project will not disturb any adjacent farming activities. The site will be leased to the developer and will not be subdivided in terms of Act 70. It will, therefore not lead to fragmentation of farm land.</p>
<p>3.3.7. A substantiated statement from the soil scientist or agricultural specialist on the acceptability of the proposed development and a recommendation on the approval of the proposed development;</p>	<p>The PV site development takes place on low/medium potential land that has a medium sensitivity related to agriculture. It consists of moderately deep and shallow and rocky soils. It is the author's opinion that there is no reason to prevent the project from being implemented. Further, any measure or project that can help to relieve the country's electricity problems should be encouraged.</p>
<p>3.3.8. Any conditions to which this statement is subjected</p>	<p>There are no conditions imposed on the approval of the project</p>
<p>3.3.9. in the case of a linear activity, confirmation from the agricultural specialist or soil scientist, that in their opinion, based on the mitigation and remedial measures proposed, the land can be returned to the current state within two years of completion of the construction phase.</p>	<p>The PV site is not a linear activity. An overhead line (OHL) will be installed. Some land will be cleared from grass during installation and will take time to recover. However, only the transmission line footprint will be disturbed and by planting locally occurring grass species, the grazing land will have no negative impact.</p>
<p>3.3.10. Where required, proposed impact management outcomes or any monitoring requirements for inclusion in the EMPr; and</p>	<p>The only recommendation is that the EMP includes erosion control measures and that the SWMP be implemented.</p>
<p>3.3.11. A description of the assumptions made and any uncertainties or gaps in knowledge or data.</p>	<p>The observations are accepted as representative of the soil conditions. The author feels confident that this is the case. There were sufficient observations made that no gaps in knowledge or data is expected.</p>
<p>The duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;</p>	<p>Assessment date: April 2023. The duration, date and season of the site inspection and the significance of the season to the outcome of the assessment is not relevant. The main criteria for farming potential are soils, climate and water availability. These are not bound to seasons.</p>
<p>A description of the methodology used to undertake the on-site assessment</p>	<p>Refer to Section 5.</p>

## 2 BACKGROUND

Nemai Consulting was appointed for a number of solar projects (Kroonstad PV Cluster) at Kroonstad. They are located south west of the town in the Free State Province. INDEX was then appointed as agricultural specialist to do the agricultural impact statement in terms of Notice 320 of the National Environmental Management Act in May 2020 of the Department of Environmental Affairs.

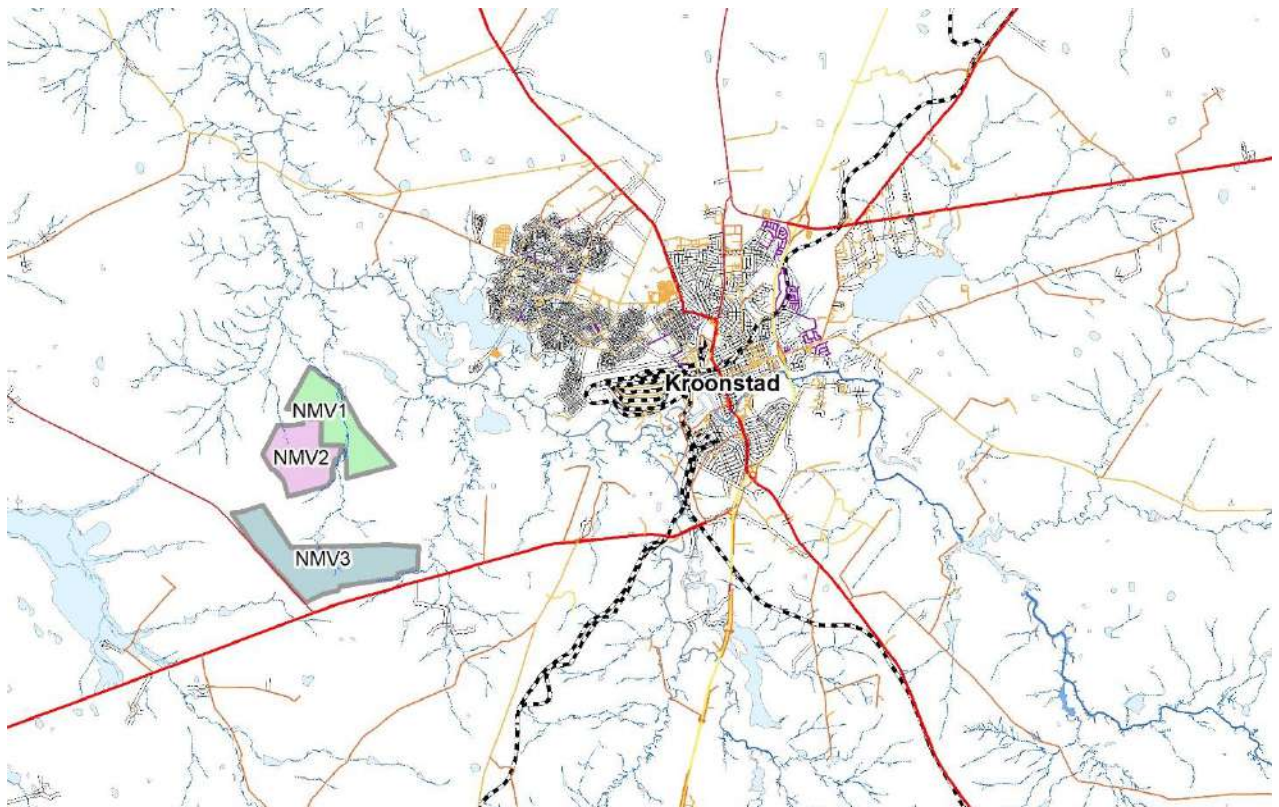
This report will describe the findings of the initial site verification and then assess the agricultural potential of the site in terms of the guidelines of Notice 320.

The location is indicated in Figure 1.

The Kroonstad PV Cluster consists of the following three PV energy facilities:

1. Mooivlei Solar 1 (MV1): PV Site, 132 kV facility substation and 132 kV powerline to new 132/275 kV MTS, a new 132/275 kV MTS (Eskom substation/switching station), as well as 275 kV powerlines (LIL0) between Eskom substation/switching station and existing 275 kV lines.
2. Mooivlei Solar 2 (MV2): PV Site, 132 kV facility substation and 132 kV powerline to new 132/275 kV MTS.
3. Mooivlei Solar 3 (MV3): PV Site, 132 kV facility substation and 132 kV powerline to new 132/275 kV MTS.

This report deals with MV2.



**Figure 1. Locality of the project**

The details of the site are as follows:

## SITE DESCRIPTION

Farm names (Size)	Farm Mooivlei No. 284 (259ha)
Development footprint Alternative 1	385ha
Development footprint Alternative 2	378ha

## 3 TERMS OF REFERENCE

The Applicant, Mooivlei Solar 2 (Pty) Ltd, is proposing the construction of a photovoltaic (PV) solar energy facility (known as Mooivlei Solar 2) located on the Farm Mooivlei No. 284 and an access road crossing Portion 1 of Farm No. 1475 and the Farm Leidzaamheid No. 213, approximately 10 km west of Kroonstad in the Free State Province.

Nemai Consulting was appointed to do the Environmental impact for MV2. It consists of a solar PV plant, Battery Energy Storage System (BESS) and support infrastructure. In turn, they appointed Index to do a specialist assessment for agriculture.

### APPROACH

- Determine agricultural potential in the Project's footprint.
- Determine impacts of the Project from an agricultural perspective.
- Suggest suitable mitigation measures to address the identified impacts.

The following were indicated by the client as particular outputs:

- Indicate Key Issues & Triggers Identified During Scoping and subsequent Environmental impact phase
- Indicate loss of agricultural land with high capability due to direct occupation by the development footprint.
- Indicate loss of fertile soil (high potential land).
- Soil erosion due to inadequate stormwater management.

## 4 PROPOSED DEVELOPMENT

The project consists of a PV site and the associated infrastructure (refer to Figure 3).



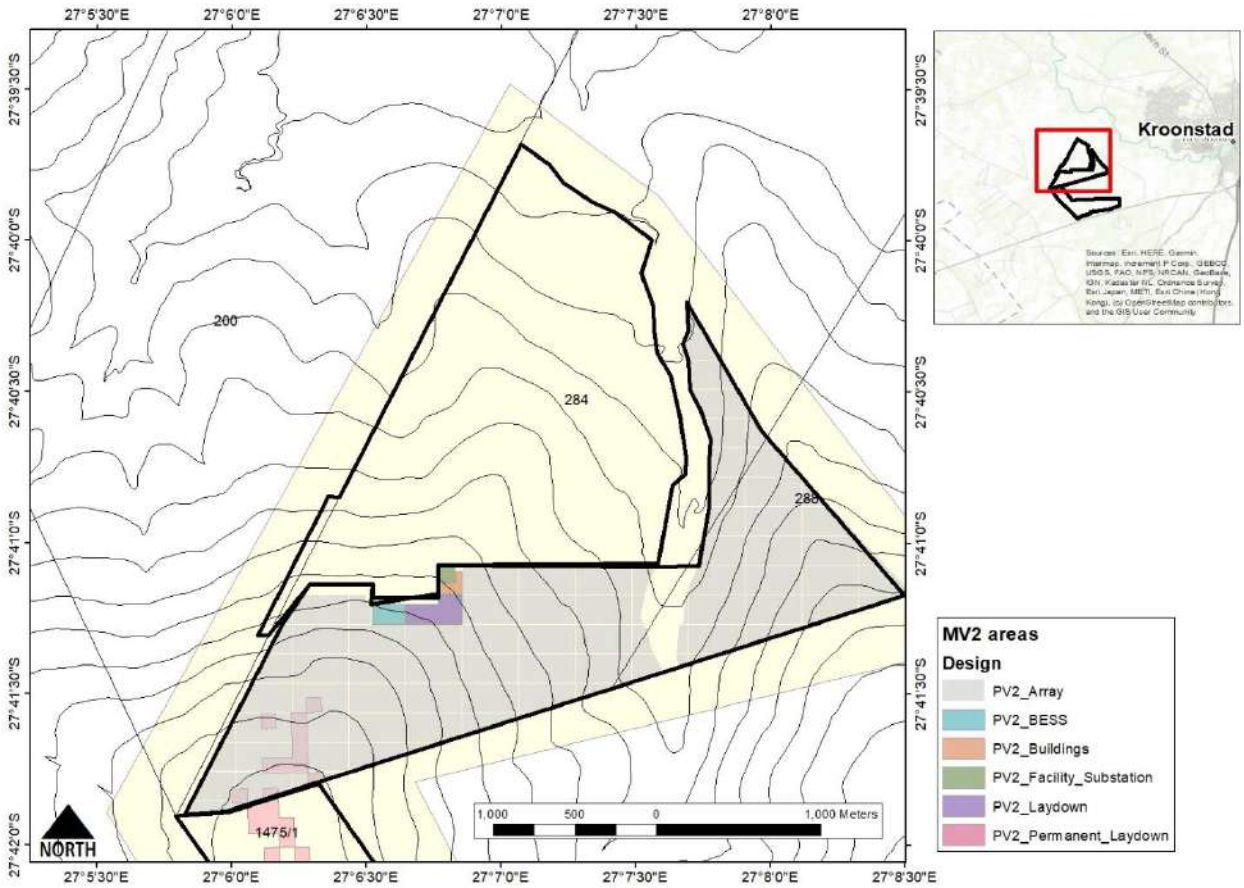


Figure 2. Main components of the development on site sensitivity map

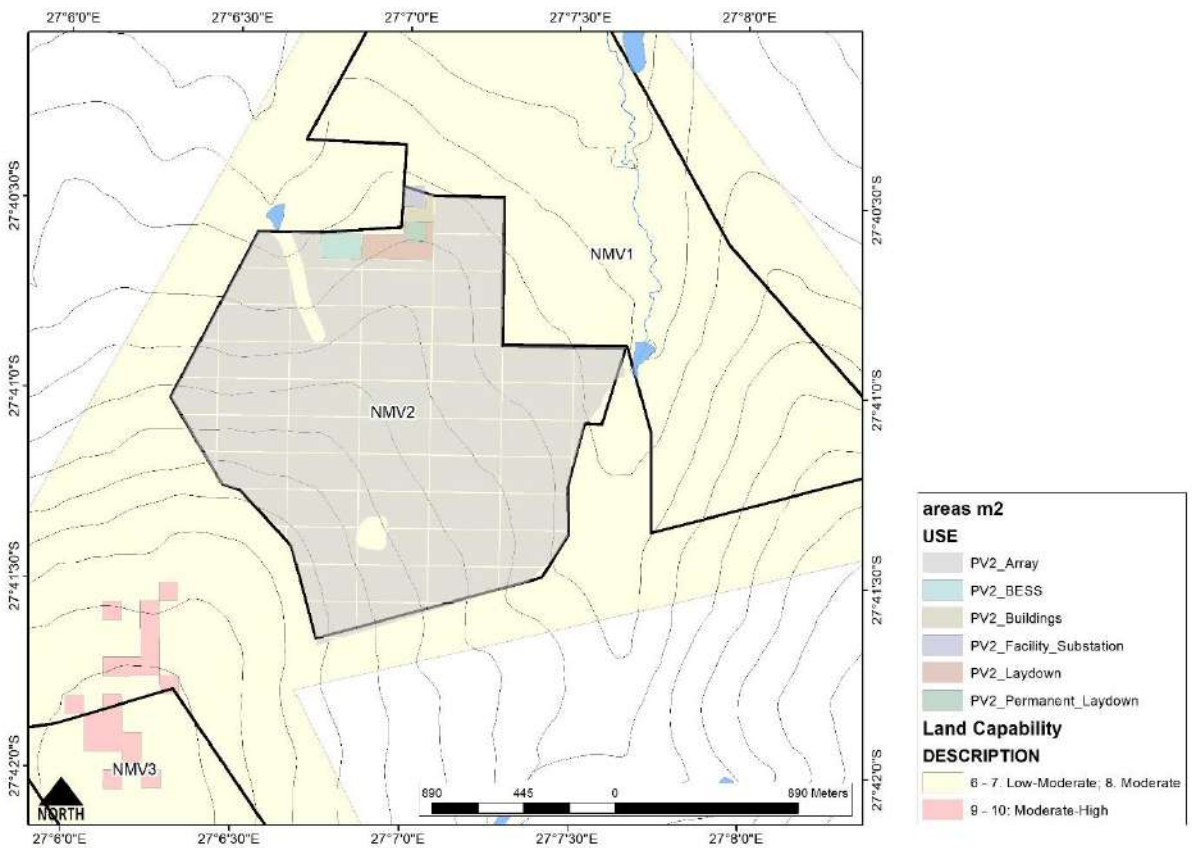


Figure 3. Main components of the development on site sensitivity map

## 5 METHODS AND PROCEDURES

### SITE SENSITIVITY VERIFICATION

The verification is a review of existing information on soils and topography on a desktop level to determine areas with high sensitivity in terms of Notice 320 of the National Environmental Management Act published in May 2020 of the Department of Environmental Affairs.

The current use of the land and the environmental sensitivity of the site as indicated in the screening tool, were used in assessing the site.

- The desktop verification was done through use of satellite imagery and a site visit took place on 25 April 2023.
- The aim of the site survey was to verify the findings of the interpretation done on the satellite images and of the data obtained from the Screening Tool.
- The outcome of the site verification is included in this report.

The report compared the current crop land and the environmental sensitivity as identified by the screening tool with the present situation.

The results are indicated in Section 7.

### SITE EVALUATION PROCESS

Satellite images were used as backdrop and the present land uses digitised.

Soil profiles were augured to determine soil depth, clay content is land conditions.

Capability classification is according to the guidelines published on the AGIS website of the National Department of Agriculture (NDA) was used to determine the capability of soils and their agricultural potential (DALRRD, 2019).

## 6 ECOLOGICAL SENSITIVITY

### BACKGROUND

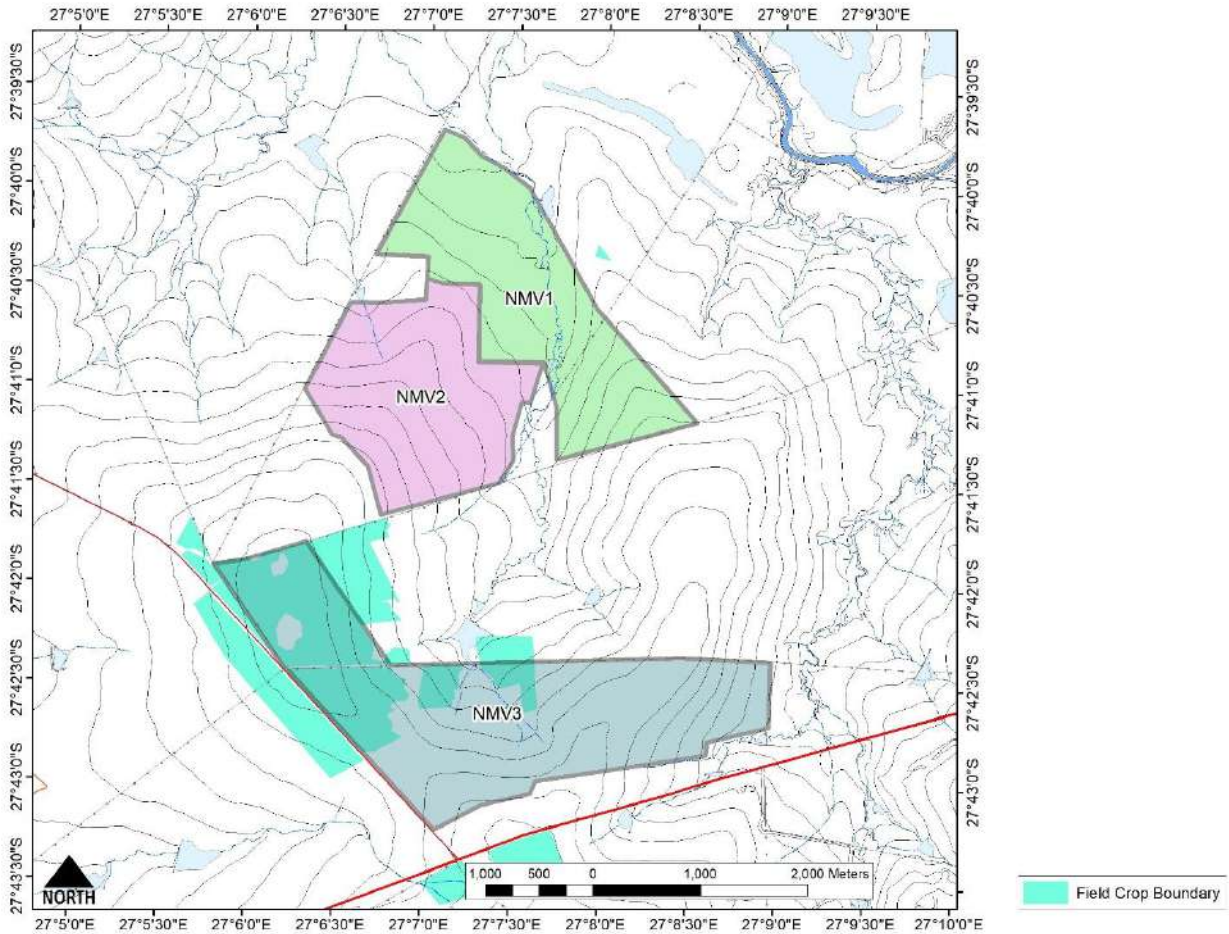
The Department of Forestry, Fisheries and Environment published Notice 320 in 2020 that describes the minimum criteria when applying for environmental authorisation.

This protocol provides the criteria for the assessment and reporting of impacts on agricultural resources for activities requiring environmental authorisation. The requirements of this protocol are according to the level of environmental sensitivity as indicated by the national web-based environmental screening tool for agricultural resources. It is based on the most recent land capability evaluation as provided by the DALRRD.

According to the protocol, an applicant intending to undertake an activity where it occurs on land with 'very high' or 'high' sensitivity for agricultural resources must submit an Agricultural Agro-Ecosystem Specialist Assessment. Alternatively, a Compliance Statement will suffice.

#### 6.1 Sensitivity Screening Tool findings

- Field crop boundary  
The sensitivity tool indicates no cultivated land on MV2.



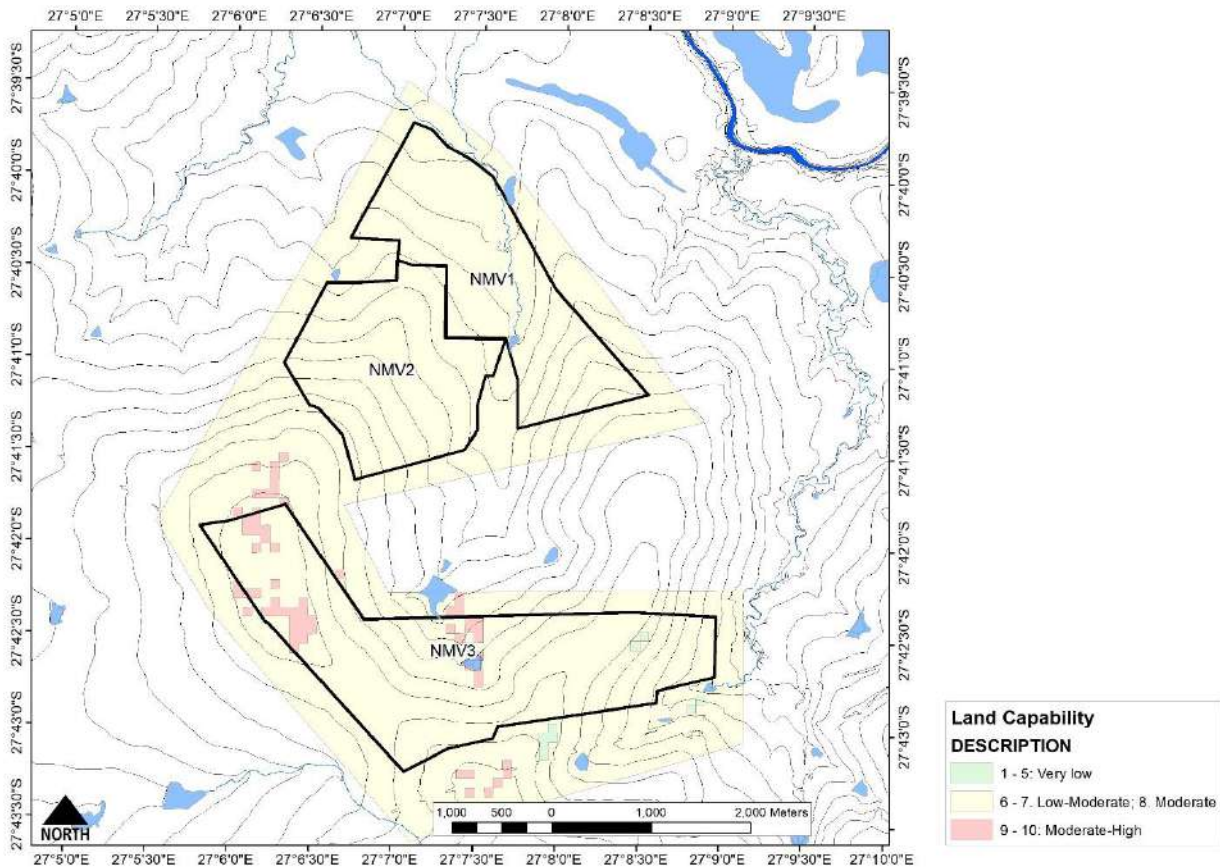
**Figure 4. Cultivated land boundary according to the Screening Tool**

- Land sensitivity to agriculture
 

The tool indicates the sensitivity of the site as moderately (Category 6 and 7) and some isolated portions in the south-western corner that is moderately high.

See Figure 5 for the results of the Sensitivity Screening Tool.





**Figure 5. Sensitivity (screening tool)**

## 6.2 FINDINGS OF THE SITE SENSITIVITY INVESTIGATION

The verification was done by desk top analysis, using satellite imagery and then a preliminary on-site inspection. The outcome of the site sensitivity verification found the following:

### 6.2.1 FIELD CROP BOUNDARY

The survey agrees with the screening tool that there is no cultivated land on the proposed MV2 site. It is used for game farming.

### 6.2.2 LAND CAPABILITY

- The environmental sensitivity of nearly all land, according to the tool is indicated as moderately sensitive. This was confirmed by the site investigation. The south-western corner is indicated as highly sensitive. This was found to be incorrect. It was found that this portion is underlain by plinthite and that it has a low sensitivity.
- Alternative 2 has no high sensitivity land.
- Using the same guidelines as in AGIS (DALRRD), the land has low/moderate arable potential. This is because of the shallow plinthite and structure in the subsoil.
- In line with the provisions of the Protocol, a compliance statement is required for the EIA report.

See Section 7.5 for a detailed description and results of the site visit related to soil and agricultural potential.

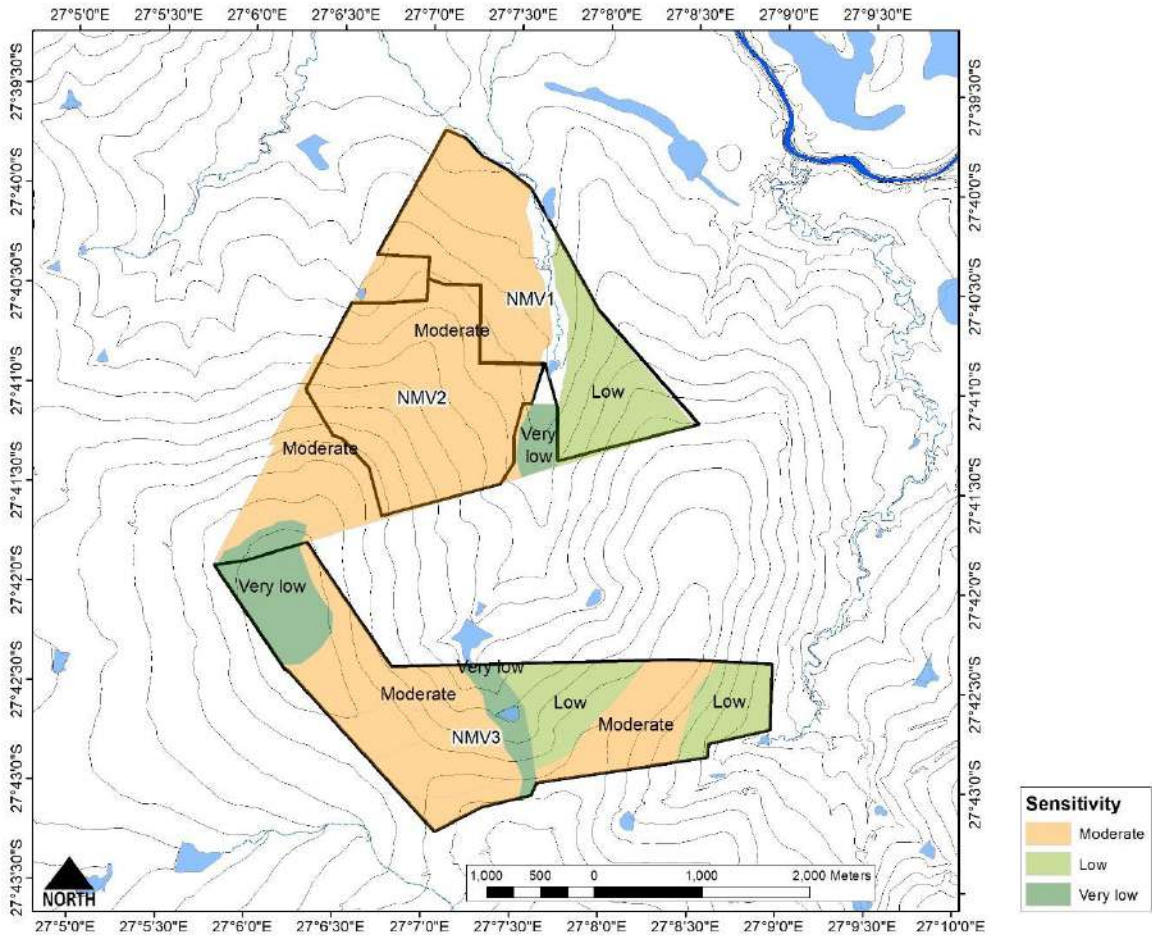


Figure 6. Site sensitivity following the site visit (Refer to MV2 outlined in dark green)

## 7 SITE EVALUATION

### 7.1 PRESENT LAND USES

The entire site is used for game farming like Rhone, springbok and buffalo. The veld is in relatively good condition with a large percentage of palatable grass species.





## **7.2 CLIMATE**

### **RAINFALL**

The average annual rainfall varies between 515mm and 560mm for the different stations around the site. Rain occurs mainly during the summer months, commencing in October lasting to March. This is typical of the summer rainfall pattern of the Highveld region of South Africa.

The rainfall is sufficient for crop production provided that the soils are suitable.

### **WIND**

The predominant wind direction is north, varying between north-easterly and north-westerly. Wind damage is not normally expected to be a deciding factor in crop selection.

### **TEMPERATURE**

The average daily temperature varies from 18,5°C in July to 27,9°C in January. The lowest daily minimum temperature is below freezing for June and July, with frost risk from as early as March and as late as September.

Kroonstad can be classified as a high frost risk area. It has, however, 500 to 750 accumulated chill units for the winter months.

The temperature is suitable for crop production.

## **7.3 WATER**

There is no surface runoff on the property that can be used for irrigation.

## **7.4 VEGETATION**

The land in its natural state is grassland with *Themeda triandra* the dominant species. Annual *Aristida* occurs in the lower laying portions and where the soils are shallow.

The grazing capacity according to DALRRD is estimated at 5-6 ha/large livestock unit (LSU). The carrying capacity for the PV site is approximately 64 LSU.

## **7.5 SOIL AND LAND CAPABILITY**

### **SOIL TYPES**

The PV site is located on mudstone and shale of the Beaufort formations. These are notorious for their high erodibility as can be seen, among other places, in the Eastern Cape at East London and in the former Transkei and Ciskei where deep gullies are common.

Clay migrates to above the bedrock where cutanic structures are formed. These seem to dissolve or fall apart when the protective topsoil is eroded. Dongas are often the result.

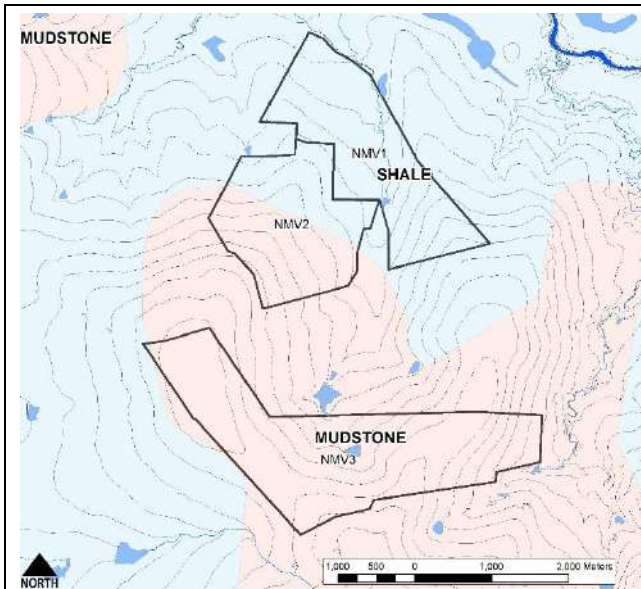


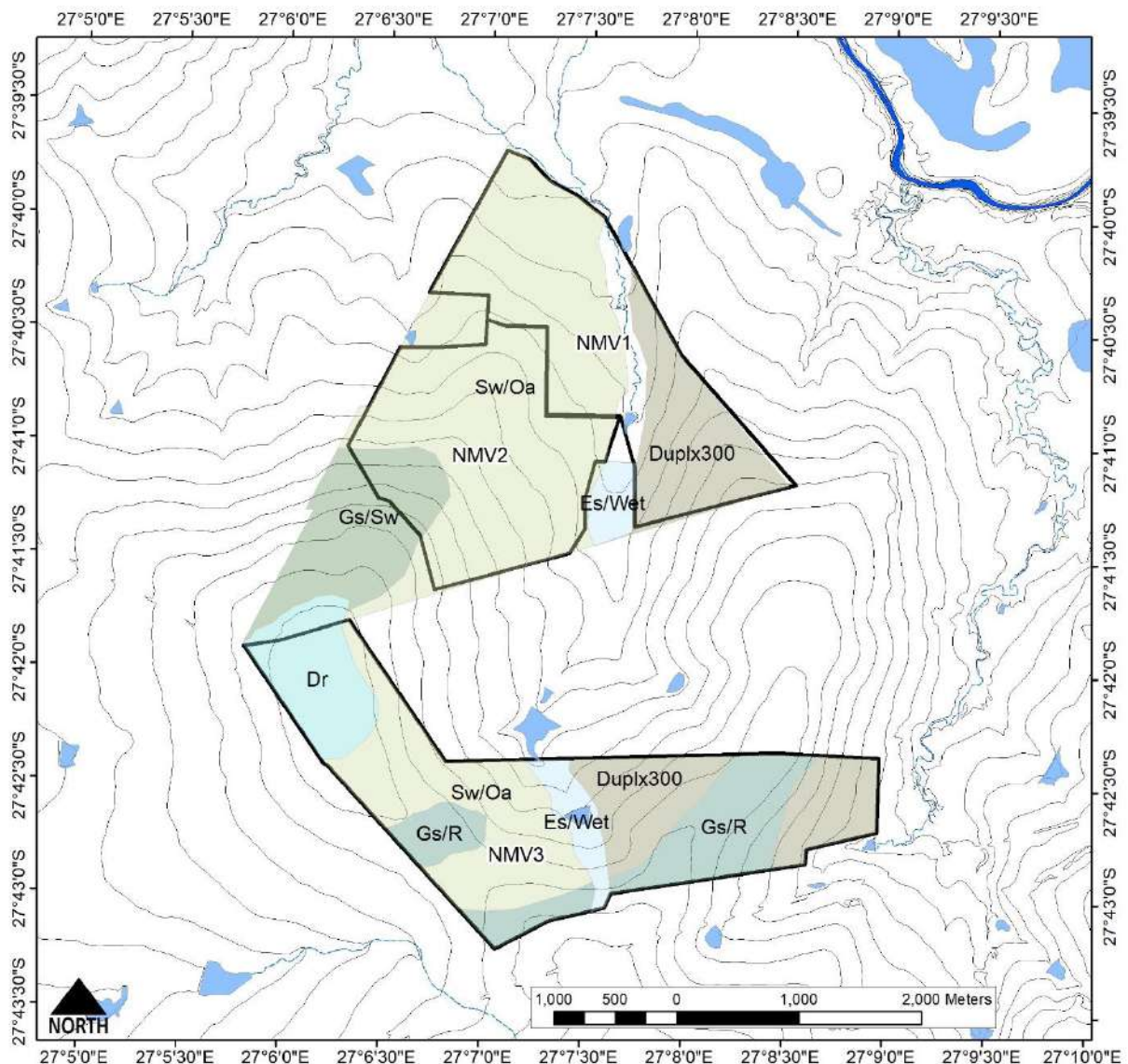
Figure 7. Geology of the Northern Cluster PV sites



Photo 1. Erodible soils common in the project area

Table 1. Capability description according to Montgomery *et al.*

Soil Type	Soil description	Capability (Montgomery)	Sensitivity	Flood hazard	Erosion susceptibility	Depth restriction	Texture restriction	Drainage restriction	Restriction to cultivation
Dr	Dresden dominant- shallow soil on hard plinthite.	vi	Very low	1	1	5	3	4	4
Duplx300	Escourt, Swartland dominant. Shallow highly erodible soils.	v	Low	1	4	4	2	4	3
Es/Wet	Structured soils in watercourses and their headlands.	v	Very low	1	5	4	2	5	3
Gs/Sw	Glenrosa and Swartland dominant. Shallow and moderately deep soils on semi-weathered mudstone or shale.	iv	Moderate	1	3	3	2	4	2
Sw/Oa	Swartland and Oakleaf dominant. Shallow and moderately deep soils on semi-weathered mudstone or shale.	iv	Moderate	1	3	3	2	4	2



**Figure 8. Soil map**

There are already gullies that have formed due to erosion. The farmer attempted to slow down flow speeds during high intensity rains by placing car tyres in gullies. High erosion susceptibility is one of the main reasons why the land use potential is low or that the ecological sensitivity is high.

As indicated earlier, erosion is a major concern on soil that derived from Beaufort sediments. Erosion control measures should receive special attention in the design of the stormwater plan.

#### LAND CAPABILITY DETERMINATION

In 2002 the Directorate: Land Use and Soil Management within DALRRD developed a national spatial land capability data set to indicate the spatial delineation of the then defined eight land capability classes. The approach followed was based on the approach of Klingebiel and Montgomery (1961) but adapted for South Africa. The aim was to develop a system for soil and land capability classification. It further aimed to incorporate the parameters within a Geographic Information System (GIS). The resulted spatial data set was derived at from a 1:250 000 land type data set being the main input data set for the derived land capability classes together with climatic and terrain parameters.

This dataset is used within the Sensitivity Screening tool.

While the new dataset is more complex than that of Klingebiel *et al*, the latter has clear guidelines and is generally still followed when assigning capability to land. A comparison between the two systems is provided below.

**Table 2. Relationship between grading of the Sensitivity Screening tool and that of Klingebiel *et al.***

DALRRD (2016)	Klingebiel	Capability	Arability
1-2	viii	Very low	Not arable
3-4	vii	Very low to low	
5-6	vi	Low	
7	v	Low to moderate	
8	iv	Moderate	Arable
9-10	iii	Moderate to high	
11-12	ii	High	
13-14	i	High to very high	
15	i	very high	

Land capability classes are interpretive groupings of land with similar potential and limitations or similar hazards. Land capability involves consideration of difficulties in land use owing to physical land characteristics, climate and the risks of land damage from erosion and other causes.

The classic eight-class land capability system (Klingebiel & Montgomery, 1961) was adapted for use by the South African Department of Agriculture in their Agriculture Geographic Information System (AGIS).

According to the soil capability classification, the soils have medium capability (or sensitivity as related to the Sensitivity Screening Tool).

- According to Klingebiel *et al.*, the soil capability is Class v and lower, mainly because of soil properties.
- Using the same criteria as AGIS, the farm is Class 7 (or Class iv or v according to Montgomery *et al.*) or poorer, which has *moderate/low* sensitivity.

## 8 IMPACT ASSESSMENT

### 8.1 LOSS OF HIGH POTENTIAL LAND

No high potential or sensitive soils were found; therefore, there will not be a loss of high potential land. According to the guidelines of various publications of DALRRD that deals with land capability and crop yield, the land is not high potential.

Further, the PV infrastructure does not alter the soil properties or land conditions, and once removed after the project life, it can be utilised for grazing once again.

- The impact is low, temporary and totally reversible.

### 8.2 LOSS OF AGRICULTURAL PRODUCTION

The site is used for game farming. These animals can be moved to another part of the farm without any impact on farming income.

The grazing opportunity that the farm provides cannot be replaced or mitigated on a national level.

Our national electricity problems far outweigh the loss of income that the farm will sacrifice.

- The impact is low on a regional or national scale.
- The loss is temporary and will be for the medium term.
- There will be no loss of labour opportunities. The labourer that tends the livestock can be employed elsewhere on the farm.

### 8.3 LOSS OF AGRICULTURAL INFRASTRUCTURE

There is no farming infrastructure on the site.

- In conclusion, no agricultural infrastructure will be lost.
- There is now impact.

### 8.4 LOSS OF SOIL DUE TO EROSION

The soil is very erodible (see section 6.2.2) because of the strongly developed structure of the B2 horizon. Nevertheless, the PV projects creates areas that are cleared of vegetation, and that could be subject to erosion. Runoff from hard surfaces should be dealt with by a Stormwater Management Plan (SWMP). This is an engineering function and is normally addressed as part of the project design.

- Severe erosion can be expected if the topsoil is removed, especially where the slope is high. It is essential that the stormwater management plan includes orderly runoff and that there are no or little bare surfaces that can be subject to erosion.
- Mitigation is achieved by allowing grass to re-establish after construction and by guidelines in the SWMP.
- All stormwater runoff structures should be grassed and flow retarding structures should be placed where runoff speeds become too high.
- Wetlands areas should not be disturbed and where eroded areas should be repaired.

## 9 CONCLUSIONS AND RECOMMENDATIONS

The Screening Tool correctly indicates that there is no cultivated land and there is also no highly sensitive land that needs to be protected. According to the Protocols for agricultural impact assessment in terms of Notice No. 320 Government Gazette 43110 20 March 2020 of the proposed PV site, a compliance statement is required for inclusion into the Project Environmental impact report.

The impacts of the development are as follows:

- Loss of high potential land

There will not be permanent loss of high potential land. According to the guidelines of various publications of DALRRD that deals with land capability, the land is not high potential.

- Loss of agricultural production

The land is used for game farming. However, the land is grazing land and the potential loss should be compared to that of livestock as a potential loss. The impact of the project on agricultural production is low. The loss in net farm income from livestock production is approximately R451 392 per year.

- Loss of Agricultural infrastructure

There is no agricultural infrastructure on the site.

- Loss of soil due to erosion

Severe erosion can be expected if the topsoil is removed. It is essential that the stormwater management plan includes orderly runoff and that there are no or little bare surfaces that can be subject to erosion.

Mitigation is achieved by allowing grass to re-establish after construction.

Wetlands areas should not be disturbed and where eroded areas should be repaired.

Runoff from hard surfaces should be dealt with by a Stormwater Management Plan (SWMP).



## **RECOMMENDATIONS**

The conclusion is that there will be no permanent loss of high potential land and only limited loss of agricultural production from the livestock.

There is no preference between either Alternative 1 or 2.

There were no gaps found in knowledge in the investigation. The recommendations made in this report is based on the findings during the investigation.

The PV site development takes place on low potential land that has a low sensitivity related to agriculture.

It is the author's opinion that there is no reason to prevent the project from being implemented.

Further, any measures or projects that can help to relieve the country's electricity problems should be encouraged.

# 10 ADDENDA

## 10.1 SOURCES OF INFORMATION

- a) Criteria for high potential agricultural land in South Africa, Department of Agriculture, Directorate Land Use and Soil Management, 2002.
- b) Grondklassifikasie Werkgroep, 1991. Grondklassifikasie, 'n Taksonomiese sisteem vir Suid Afrika, Departement van Landbou-ontwikkeling, Pretoria.
- c) Department of Agriculture. Grazing capacity. Development of Agricultural Land Framework Bill, 2016
- d) WRC, 2003 South African Atlas of Agrohydrology and Climatology, Water Research Commission
- e) CROPWAT 8.0 has been developed by Joss Swennenhuis for the Water Resources Development and Management Service of FAO.

## 10.2 GROSS MARGINS

### LIVESTOCK

<b>CATTLE MARGINS</b>	<b>R/LSU</b>
<b>Income</b>	<b>10 750</b>
<b>Costs</b>	<b>3 697</b>
Summer licks	217
Winter licks	652
Vet costs	127
Bull costs	200
Labour	1 046
Pastures	672
Repairs	320
<b>VARIABLE COSTS</b>	<b>463</b>
Marketing	438
Transport	25
<b>Margin</b>	<b>7 053</b>

## 10.3 SACNASP CERTIFICATE



### THE SOUTH AFRICAN COUNCIL FOR NATURAL SCIENTIFIC PROFESSIONS

herewith certifies that

**Johan Andries Gouws**  
Registration number: 400140/06

has been registered as a

**Professional 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)

**Agricultural Science**

11 July 2006  
Pretoria

  
President

  
Chief Executive Officer

## 10.4 CURRICULUM VITAE (CV)

Position Title and No.	Agriculture, Land use planning and wetland specialist. INDEX
Name of Expert:	Andries Gouws
Date of Birth	12/04/1955
Country of Citizenship /Residence	South Africa

### Education

Name of institution: College/University or other	Degree/diploma/certificate or other specialized education	Date completed
University of Pretoria, South Africa	BSc. Agriculture	1979
University of Bloemfontein	BSc. Honours, Agriculture	1987
Potchefstroom Collage for Agriculture	Diploma: Stereoscopic aerial photo interpretation of natural resources for farm planning	1981
University of South Africa	Diploma: Financial management	1992
University of Trinity	PhD: Integrated agricultural development	2007

### Employment record relevant to the assignment:

Period	Employing organization and your title/position. Contact info for references	Country	Summary of activities performed relevant to the Assignment
1993 - current	INDEX - Director and co-owner: Responsibility: Agriculture and land use planning. Contact: Eugene Gouws - Director +27 82 55 33 787	RSA	Provided specialist assessment services in agriculture and land use planning for various development projects.

### Membership in Professional Associations and Publications:

Soil Science society of South Africa.

South African Council for Natural Scientific Professions – Registered Professional Scientist (Reg no: 400140/06)

### Adequacy for the Assignment:

Detailed Tasks Assigned on Consultant's Team of Experts:	Reference to Prior Work/Assignments that Best Illustrates Capability to Handle the Assigned Tasks
Position: Agricultural Specialist	Agricultural Impact Assessment for the Proposed Mookodi- Mahikeng 400kv Line. 2018. Client: Nemai Consulting
	Agricultural Impact Assessment for the Proposed Foxwood Dam 2015 – 2016 Compiled the specialist report on Agricultural impact



	Client: Nemaï Consulting, DWS
	Agricultural Impact Assessment for the Proposed Mokolo and Crocodile River (West) Water Augmentation Project (MCWAP) (2017 – 2019) Compiled the specialist report on Agricultural impact Client: Nemaï Consulting, DWS
	MSOBO COAL – HARWAR; economic study for the farming enterprises Discussion of the natural resources that influences agricultural potential; Farming and the potential for different enterprises; Indicate the potential income from main enterprises and Indicate the financial impact of the development on the farmers. (2013/4) Client: Demacon
	Agricultural potential study of Portion 21 (Portion 1) of the farm Koppieskraal 1157-IR 2019. Client: Adv Johan du Plessis
	Agricultural Potential Assessment: Albany Wind Energy Facility & Grid Infrastructure Near Makhanda, Eastern Cape Province 2020 Client: CES Environmental and Social advisory Services
	Agricultural potential and impact assessment of Available Land At Mopeia, Mozambique 2016 Client: Barari Forest Management. Department: Research & Development Abu Dhabi

Expert's contact information: E-mail: [index@iafrica.com](mailto:index@iafrica.com)  
Phone: +27 (0) 82 807 6717

**Certification:**

I, the undersigned, certify that to the best of my knowledge and belief, this CV correctly describes my qualifications, my experience and myself.

Andries Gouws

Name of Expert



Signature

April 2023

Date

## 10.5 OBSERVATIONS

