Avifauna Assessments for the Mutsho Solar PV3 Project

Makhado, Limpopo Province

June 2022

CLIENT

Prepared by:

The Biodiversity Company

Cell: +27 81 319 1225

Fax: +27 86 527 1965

info@thebiodiversitycompany.com

www.thebiodiversitycompany.com

Table of Contents

1 Introduction 1
1.1 Project Description 1
1.2 Background Information 2
1.3 Specialist Details 6
1.4 Scope of Work 7
1.5 Assumptions and Limitations 7
2 Key Legislative Requirements 7
3 Methods 8
3.1 Desktop Assessment 8
3.1.1 Ecologically Important Landscape Features 8
3.1.2 Desktop Faunal Assessment 10
3.2 Field Assessment 10
3.2.1 Data analysis 11
3.3 Terrestrial Site Ecological Importance 12
4 Receiving Environment 14
4.1 Desktop Assessment 14
4.1.1 Ecologically Important Landscape Features 14
4.1.2 Avifauna Expected 22
5 Literature Review 23
6 Field Assessment 25
6.1 Dominant species 26
6.2 Trophic Guilds 28
6.2.1 Flight and Nest Analysis 29
6.3 Fine-Scale Habitat Use 30
7 Site Sensitivity 33
8 Impact Assessment 38
8.1 Current Impacts 38
8.2 Avifauna Impact Assessment 39
8.2.1 Alternatives considered 40
8.2.2 Loss of Irreplaceable Resources 40
8.3 Assessment of Impact Significance 40
8.3.1 Construction Phase 40

8.3.2 Operational Phase 43
8.3.3 Decommissioning Phase 46
8.4 Cumulative Impacts 47
9 Specialist Management Plan 49
10 Monitoring 51
11 Recommendations 51
12 Conclusion 52
12.1 Impact Statement 52
13 References 53
14 Appendix Items 55
14.1 Appendix A – Specialist Declaration of Independence 55
14.2 Appendix A: Avifaunal species expected in the area. 56
14.3 Appendix B: Avifauna species recorded in the survey 63
14.4 CV of Specialist 65

List of Tables

Table 2-1 A list of key legislative requirements relevant to biodiversity and conservation in the Limpopo Provinces 7

Table 3-1 Summary of Conservation Importance (CI) criteria 12

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) 13

Table 3-4 Summary of Receptor Resilience (RR) criteria 13

Table 3-5 Matrix used to derive Site Ecological Importance from Receptor Resilience (RR) and Biodiversity Importance (BI) 13

Table 3-6 Guidelines for interpreting Site Ecological Importance in the context of the proposed development activities 14

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 project area 22

Table 5-1 Dominant species found in the Pachnoda (2018) report. 24

Table 5-2 SCCs and important species observed in the Pachnoda (2018) assessment 24

Table 6-1 Risk species observed during this survey 25

Table 6-2 Dominant avifaunal species within the project area as defined as those species whose relative abundances cumulatively account for more than 72% of the overall abundance shown alongside the frequency with which a species was detected among point counts. 27

Table 7-1 SEI Summary of habitat types delineated within field assessment area of project area .. 35

Table 7-2 Guidelines for interpreting Site Ecological Importance in the context of the proposed development activities 37

Table 8-1 Construction activities impacts on the avifauna 41

Table 8-2 Construction activities impacts on the avifauna 41

Table 8-3 Construction activities impacts on the avifauna 42

Table 8-4 Construction activities impacts on the avifauna 42

Table 8-5 Operational activities impacts on the avifauna 43

Table 8-6 Operational activities impacts on the avifauna 44

Table 8-7 Operational activities impacts on the avifauna 44

Table 8-8 Operational activities impacts on the avifauna 45

Table 8-9 Decommissioning activities impacts on the avifauna 46

Table 8-10 Decommissioning activities impacts on the avifauna 46

Table 8-11 Cumulative impact of the solar facility 47

Table 9-1 Summary of management outcomes pertaining to impacts to avifauna and their habitats 49

List of Figures

Figure 1-1 Proposed location of the project area in relation to the nearby towns 3

Figure 1-2 Project area of relevance 4

Figure 1-3 The project infrastructure layout 5

Figure 3-1 Map illustrating the field survey area 11

Figure 4-1 Map illustrating the ecosystem threat status associated with the project area. 15

Figure 4-2 Map illustrating the ecosystem protection level associated with the project area 16

Figure 4-3 Map illustrating the locations of CBAs in the project area 17

Figure 4-4 The project area in relation to the protected areas 18

Figure 4-5 The project area in relation to the National Protected Area Expansion Strategy 19

Figure 4-6 The project area in relation to the Soutpansberg IBA 20

Figure 4-7 Map illustrating ecosystem threat status of rivers and wetland ecosystems in the project area 21

Figure 4-8 The project area in relation to the National Freshwater Ecosystem Priority Areas. 22

Figure 5-1 Wahlberg eagle nest observed in the Pachnoda (2018) assessment 25

Figure 6-1 The location of the recordings of the species of conservation concern 26

Figure 6-2 Photographs of two of the risk species, A) Dark Chanting Goshawk, and B) Helmeted Guineafowl 26

Figure 6-3 Some of the birds recorded in the project area: A) Red-faced Mousebird B) Cape Turtle Dove, C) Golden-breasted Bunting, D) Southern Red-billed Hornbill, F) Blue Waxbill, F) Emerald-spotted Wooddove, G) Southern Yellow-billed Hornbill and H) Southern White-crowned Shrike 28

Figure 6-4 Avifaunal trophic guilds. CGD, carnivore ground diurnal; CGN, carnivore ground nocturnal, CAN, carnivore air nocturnal, CWD, carnivore water diurnal; FFD, frugivore foliage diurnal; GCD, 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. 29

Figure 6-5 Flight paths and nest locations 30

Figure 6-6 The avifauna habitats found in and around the project area. 32

Figure 6-7 Photographs illustrating the habitats identified during the assessments: A & B) Closed Woodland, C) Rocky Areas, D) Mopane Bushveld and E) Water Resources 33

Figure 7-1 Terrestrial Biodiversity Theme Sensitivity, National Web based Environmental Screening Tool. 34

Figure 7-2 Fauna Theme Sensitivity, National Web based Environmental Screening Tool. 35

Figure 7-3 Sensitivities based on the avifauna assessment 36

Figure 7-4 The sensitivities in relation to the project layout 36

Figure 8-1 Some of the identified impacts within the project area; A) Fences and roads, B) Powerline, C) Railway Track, D) Fences 39

1 Introduction

The Biodiversity Company was appointed by Savannah Environmental (Pty) Ltd (Savannah) to undertake an avifauna assessment for the Mutsho Power Project, which this scoping report makes specific reference to the terrestrial ecology expertise. The project area is located in the magisterial district of Vhembe, in the Limpopo Province, approximately 39 km north of the town Makhado (Louis Trichardt) and 8 km south-west of Mopane Town (Figure 1-1). The project consists of four components (separate reports), the fieldwork were assessed simultaneously (Figure 1-2 and Figure 1-3).

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 project area as "Very High") while the fauna sensitivity was rated as 'Moderate'.

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 at a scoping level, enabling informed decision making.

1.1 Project Description

Mutsho Power (Pty) Ltd is proposing the construction and operation of a Photovoltaic (PV) Solar Energy Facility and associated infrastructure on the Farm Vrienden 589, located approximately 8 km south-west of Mopane and 39 km south-west of Musina, within the Musina Local Municipality and the Vhembe District Municipality in the Limpopo Province. The facility will have a contracted capacity of up to 100MW and will be known as Mutsho Solar PV3. The project is planned as part of a cluster of Solar PV Facilities with a total capacity of up to 400MW, and will be connected to the electricity grid via a 132kV Collector Station and 132kV double circuit overhead power line to the Nzhelele Substation. The grid connection infrastructure is the subject of a separate Basic Assessment process.

A preferred project site with an extent of ~1237ha and a development area of ~277ha within the project site has been identified by Mutsho Power (Pty) Ltd as a technically suitable area for the development of the Mutsho Solar PV3 Facility.

Infrastructure associated with the facility, which will enable the facility to supply a contracted capacity of up to 100MW, will include:

- Solar PV array comprising PV modules and mounting structures;
- Inverters and transformers;
- Cabling between the panels;
- 33/132kV onsite facility substation, including associated equipment and infrastructure;
- Electrical and auxiliary equipment required at the Collection Station that serves the solar energy facility, including a switchyard/bay, control building, fences, etc;
- Cabling from the onsite substation to the Collection Station (either underground or overhead);
- Site offices, warehouses, and guardhouses;

- Water storage tanks at admin block for human consumption;
- Laydown areas; and
- Internal gravel distribution roads.

The Solar PV Facility is proposed in response to the identified objectives of the national and provincial government and local and district municipalities to develop renewable energy facilities for power generation purposes. It is the developer's intention to bid the Mutsho Solar PV3 Facility under the Department of Mineral Resources and Energy's (DMRE's) Renewable Energy Independent Power Producer Procurement (REIPPP) Programme, or a similar programme, with the aim of evacuating the generated power into the national grid. This will aid in the diversification and stabilisation of the country's electricity supply, in line with the objectives of the Integrated Resource Plan (IRP) with Mutsho Solar PV3 set to inject up to 100MW into the national grid.

1.2 Background Information

Specialist studies were undertaken for the proposed project, dated 2018. These studies have been considered to supplement the findings for the newly commissioned process. The following studies are applicable:

- Bathusi Environmental Consulting cc (2018). Terrestrial Biodiversity EIA assessment for the proposed Mutsho Power Project near Makhado, Limpopo Province. Reference Number SVE – MPS – 2018/07, Version 2018.04.12.03; and
- In the Bathusi Environmental Consulting cc (2018) study the Avifaunal attributes of the receiving Environment by Lucas Niemand of Pachnoda Consulting was incorporated.

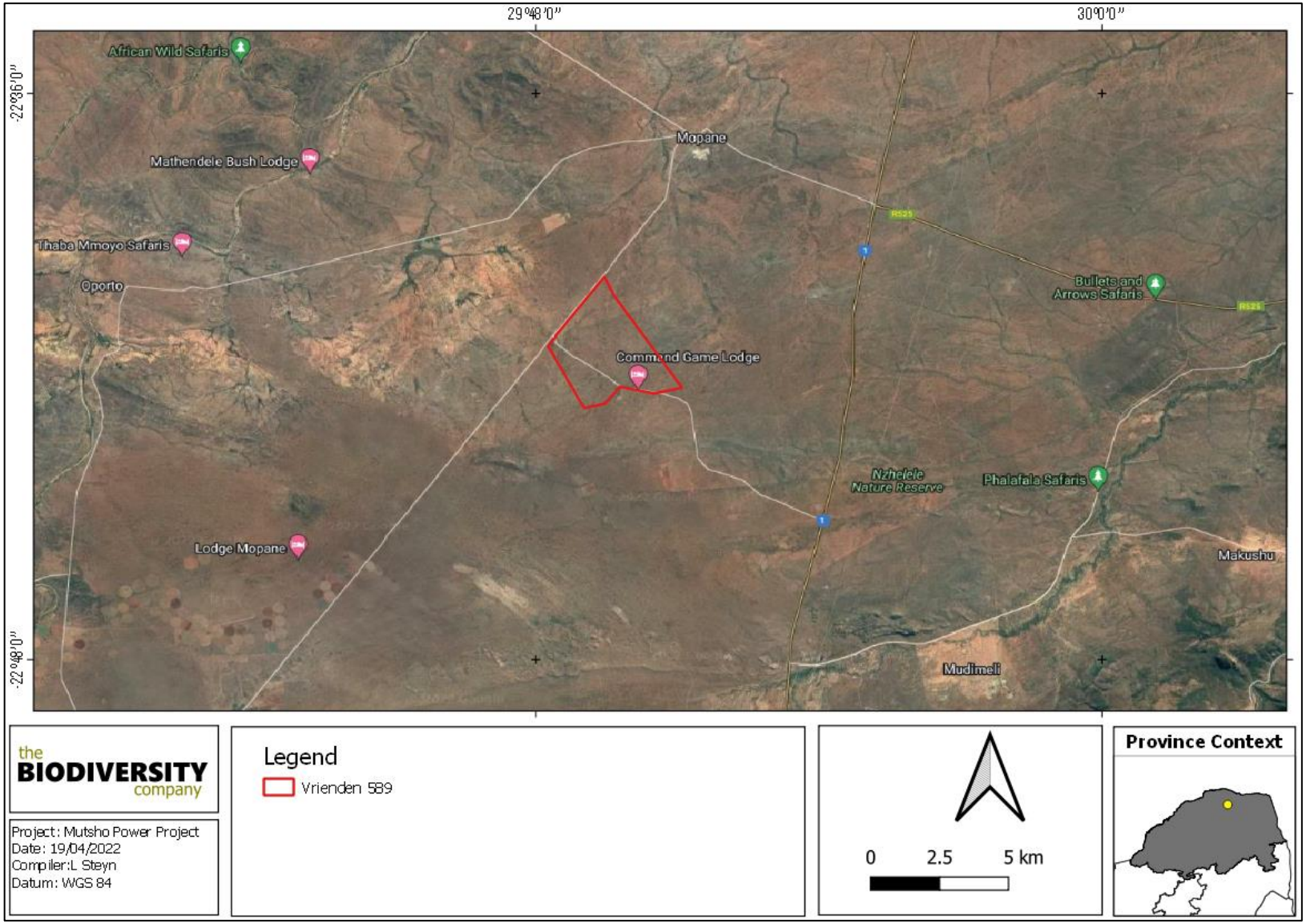

Figure 1-1 Proposed location of the project area in relation to the nearby towns

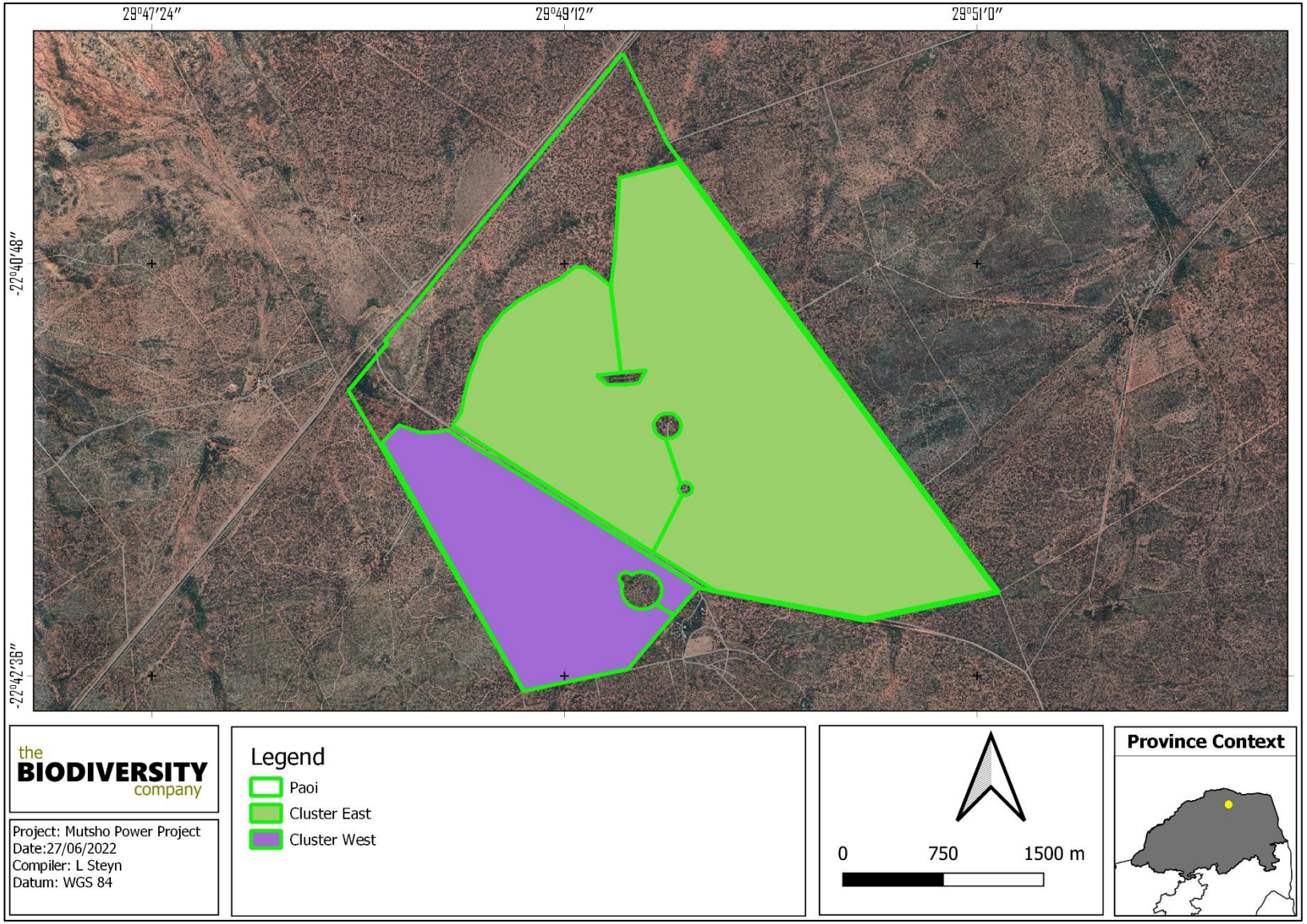

Figure 1-2 Project area of relevance

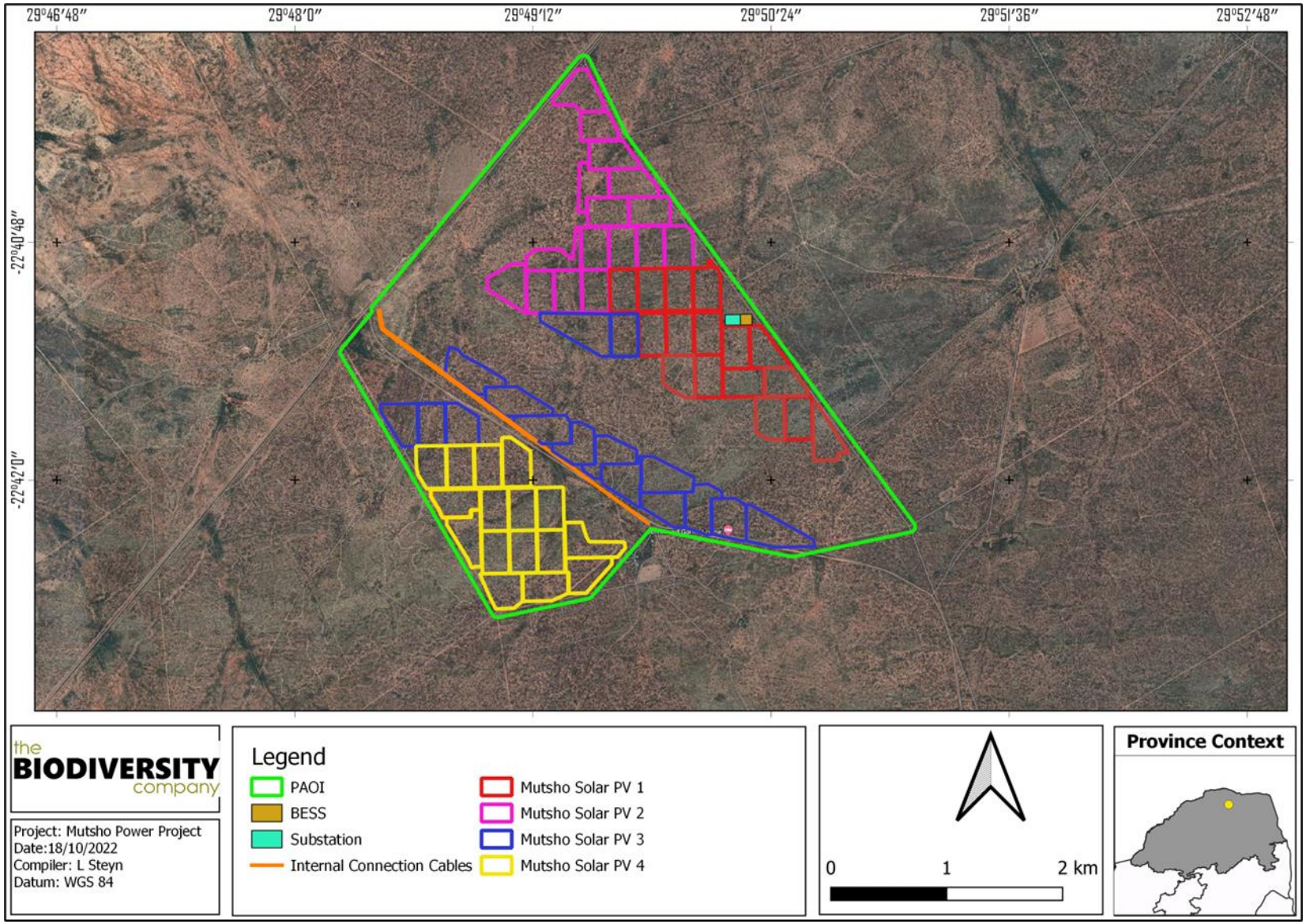

Figure 1-3 The project infrastructure layout

1.3 Specialist Details

Report Name	**Avifauna Assessments for the Mutsho Solar PV3 Project**
Reference	**Mutsho**
Submitted to	savannah environmental
Report Writer	**Lindi Steyn** 
	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	**Andrew Husted** 
	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 12 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 assessment within solar energy facilities as outlined by Birdlife South Africa.

The scope of the avifaunal assessment included the following:

- Description of the baseline avifaunal community;
- Identification of present or potentially occurring Species of Conservation Concern (SCC);
- Sensitivity assessment and map to identify sensitive areas in the project area; and
- Impact assessment, mitigation measures to prevent or reduce the possible impacts.

1.5 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 footprint and/or missing GIS information pertaining to the assessment area would have affected the area surveyed;
- The assessment was done in the winter season and the water sources were all dry;
- The weather conditions during the survey were cold and windy;
- No night surveys were performed due to safety risk;
- The assessment was a follow up assessment of a survey conducted in 2018 by Pachnoda Consulting cc which formed part of the Bathusi Environmental Consulting cc (2018). Terrestrial Biodiversity EIA assessment for the proposed Mutsho Power Project near Makhado, Limpopo Province. Reference Number SVE – MPS – 2018/07, Version 2018.04.12.03;
- This project as a whole consists of four separate development areas, the field assessment assessed the areas simultaneously;
- Although considerable time has been spent to ensure that information utilised in this report is verified. It is assumed that all third-party information utilised in the compilation of this report is correct at the time of compilation (e.g., spatial data, online databases, and species lists).

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 Limpopo Provinces

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)
	National Protected Areas Expansion Strategy (NPAES)
	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)
	National Spatial Biodiversity Assessment (NSBA)
	World Heritage Convention Act (Act No. 49 of 1999)
	Municipal Systems Act (Act No. 32 of 2000)
	Alien and Invasive Species Regulations and, Alien and Invasive Species List 20142020, published under NEMBA
	South Africa's National Biodiversity Strategy and Action Plan (NBSAP)
	Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983) (CARA)
	Sustainable Utilisation of Agricultural Resources (Draft Legislation).
	White Paper on Biodiversity
Provincial	Limpopo Conservation Plan (2018)
	Limpopo Environmental Management Act (2003)

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 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 Plans:

The **Limpopo Conservation Plan** was completed in 2018 for the Limpopo Department of Economic Development, Environment & Tourism (LEDET) (Desmet *et al.,* 2013). The purpose of the LCPV3 was to develop the spatial component of a bioregional plan (i.e., map of Critical Biodiversity Areas and associated land-use guidelines). The previous Limpopo Conservation Plan (LCPv1) was completely revised and updated (Desmet et al., 2013). A Limpopo 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 (CBA1);
- Critical Biodiversity Area 2 (CBA2);
- Ecological Support Area 1 (ESA1);
- Ecological Support Area 2 (ESA2);
- Other Natural Area (ONA);
- Protected Area (PA); and
- No Natural Remaining (NNR).

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 (Desmet et al., 2013).

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 (Driver *et al.,* 2017).

Areas with No Natural Habitat Remaining (NNR) 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). A biodiversity sector plan or bioregional plan must not specify the desired state/management objective or provide land-use guidelines for NNR areas (Driver *et al.,* 2017).

- 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; 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.

3.1.2 Desktop Faunal Assessment

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

- Avifauna list, generated from the SABAP2 dataset by looking at pentads 2230_2945; 2230_2950; 2230_2955; 2235_2945; 2235_2950; 2235_2955; 2240_2945; 2240_2950; 2240_2955).

3.2 Field Assessment

The field survey was undertaken during 20-24 June 2022. Effort was made to cover all the different habitat types within the limits of time and access. Areas surrounding the project area were also surveyed, this included areas on the river just south of the project area (Figure 3-1).

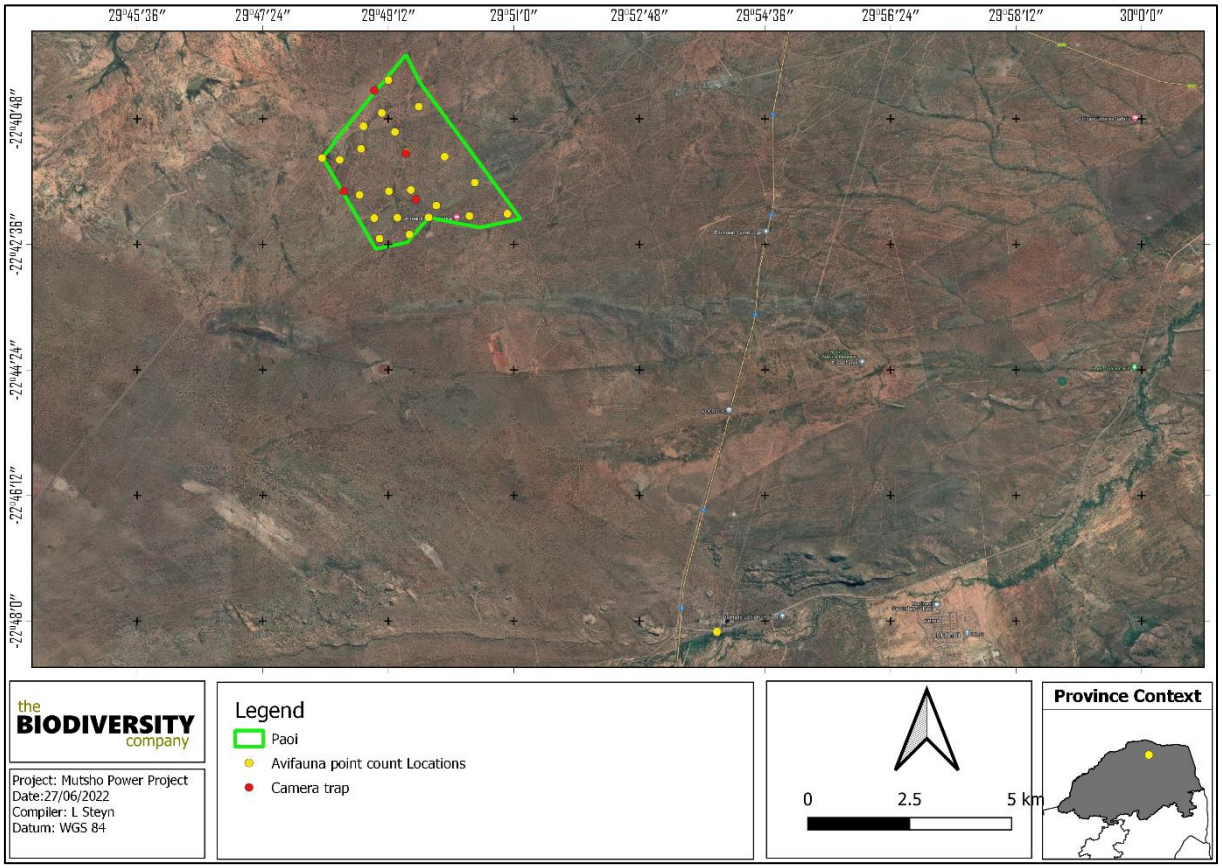

Figure 3-1 Map illustrating the field survey area

Sampling consisted of standardized point counts as well as random diurnal incidental surveys and vantage point surveys. Standardized point counts (following Buckland *et al.* 1993) were conducted to gather data on the species composition and relative abundance of species within the broad habitat types identified. Each point count was run over a 10 min period. The horizontal detection limit was set at 500 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 incidental searches were conducted. This involved the opportunistic sampling of species between point count periods and road cruising. Camera traps were also deployed in four locations for passive sampling.

3.2.1 Data analysis

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. 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).

3.3 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 will be 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 Critically Endangered (CR), Endangered (EN), Vulnerable (VU) or Extremely Rare or CR species that have a global extent of occurrence (EOO) of < 10 km^2. 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^2. 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 Near Threatened (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
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.
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, with no signs of major past disturbance 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 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.

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 Receptor Resilience (RR) criteria

Resilience	**Fulfilling Criteria**
Very High	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: (i) remaining at a site even when a disturbance or impact is occurring, or (ii) 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: (i) remaining at a site even when a disturbance or impact is occurring, or (ii) 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: (i) remaining at a site even when a disturbance or impact is occurring, or (ii) 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: (i) remaining at a site even when a disturbance or impact is occurring, or (ii) 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: (i) remain at a site even when a disturbance or impact is occurring, or (ii) 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 from Receptor Resilience (RR) and Biodiversity Importance (BI)

Site Ecological Importance		**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 project is provided in Table 3-6

Table 3-6 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.
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.

4 Receiving Environment

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	Relevant/Irrelevant	Section
Ecosystem Threat Status	Relevant – Overlaps with a Least Concern ecosystem	4.1.1.1
Ecosystem Protection Level	Relevant – Overlaps with a Moderately Protected Ecosystem	4.1.1.2
Protected Areas	Relevant – The project area overlaps with the Vhembe Biosphere Reserve	4.1.1.4
Renewable Energy Development Zones	Irrelevant - The project area is 309 km for the closest REDZ	-
Powerline Corridor	Relevant- The project area overlaps with the International Corridor	-
National Protected Areas Expansion Strategy	Relevant – The project area is approximately 3.7 km from a priority focus area	4.1.1.5
Critical Biodiversity Area	Relevant – The project area overlaps with ESA1 classified areas	4.1.1.3
Important Bird and Biodiversity Areas	Relevant – The project area is 12 km to the Soutpansberg IBA.	4.1.1.6
South African Inventory of Inland Aquatic Ecosystems	Relevant - The project area is 11km away from the closest NBA river and 7.6 km away from the closest wetland	4.1.1.7
National Freshwater Priority Area	Relevant – A non-priority seepage system is located within the extent of the project area.	4.1.1.8
Strategic Water Source Areas	Irrelevant- The project area is 31 km from the closest SWSA	-
Coordinated Avifaunal Road Count	Relevant – 275 km from the closest CAR route	-

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 project overlaps with a LC ecosystem (Figure 4-1).

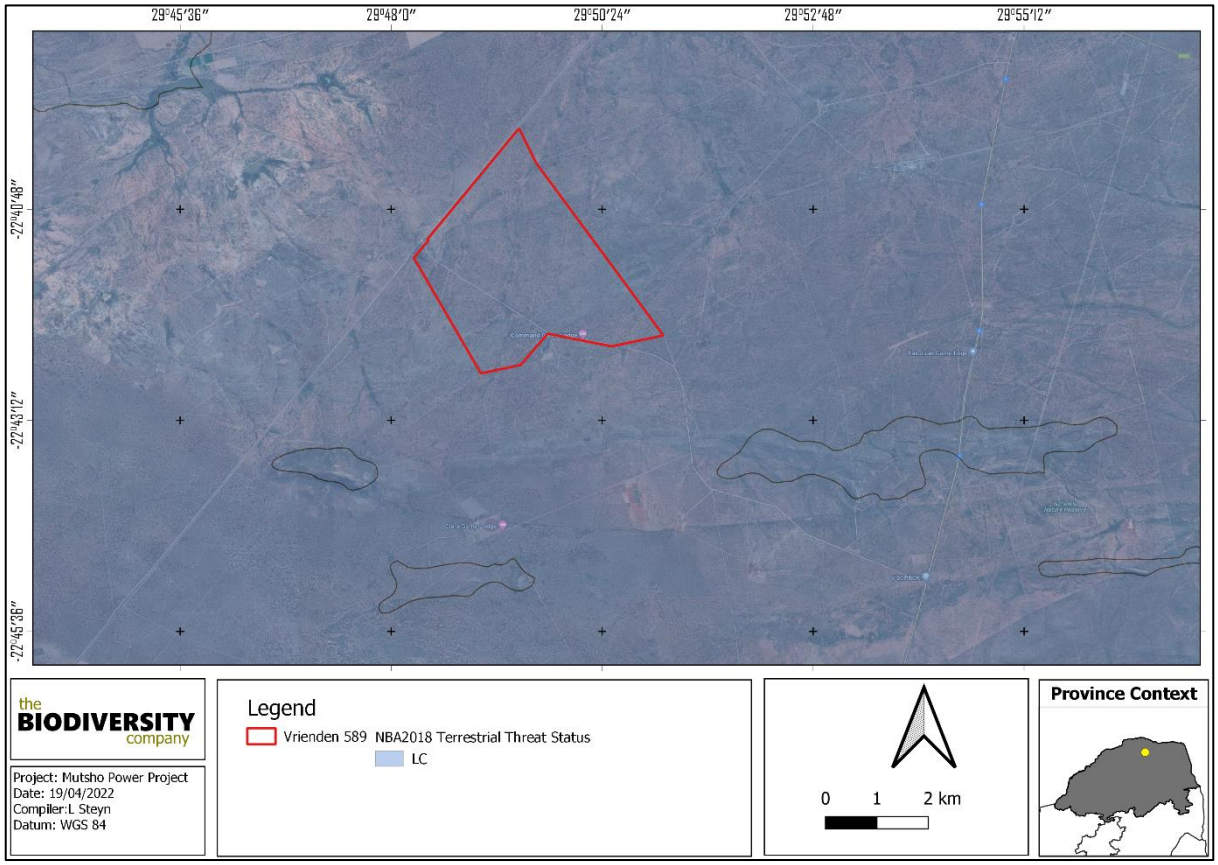

Figure 4-1 Map illustrating the ecosystem threat status associated with the project area.

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 project overlaps with a MP ecosystem (Figure 4-2).

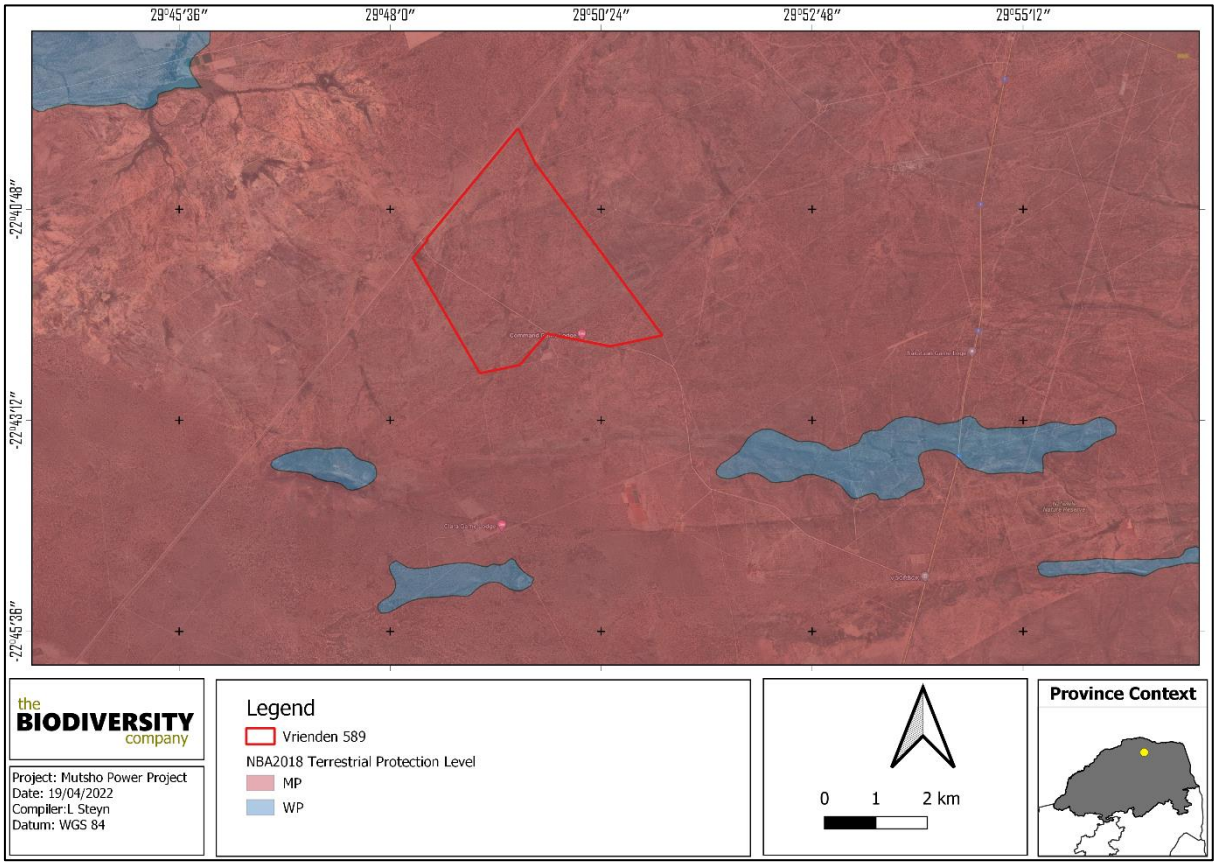

Figure 4-2 Map illustrating the ecosystem protection level associated with the project area

4.1.1.3 Critical Biodiversity Areas and Ecological Support Areas

The conservation of CBAs is crucial, in that if these areas are not maintained in a natural or near-natural state, biodiversity conservation targets cannot be met. Maintaining an area in a natural state can include a variety of biodiversity compatible land uses and resource uses (SANBI-BGIS, 2017).

The provincial CBA spatial data for the Limpopo province indicates that both feasibility areas don't traverse any CBA nor Ecological Support Areas (ESAs) and Other Natural Areas (ONAs). Based on the Limpopo Conservation Plan the SCSC feasibility area traverses ESA1 and NNR areas, whereas the SBPM feasibility area traverses ESA1, NNR and ONA area.

The purpose of the Limpopo C-Plan (2018) is to inform land-use planning and development on a provincial scale and to aid in natural resource management. One of the outputs is a map of Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs). These are classified into different categories, namely Protected Areas, CBA1 areas, CBA2 areas, ESA1 areas, ESA2 areas, Other Natural Areas (ONAs) and areas with No Natural Habitat Remaining (NNR) based on biodiversity characteristics, spatial configuration, and requirements for meeting targets for both biodiversity patterns and ecological processes.

Figure 4-3 shows the project area superimposed on the Terrestrial CBA maps. The project area overlaps with ESA1 classified areas.

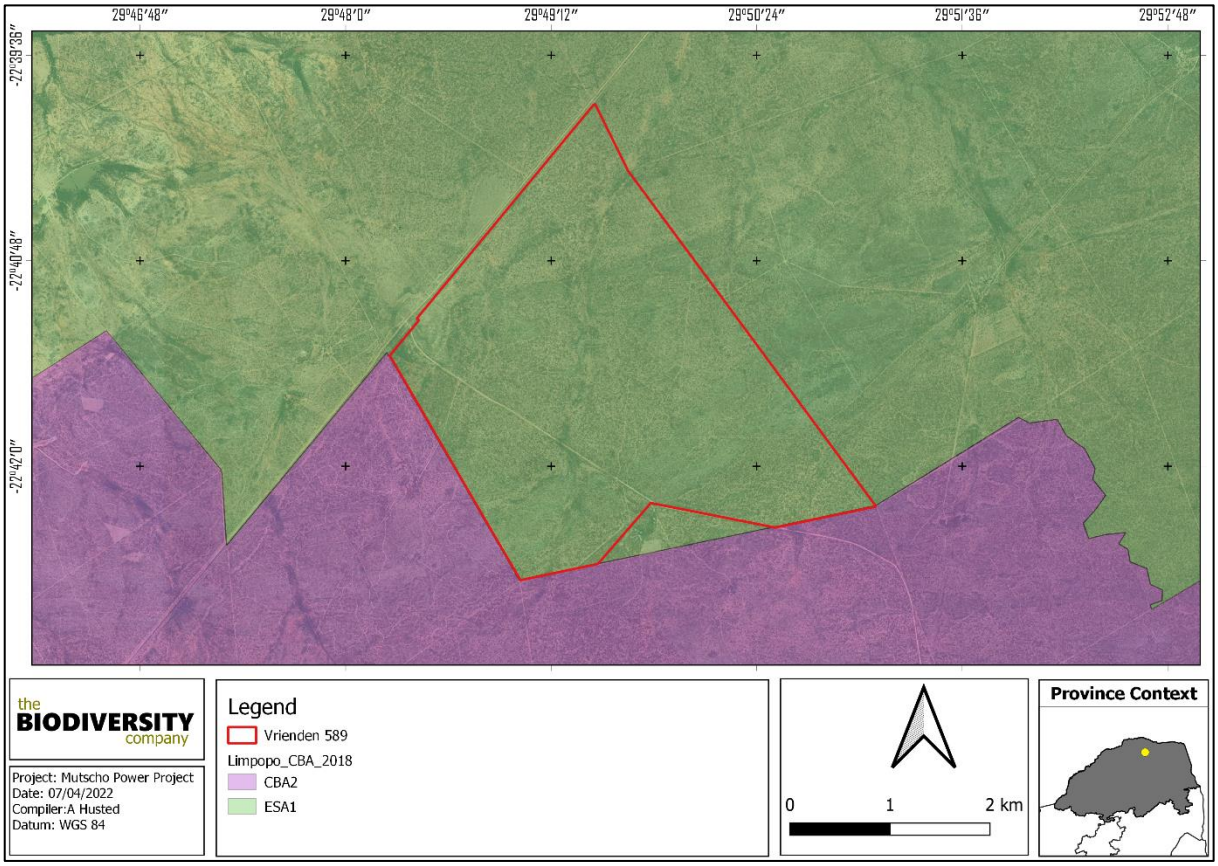

Figure 4-3 Map illustrating the locations of CBAs in the project area

4.1.1.4 Protected areas

According to the protected area spatial datasets from SAPAD (2021), the project area overlaps with the Vhembe Biosphere Reserve (Figure 4-4). No protected areas were found withing 5km of the project area. The closest reserve is the Boabab Private Nature Reserve that is 8.8 km form the project area.

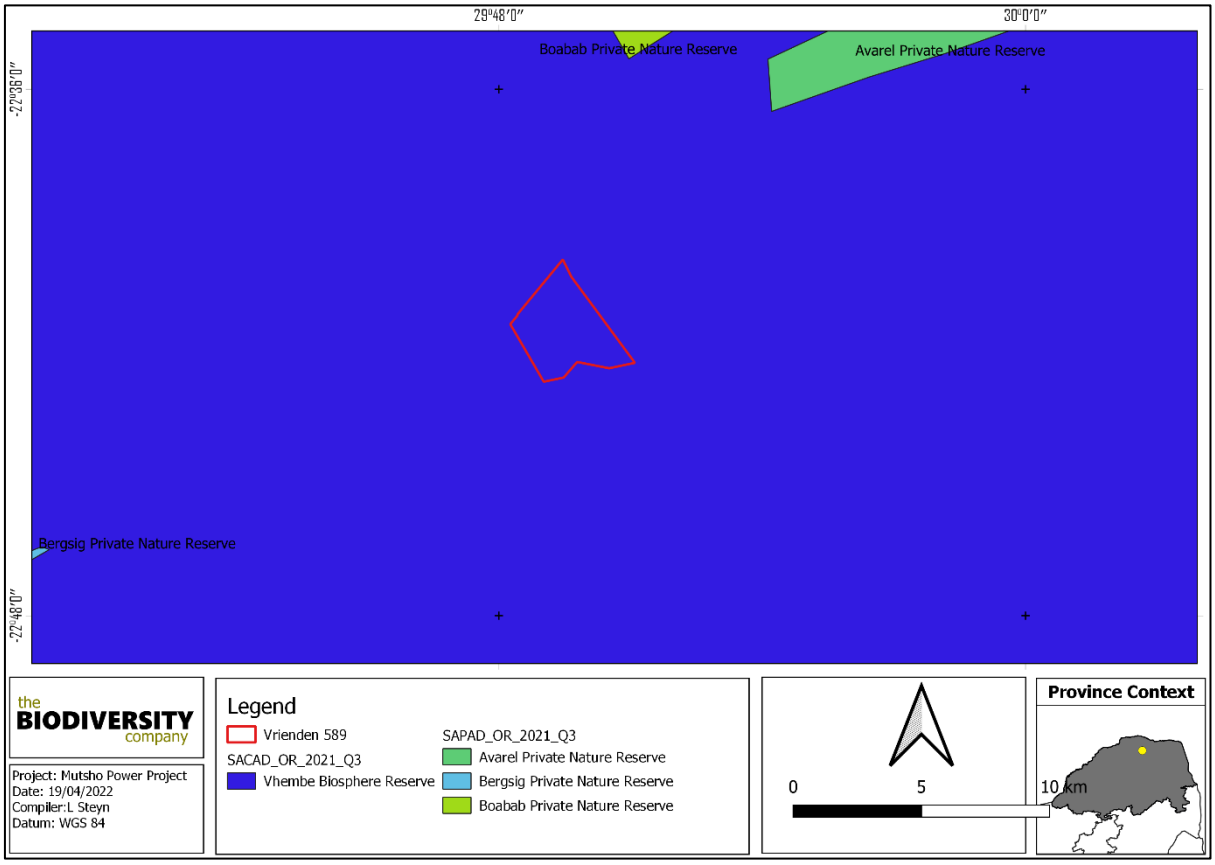

Figure 4-4 The project area in relation to the protected areas

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 project area is approximately 3.7 km from a priority focus area as can be seen in Figure 4-5.

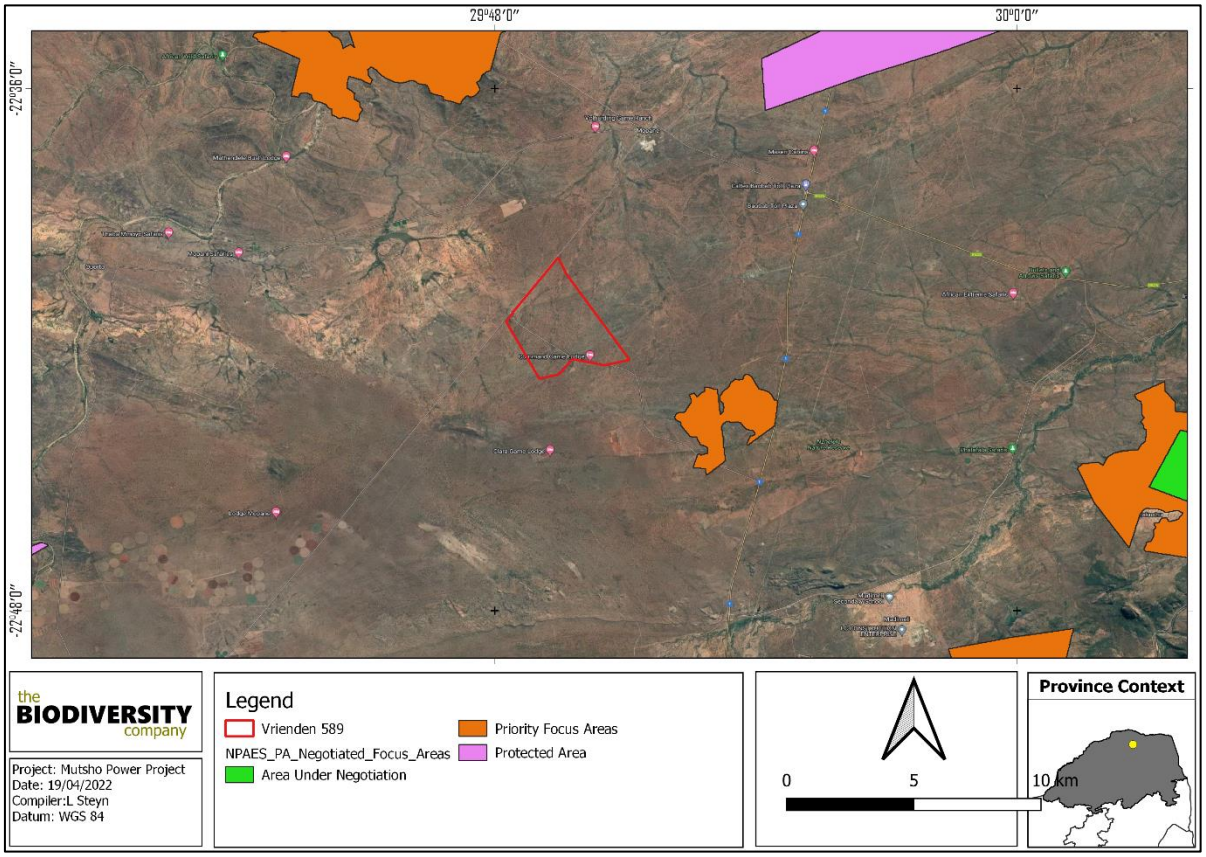

Figure 4-5 The project area in relation to the National Protected Area Expansion Strategy

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, 2017).

According to Birdlife International (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 the project area is 12 km to the Soutpansberg IBA.

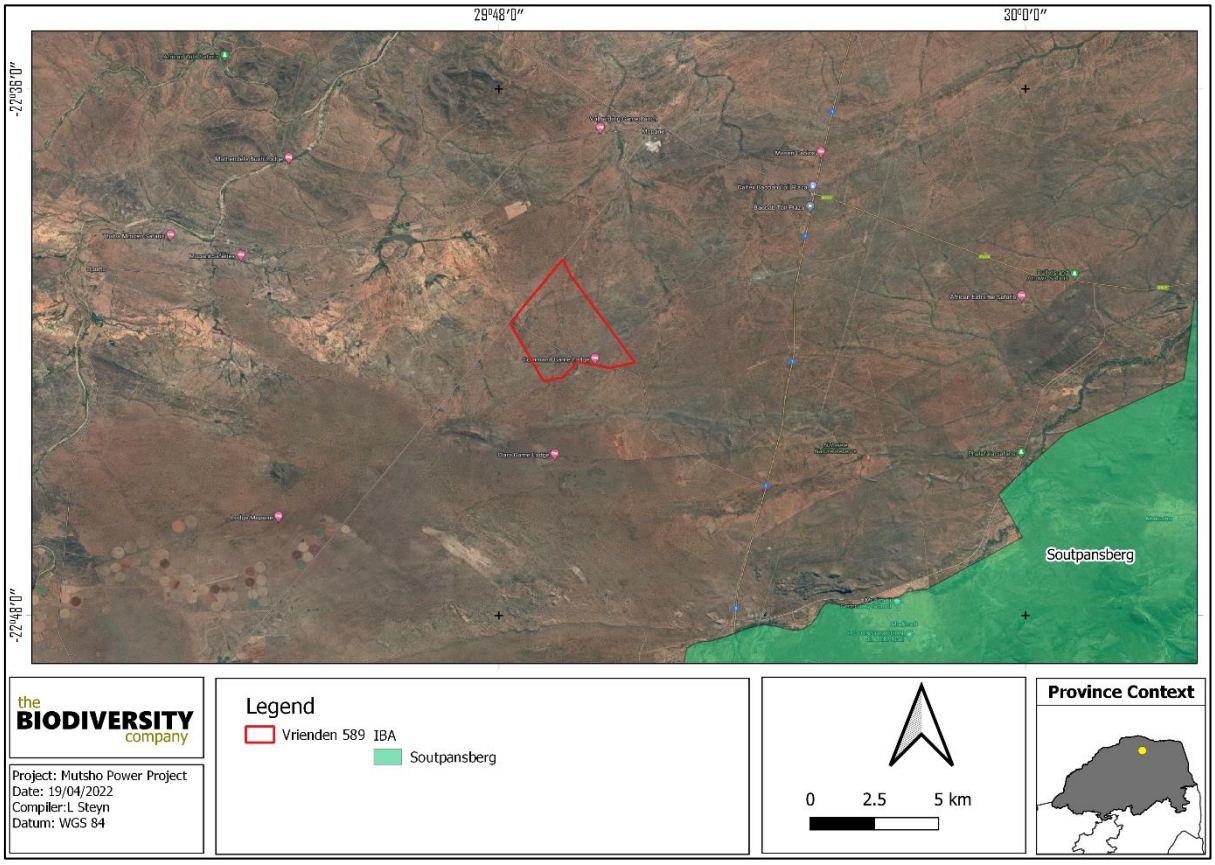

Figure 4-6 The project area in relation to the Soutpansberg IBA

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 project area is 11 km away from the closest NBA river and 7.6 km away from the closest wetland (Figure 4-7).

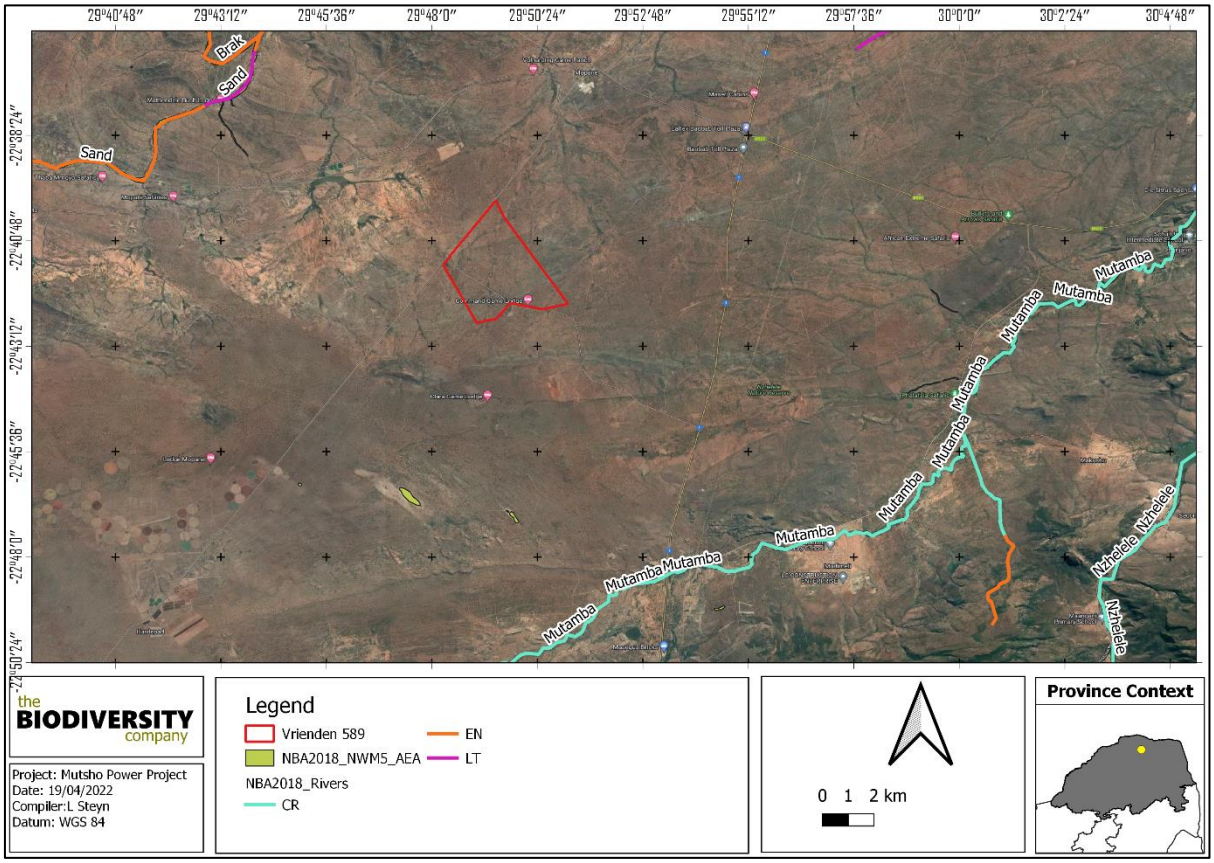

Figure 4-7 Map illustrating ecosystem threat status of rivers and wetland ecosystems in the project area

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 the location of the project area in relation to wetland FEPAs. Based on this information, a non-priority seepage system is located within the extent of the project area. The wetland is considered to be in a seriously modified ecological state.

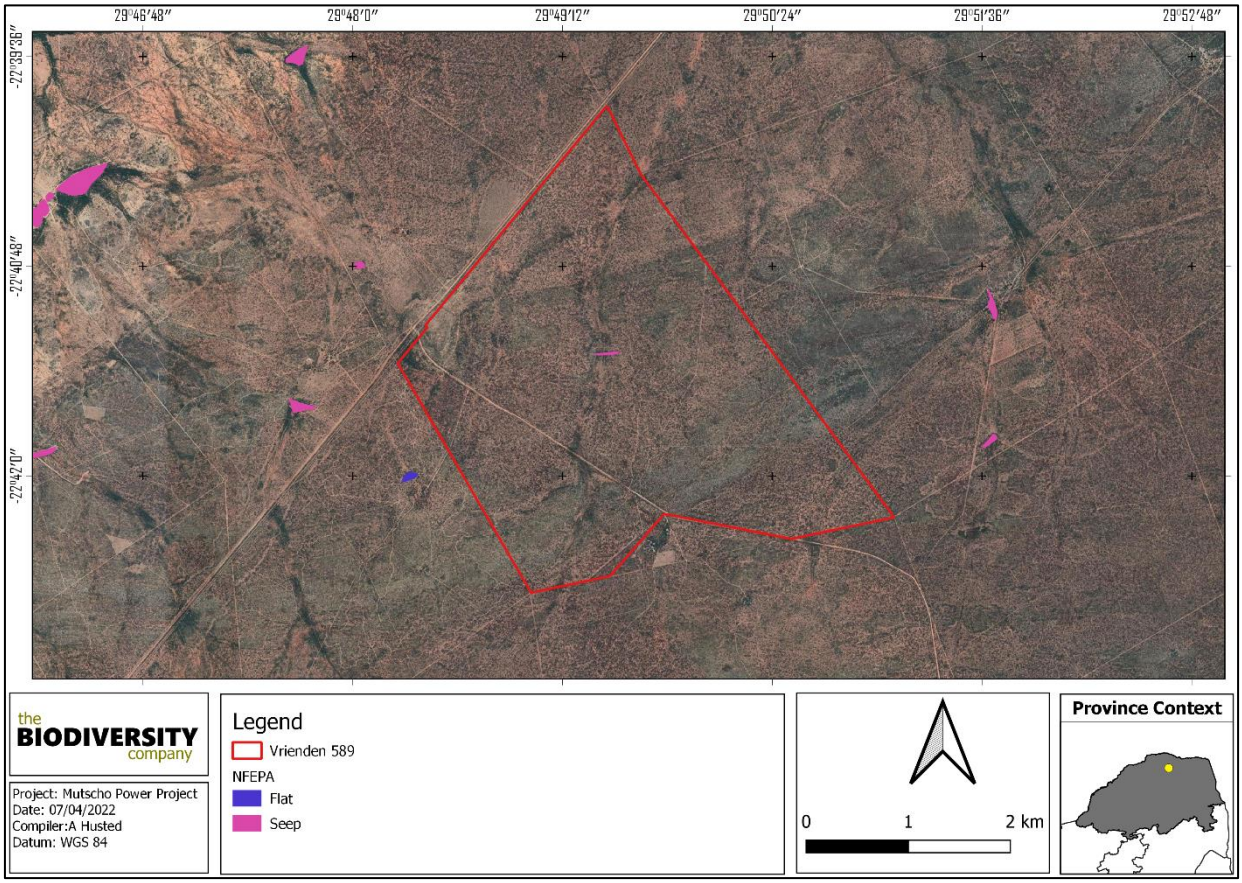

Figure 4-8 The project area in relation to the National Freshwater Ecosystem Priority Areas.

4.1.2 Avifauna Expected

The SABAP2 Data lists 237 avifauna species that could be expected to occur within the area (The full list will be provided in the final assessment). Eleven (11) of these expected species are regarded as threatened (Table 4-2). Six of the species have a low likelihood of occurrence due to lack of suitable habitat and food sources in the project area.

Table 4-2 Threatened avifauna species that are expected to occur within the project area

Species	Common Name	Conservation Status		Likelihood of Occurrence
		Regional (SANBI, 2016)	IUCN (2021)	
Aquila rapax	Eagle, Tawny	EN	VU	Moderate
Aquila verreauxii	Eagle, Verreaux's	VU	LC	Low
Ardeotis kori	Bustard, Kori	NT	NT	Moderate
Bucorvus leadbeateri	Ground-hornbill, Southern	EN	VU	Low
Ciconia nigra	Stork, Black	VU	LC	Moderate
Coracias garrulus	Roller, European	NT	LC	High
Ephippiorhynchus senegalensis	Stork, Saddle-billed	EN	LC	Moderate
Gyps africanus	Vulture, White-backed	CR	CR	High
Polemaetus bellicosus	Eagle, Martial	EN	EN	High
Terathopius ecaudatus	Bateleur, Bateleur	EN	EN	Low
Torgos tracheliotos	Vulture, Lappet-faced	EN	EN	Moderate

Aquila rapax (Tawny Eagle) is listed as EN on a regional scale and VU on an international scale and occupies dry open habitats from sea level to 3000 m. It will occupy both woodland and wooded savannah (IUCN, 2017). Due to its large distributional range the likelihood of occurrence of this species is rated as moderate.

Ardeotis kori (Kori Bustard) is listed as NT both on a regional and global scale. It occurs in flat, arid, mostly open country such as grassland, karoo, bushveld, thornveld, scrubland and savanna but also including modified habitats such as wheat fields and firebreaks. Collisions with high voltage power lines are a major threat to this species in the Karoo of South Africa (IUCN, 2007). The habitat at the project area, is somewhat suitable. This species has been recorded by Pachnoda in 2018 in the adjacent site.

Coracias garrulous (European Roller) is a winter migrant from most of South-central Europe and Asia occurring throughout sub-Saharan Africa (IUCN, 2017). The European Roller has a preference for bushy plains and dry savannah areas (IUCN, 2017). There is a high chance of this species occurring in the project area as suitable habitat and food sources can be found in the project area.

Ciconia nigra (Black Stork) is native to South Africa, and inhabits old, undisturbed, open forests. They are known to forage in shallow streams, pools, marshes swampy patches, damp meadows, flood-plains, pools in dry riverbeds and occasionally grasslands, especially where there are stands of reeds or long grass (IUCN, 2017). The species has a moderate likelihood of occurring in the project area and was recorded by Pachnoda (2018) on an adjacent property.

Ephippiorhynchus senegalensis (Saddle-billed Stork) is listed as EN on a local basis and is known to inhabit extensive fresh, brackish or alkaline wetlands in open, semi-arid areas and savanna, with relatively high abundances of fish and with large trees nearby for nesting and roosting (IUCN, 2017). Suitable habitats include shallow freshwater marshes, wet grasslands, the margins of large or small rivers, lake shores pans and flood-plains. A wetland that would be suitable can be found in the project area, the species was also recorded by Pachnoda (2018).

Gyps africanus (White-backed Vulture) has a large range and only occurs throughout sub-Saharan Africa. Primarily a lowland species of open wooded savanna, particularly areas of *Acacia (Vachellia*). It requires tall trees for nesting. According to the IUCN (2017) this species faces similar threats to other African vultures, being susceptible to habitat conversion to agro-pastoral systems, loss of wild ungulates leading to a reduced availability of carrion, hunting for trade, persecution and poisoning. Suitable trees for nesting can be found in the project area.

Polemaetus bellicosus (Martial Eagle) is listed as EN on a regional scale and EN on a global scale. This species has an extensive range across much of sub-Saharan Africa, but populations are declining due to deliberate and incidental poisoning, habitat loss, reduction in available prey, pollution and collisions with power lines (IUCN, 2017). It inhabits open woodland, wooded savanna, bushy grassland, thorn-bush and, in southern Africa, more open country and even sub-desert (IUCN, 2017). Trees for roosting and nesting can be found in the project area.

Torgos tracheliotus (Lappet-faced Vulture) is listed as EN, both on a regional and global level. Only a small, very rapidly declining population remains, owing primarily to poisoning and persecution, as well as ecosystem alterations (IUCN, 2017). The species inhabits dry savanna, arid plains, deserts and open mountain. It ranges widely when foraging and is mainly a scavenger, feeding predominantly on any large carcasses or their remains. This rare species is unlikely to be resident within the project area due to unsuitable nesting sites but may scavenge on any dead carcasses in the area, and therefore the likelihood of occurrence is rated as moderate.

5 Literature Review

The avifauna assessment was conducted in the summer of 2018 by Pachnoda Consulting cc which formed part of the Bathusi Environmental Consulting cc (2018). (Terrestrial Biodiversity EIA assessment for the proposed Mutsho Power Project near Makhado, Limpopo Province. Reference Number SVE – MPS – 2018/07, Version 2018.04.12.03.) The Pachnoda study assessed a larger project area which

consisted of Farm Du Toit 563 MS and Farm Vrienden 589 MS. During this survey 176 species were recorded, the species listed in Table 5-1 were the ten most dominant species.

Table 5-1 Dominant species found in the Pachnoda (2018) report.

Species	Scientific Name	Abundance
White-browed Scrub Robin	*Cercotrichas leucophrys*	1,23
Willow Warbler	*Phylloscopus trochilus*	1,53
Long-billed Crombec	*Sylvietta rufescens*	1,57
Cape turtle Dove	*Streptopelia capicola*	1,57
Southern Red-billed Hornbill	*Tockus rufirostris*	1,47
Chinspot Batis	*Batis molitor*	1,45
Barren Wren Warbler	*Calamonastes fasciolatus*	0,83
Blue Waxbill	*Uraeginthus angolensis*	1,3
Green-winged Pytilia	*Pytilia melba*	1,21
Spotted Flycatcher	*Muscicapa striata*	0,77
Golden Breasted Bunting	*Emberiza flaviventris*	0,94
White-bellied Sunbird	*Cinnyris talatala*	0,58
Brubru	*Nilaus afer*	0,92
Acacia Pied Barbet	*Tricholaema leucomelas*	0,49
Southern Black Tit	*Parus niger*	0,77
Yellow-fronted Canary	*Crithagra mozambica*	0,58
Fork-tailed Drongo	*Dicrurus adsimilis*	0,45
Southern Grey-headed Sparrow	*Passer diffusus*	0,74
Sabota Lark	*Mirafra sabota*	0,51

Species of conservation concern and important species observed in the project area are described in Table 5-2.

Table 5-2 SCCs and important species observed in the Pachnoda (2018) assessment

Common Name	Scientific Name	Observations
	SCCs	
Kori Bustard	*Ardeotis kori*	Three observed on Du Toit Farm
Black Stork	*Ciconia nigra*	One observation on Du Toit Farm
Saddle-billed Stork	*Ephippiorhynchus senegalensis*	Two observations on Du Toit Farm
White-backed Vulture	*Gyps africanus*	Two observations on Du Toit Farm
	Important species	
Wahlberg's Eagle	*Hieraaetus wahlbergi*	Four observations of which three are found on the Du Toit Farm and one nest in the corner of Vrienden Farm
African Hawk Eagle	*Aquila spilogaster*	One observation on Du Toit Farm
Brown Snake Eagle	*Circaetus cinereus*	Two observations on the Vrienden Farm
Dark Chanting Goshawk	*Melierax metabates*	One observation on the Vrienden Farm

One Wahlbergs Eagles nest was found during the Pachnoda (2018) assessment, the pin was placed on a map (Figure 5-1). During this TBC assessment the nest was observed but was not active.

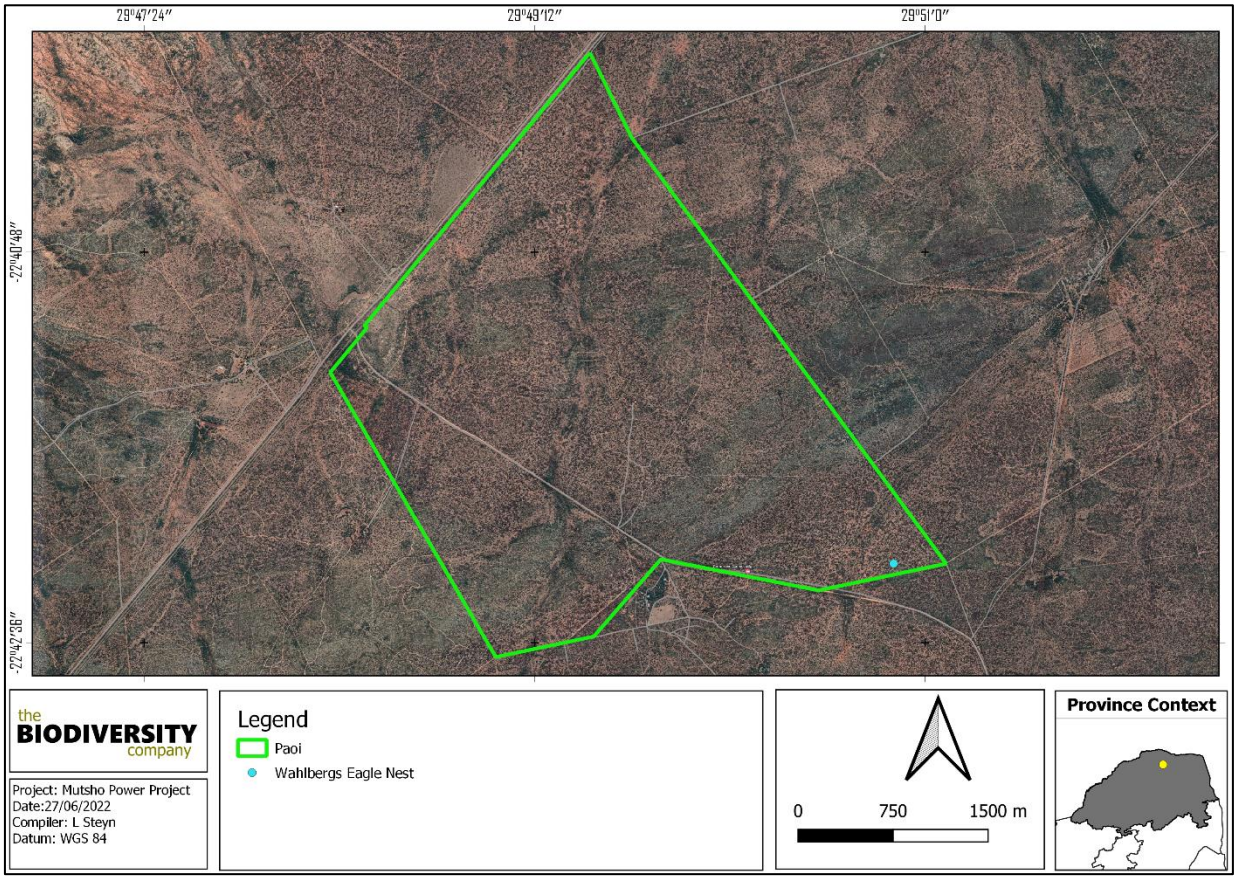

Figure 5-1 Wahlberg eagle nest observed in the Pachnoda (2018) assessment

6 Field Assessment

Fifty-seven (57) bird species were recorded in the survey. The full list of species recorded, their threat status, guild and location observed is shown in Appendix C, this includes some incidental records moving between point count locations. None of the species recorded were SCCs on a national or international scale. Three species that are regarded as risk species were however recorded (Table 6-1 and Figure 6-1). Risk species are species that would be sensitive to habitat loss, that are regarded as collision prone species and species that would have a high electrocution risk. Even though the panels do not pose an extensive collision risk for larger birds, powerlines associated with the infrastructure, guidelines (anchor lines) and connection lines does pose a risk. The fence could also pose a collision risk for various species as described in section 8.2.

Table 6-1 Risk species observed during this survey

Species	Common Name	Conservation Status		Collisions	Electrocution	Habitat Loss
		Regional (SANBI, 2016)	IUCN (2021)			
Melierax metabates	Goshawk, Dark Chanting	Unlisted	LC	x	x	x
Numida meleagris	Guineafowl, Helmeted	Unlisted	LC		x	
Polyboroides typus	Harrier-Hawk, African	Unlisted	LC	x	x	x
Corvus albus	Crow, Pied	Unlisted	LC		x	

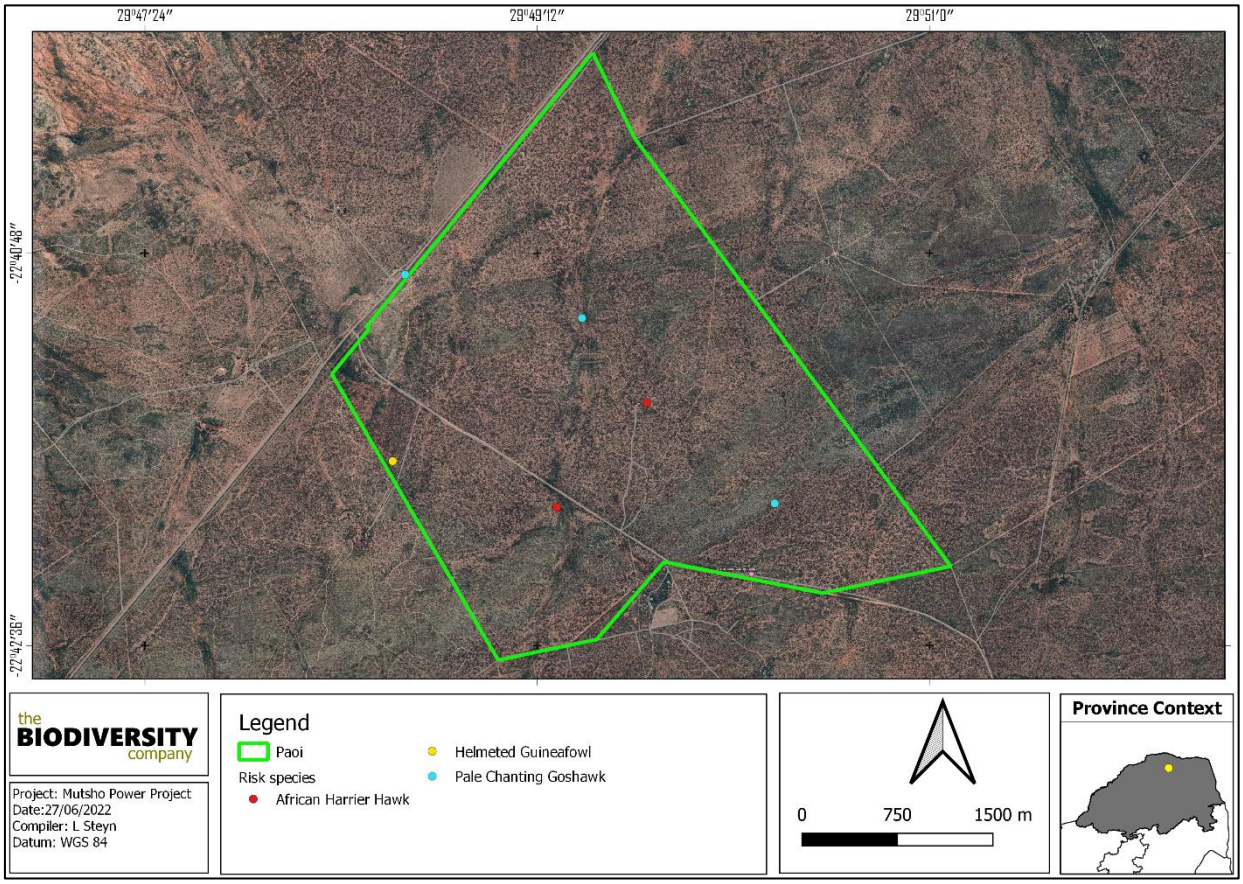

Figure 6-1 The location of the recordings of the species of conservation concern

Figure 6-2 Photographs of two of the risk species, A) Dark Chanting Goshawk, and B) Helmeted Guineafowl

6.1 Dominant species

Table 6-2 provide lists of the dominant species for the survey together with the frequency with which each species appeared in the point count samples. The data shows the Blue Waxbill, Southern Masked Weaver, Helmeted Guineafowl and Cape Turtle Dove were the most abundant species during the survey. Figure 6-3 shows some of the birds that were recorded during the survey.

Table 6-2 ***Dominant avifaunal species within the project area as defined as those species whose relative abundances cumulatively account for more than 72% of the overall abundance shown alongside the frequency with which a species was detected among point counts.***

Species	Common Name	Relative abundance	Frequency (%)
Uraeginthus angolensis	Waxbill, Blue	0,0940	40,909
Ploceus velatus	Masked-weaver, Southern	0,0805	22,727
Numida meleagris	Guineafowl, Helmeted	0,0705	13,636
Streptopelia capicola	Turtle-dove, Cape	0,0570	54,545
Eurocephalus anguitimens	Shrike, Southern White-crowned	0,0537	27,273
Crinifer concolor	Go-away-bird, Grey	0,0503	54,545
Tockus leucomelas	Hornbill, Southern Yellow-billed	0,0503	45,455
Dicrurus adsimilis	Drongo, Fork-tailed	0,0369	50
Urocolius indicus	Mousebird, Red-faced	0,0369	13,636
Cercotrichas leucophrys	Scrub-robin, White-browed	0,0302	22,727
Crithagra mozambica	Canary, Yellow-fronted	0,0268	22,727
Turdoides jardineii	Babbler, Arrow-marked	0,0268	9,0909
Emberiza flaviventris	Bunting, Golden-breasted	0,0235	13,636
Bubalornis niger	Buffalo-weaver, Red-billed	0,0201	18,182
Estrilda astrild	Waxbill, Common	0,0201	18,182
Prionops plumatus	Helmet-shrike, White-crested	0,0201	9,0909
Turtur chalcospilos	Wood-dove, Emerald-spotted	0,0201	22,727

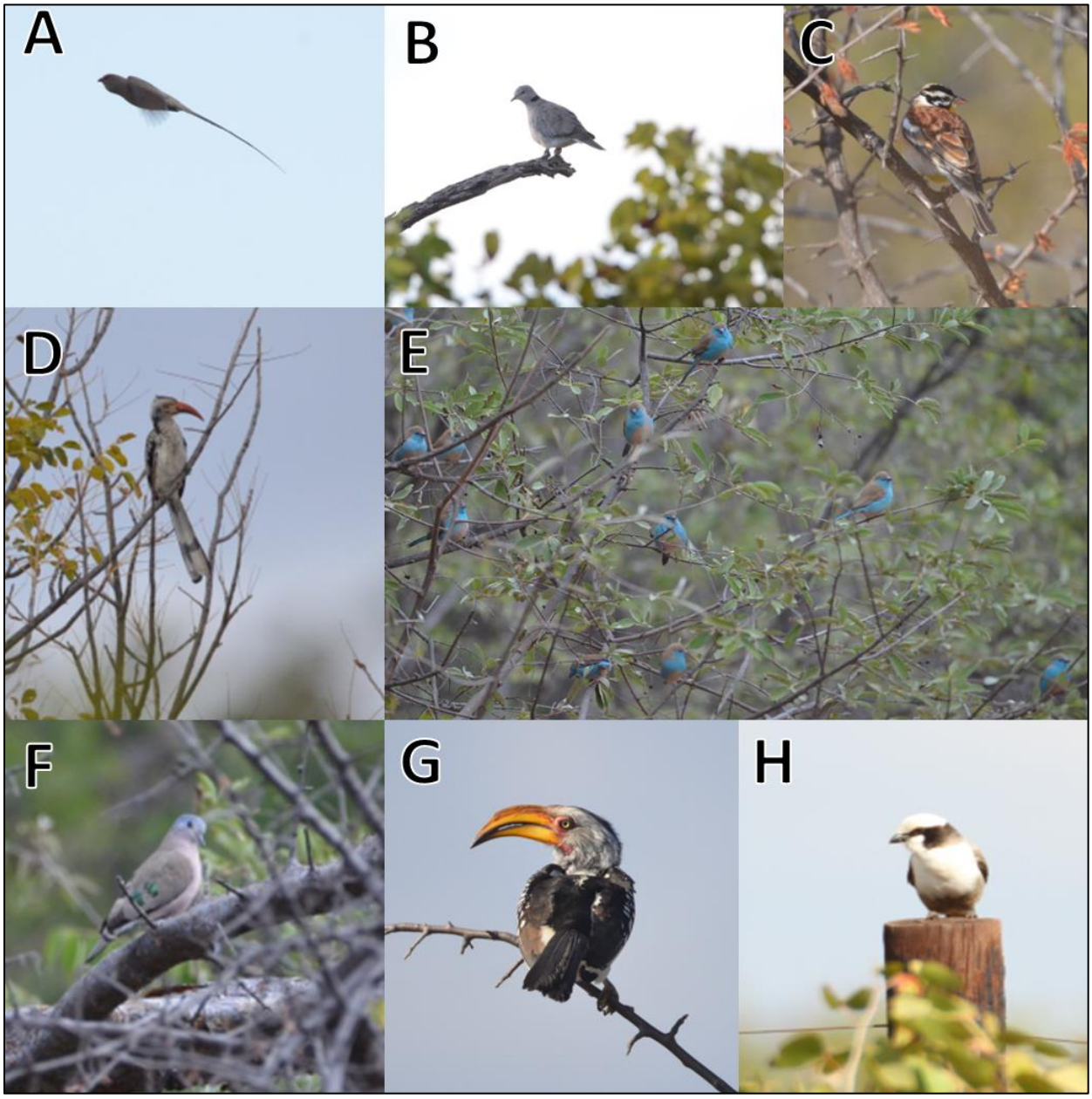

Figure 6-3 ***Some of the birds recorded in the project area: A) Red-faced Mousebird B) Cape Turtle Dove, C) Golden-breasted Bunting, D) Southern Red-billed Hornbill, F) Blue Waxbill, F) Emerald-spotted Wooddove, G) Southern Yellow-billed Hornbill and H) Southern White-crowned Shrike***

6.2 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. 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) (19%) (Figure 6-4). Omnivores that do not have a set habitat (OMD) made up the second highest group (14%), followed by granivore species (GGD) (13%). The lack of water sources in the project area, some were present but were dry during the survey, were the main cause of the lack of water birds. The seasonality of the survey was also regarded as the reason for the absence of predatory birds. No species active at night were recorded, they were also not recorded on the camera traps.

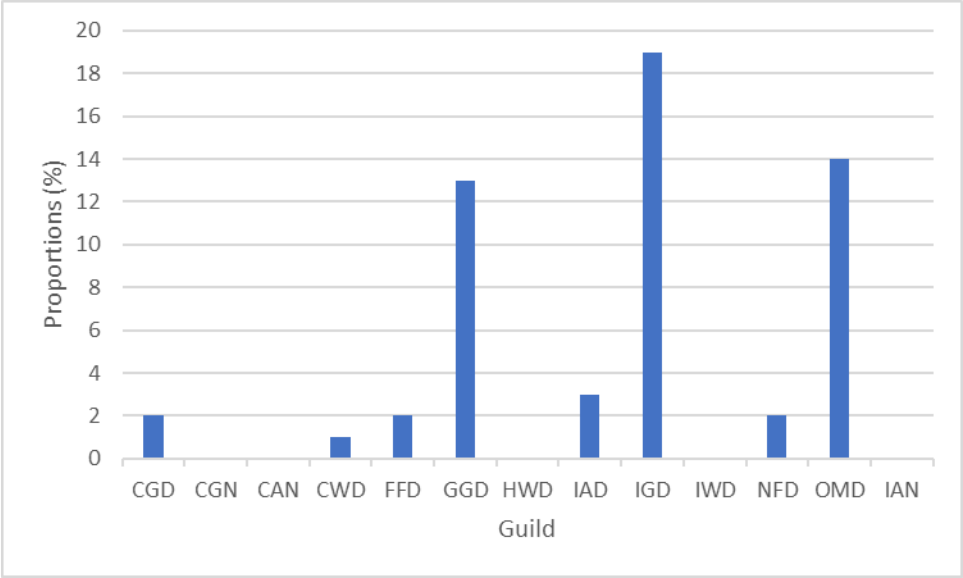

Figure 6-4 ***Avifaunal trophic guilds. CGD, carnivore ground diurnal; CGN, carnivore ground nocturnal, CAN, carnivore air nocturnal, CWD, carnivore water diurnal; FFD, frugivore foliage diurnal; GCD, granivore ground diurnal; HWD, herbivore water diurnal; IAD, insectivore air diurnal; IGD, insectivore ground diurnal; IWD, insectivore water diurnal; NFD, nectivore foliage diurnal; OMD, omnivore multiple diurnal; IAN, Insectivore air nocturnal.***

6.2.1 Flight and Nest Analysis

Observing and monitoring flight paths and nesting sites are important in ascertaining habitat sensitivity and evaluating the impact risk significance of any proposed development. There are three priority species for solar energy development and powerline infrastructure. During the field survey recording flight-paths and nesting sites were undertaken for certain species. However, given the limited time available the results of this section must be interpreted with caution, as each species movement is likely to be more extensive and there may have been nesting sites that were not observed. The two African Harrier Hawks flew in an easterly direction, while the guineafowl flew to safety after being disturbed in a westerly direction. One nest was observed, it is believed to be the Wahlbergs Eagle nest recorded in the Pachnoda (2018) study as well, during this survey the nest was however inactive. Figure 6-5 below illustrates the location and extent of flight paths and nesting sites of select priority species within the assessment area.

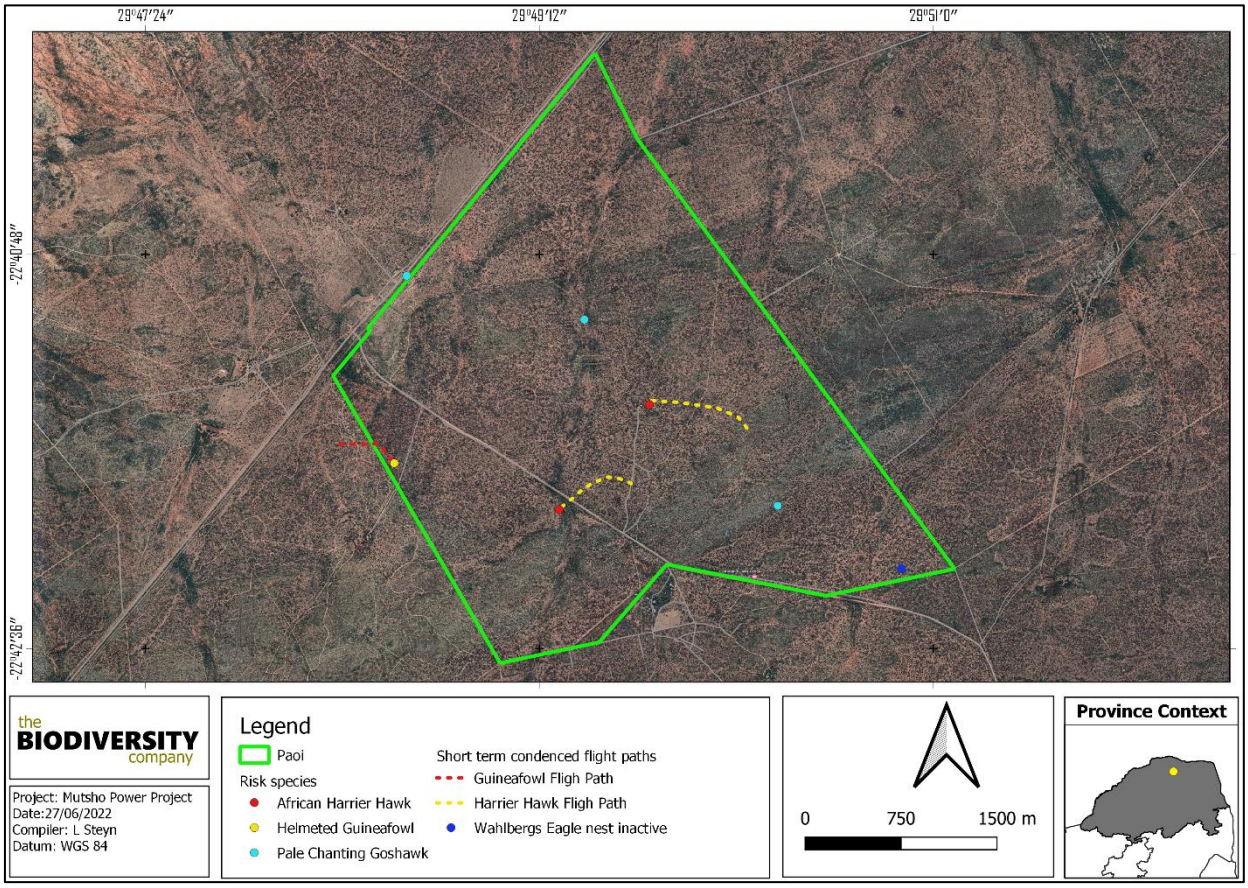

Figure 6-5 Flight paths and nest locations

6.3 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. The assessment area overlapped with four habitat types namely, Closed Woodland, Rocky Areas, Water courses and Mopane Bushveld (Figure 6-7). These habitats were based on the species compositions in the various areas. The areas of interests outside of the direct footprint were included as these areas could also support species that could be influenced by the development. The habitat on site is delineated, while the locations of a nearby river is shown in Figure 6-6.

Closed Woodland was dominated by *Combretum apiculatum* and *Grewia flavescens* and was found on sandy soil. Some portions of this habitat unit had sections where grass species were more prevalent in between the trees and shrubs. The portion of this habitat unit in the western cluster were more disturbed than the eastern cluster. Avifaunal species found in this habitat included species such as White-browed Scrub Robin, Grey Go Away Bird, all three species of hornbills i.e., Southern Red-billed Hornbill, Southern Yellow-billed Hornbill and African Grey Hornbill, Fork-tailed Drongo, Golden-breasted Bunting, Yellow-fronted Canary and two of the dove species i.e., Laughing Doves and Cape Turtle Doves. No distinction based on avifauna species composition could be made between the areas with more grasses to those consisting of largely trees therefore these two were combined.

Rocky areas had a quartzite substrate that were found in between larger trees such as *Boscia albitrunca* and some other *Commiphora* species. Avifauna species recorded here included Brown-crowned Tchagra, African Hoopoe, Long-billed Crombec and Southern White-crowned Shrike.

The mopane bushveld makes up majority of the project areas and as per the name were dominated by *Colophospermum mopane.* Avifauna species found here included; Common and Blue Waxbills, Crested Francolin, Swainson's Spurfowl, Helmeted Guineafowl, Red-billed Firefinch and Common Fiscal.

The Water Courses included the courses identified on site, some drainage lines and the Mutamba river south of the project area. A full description of the wetlands found on site can be seen in the TBC Wetland (2022) report. During the survey no running or standing water were present in the project area or in the Mutamba river. Therefore, no water dependent birds were observed during this assessment.

Closed Woodland was dominated by *Combretum apiculatum* and *Grewia flavescens* and was found on sandy soil. Some portions of this habitat unit had sections where grass species were more prevalent in between the trees and shrubs. The portion of this habitat unit on the western cluster were more disturbed than the eastern cluster. Avifaunal species found in this habitat included species such as White-browed Scrub Robin, Grey Go Away Bird, all three species of hornbills i.e. Southern Red-billed Hornbill, Southern Yellow-billed Hornbill and African Grey Hornbill, Fork-tailed Drongo, Golden-breasted Bunting, Yellow-fronted Canary and two of the dove species i.e. Laughing Doves and Cape Turtle Doves. No distinction based on avifauna species composition could be made between the areas with more grasses to those consisting of largely trees therefore these two were combined.

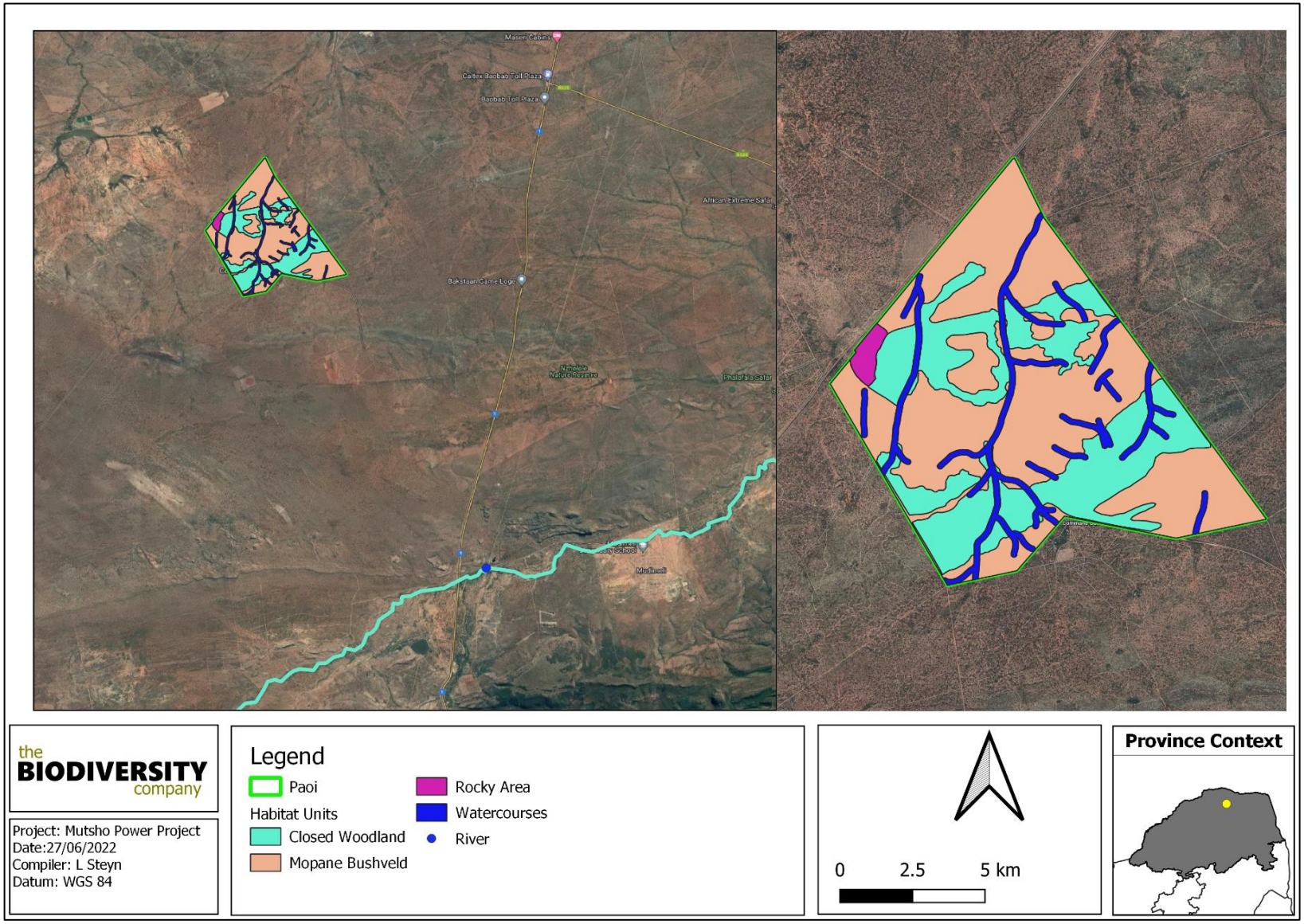

Figure 6-6 The avifauna habitats found in and around the project area.

Figure 6-7 Photographs illustrating the habitats identified during the assessments: A & B) Closed Woodland, C) Rocky Areas, D) Mopane Bushveld and E) Water Resources

7 Site Sensitivity

The biodiversity theme sensitivity, as indicated in the screening report, was derived to be Very High, (Figure 7-1) while the fauna sensitivity was rated as 'Moderate' (Figure 7-2). The moderate rating is based on the moderate likelihood of Bateleur (*Terathopius ecaudatus*) occurring. The very high terrestrial sensitivity was due to the CBA2 and ESA1 status of the project area as well as the FEPA sub catchment with which the project area overlap.

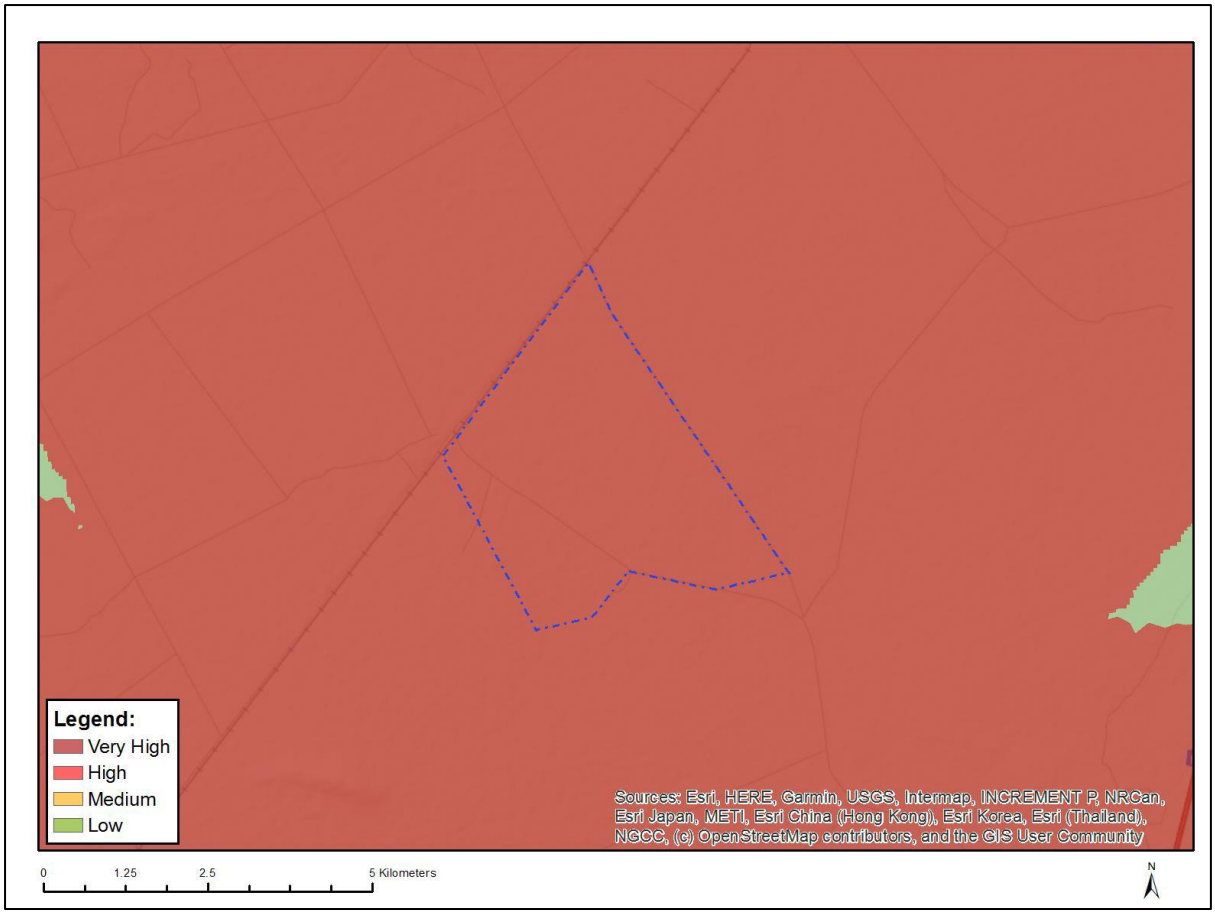

Figure 7-1 Terrestrial Biodiversity Theme Sensitivity, National Web based Environmental Screening Tool.

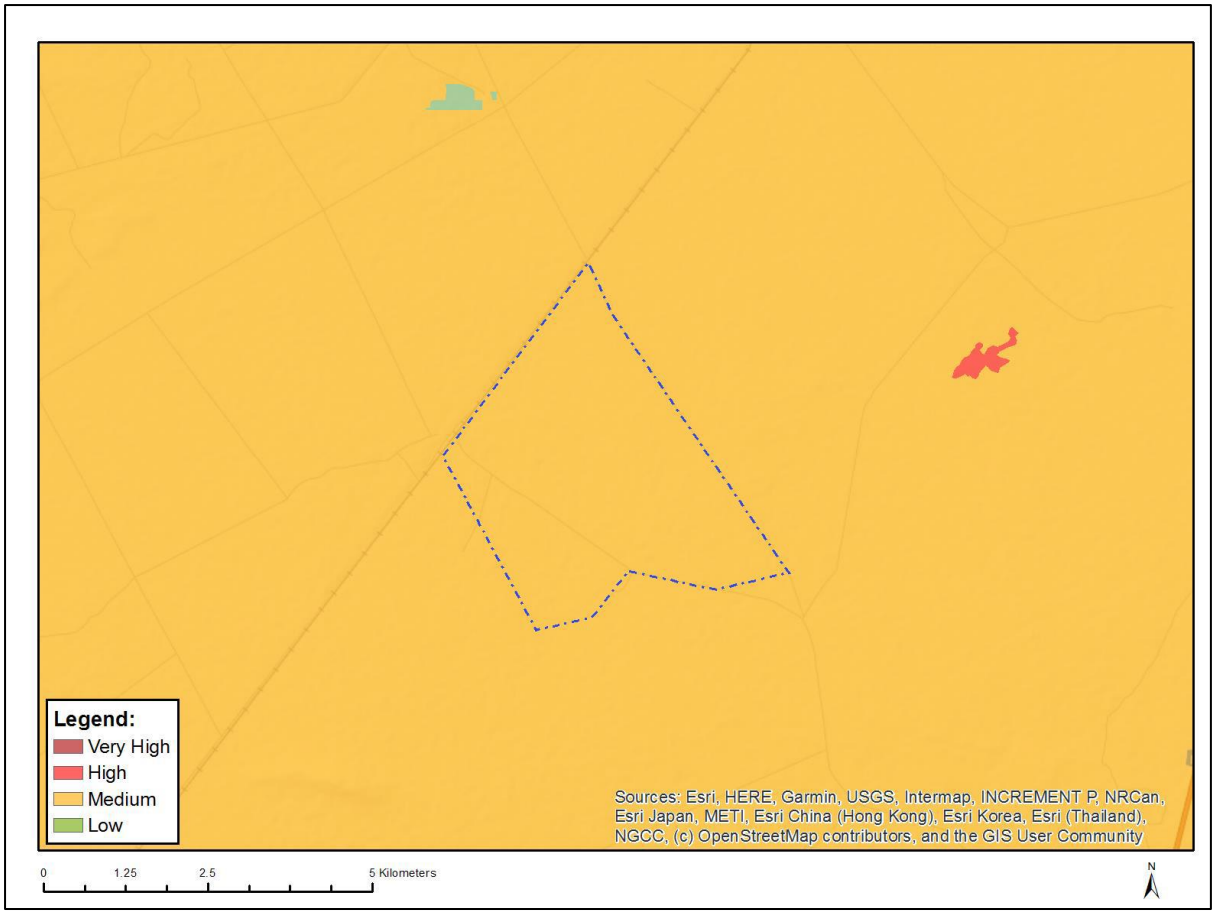

Figure 7-2 Fauna Theme Sensitivity, National Web based Environmental Screening Tool.

Based on the criteria provided in Section 3.3 of this report, all habitats within the assessment area of the proposed project were allocated a sensitivity category (Table 7-1). The SCC species recorded in the Pachnoda (2018) report were taken into account for the sensitivity assessment. The sensitivities of the habitat types delineated are illustrated in Figure 7-3 and Figure 7-4.

Table 7-1 SEI Summary of habitat types delineated within field assessment area of project area

Habitat	Conservation Importance	Functional Integrity	Biodiversity Importance	Receptor Resilience	Site Ecological Importance
Watercourses	High	High	High	Medium	High
Closed Woodland	High	High	High	Medium	High
Mopane Bushveld	Medium	Medium	Medium	Medium	Medium
Rocky Areas	Medium	Medium	Medium	Medium	Medium

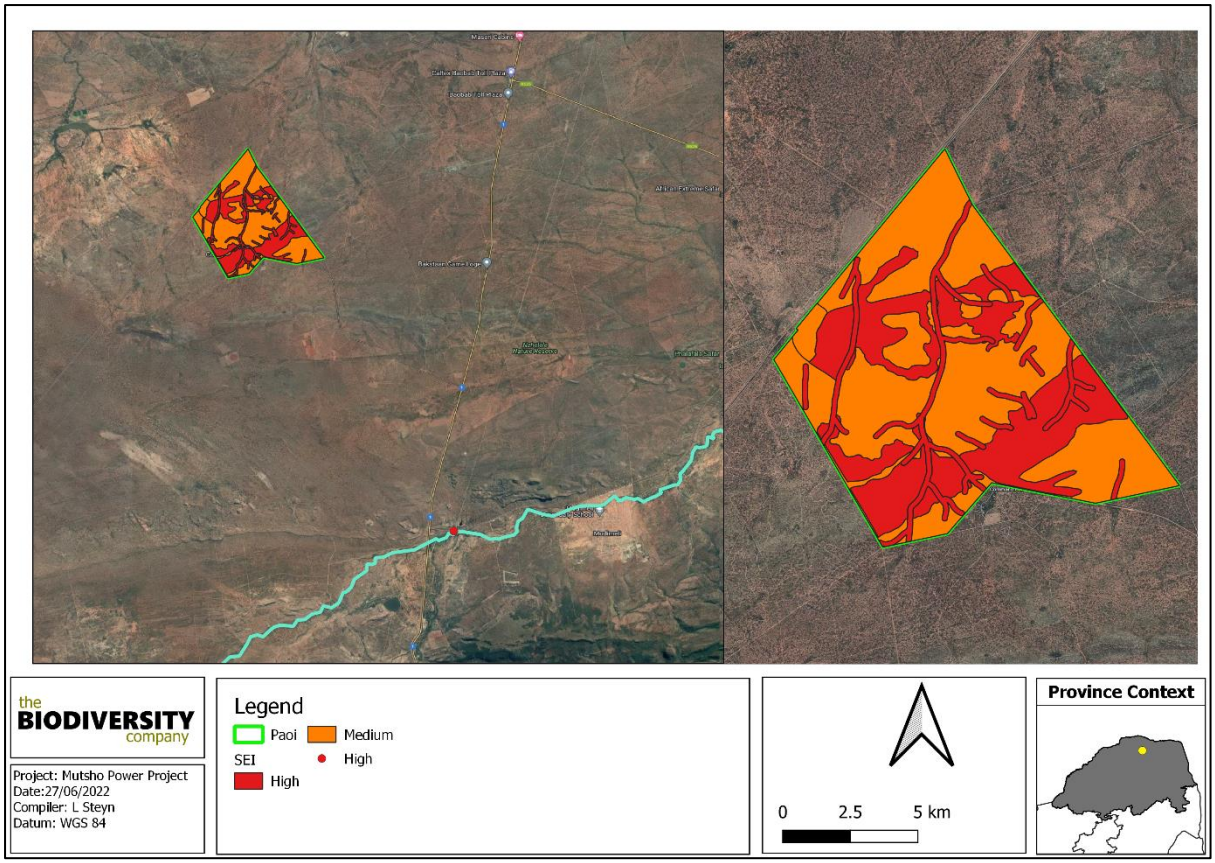

Figure 7-3 Sensitivities based on the avifauna assessment

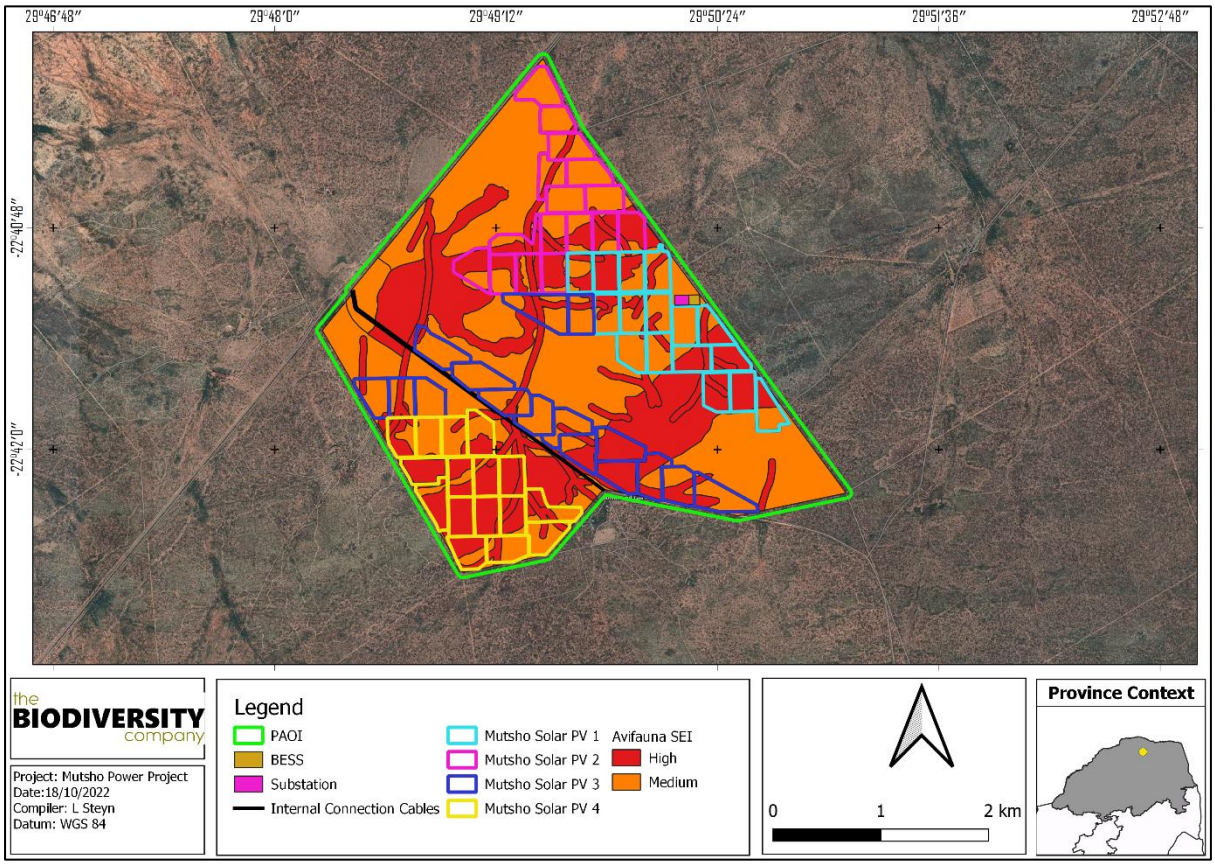

Figure 7-4 The sensitivities in relation to the project layout

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
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.

8 Impact Assessment

Potential impacts were evaluated against the data captured during the fieldwork and from a desktop perspective to identify relevance to the project area, specifically the proposed development footprint area.

The assessment of the significance of direct, indirect and cumulative impacts was undertaken using the method as developed by Savannah Environmental (Pty) Ltd.

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 frag- mentation 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.
- 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 was undertaken in consideration of the following:

- Extent of impact;
- Duration of impact;
- Magnitude of impact;
- Probability of impact; and
- Reversibility.

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 Current Impacts

The current impacts observed during the survey are listed below. Photographic evidence of a selection of these impacts is shown in Figure 8-1.

- Multiple high voltage powerlines;
- Grazing and trampling of natural vegetation by livestock;
- Farm roads and main roads (and associated traffic and wildlife road mortalities);
- Railway track just outside the footprint; and
- Fences.

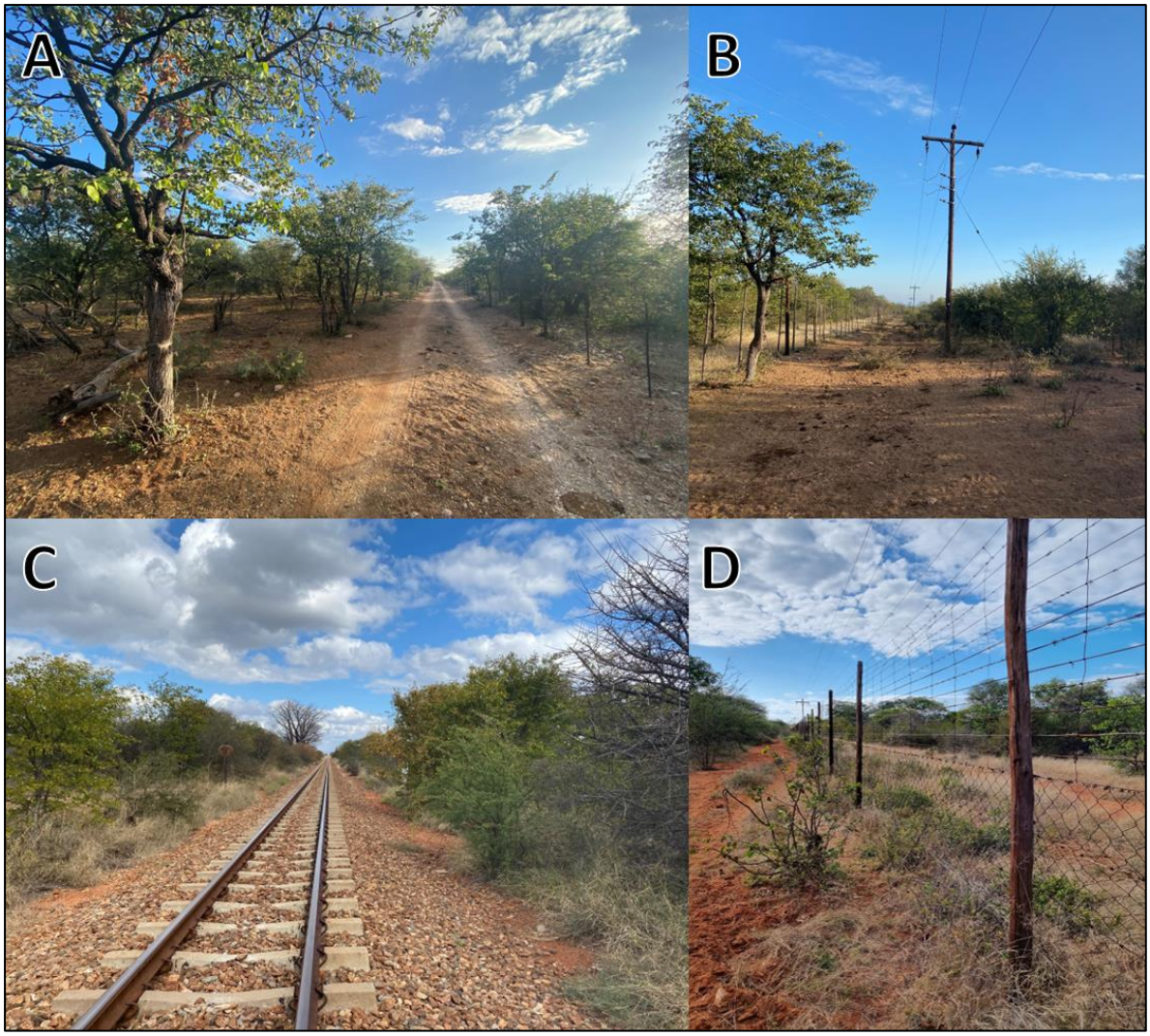

Figure 8-1 Some of the identified impacts within the project area; A) Fences and roads, B) Powerline, C) Railway Track, D) Fences

8.2 Avifauna Impact Assessment

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 and does not consider the powerline grid system. The impact section also takes into account the sensitivities and SCCs recorded in the Pachnoda (2018) report, as this survey was conducted over a longer period of time and in the summer season.

During the construction phase vegetation clearing and brush cutting of vegetation 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 and cause dust pollution. Should non-environmentally friendly dust suppressants be used, chemical pollution can take place. Increased human presence can lead to poaching and the increase in vehicle traffic will potentially lead to roadkill.

The principal impacts of the operational phase are electrocution, collisions, fencing, chemical pollution due to chemical for the 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 powerlines, fencing and large infrastructure will influence avifauna species. Visser *et al.* (2019) performed a study at a utility-scale photovoltaic solar energy facility in the Northern Cape and found that most of the species affected by the facility were passerine species. 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.

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 SA, 2015);

1. Snagging: Occurs when a body part is impaled on one or more barbs or razor points of a fence.
2. Snaring: When a birds foot/leg becomes trapped between two overlapping wires.
3. Impact injuries: birds flying into a fence, the impact may kill or injure the bird
4. Snarling: When birds try and push through a mesh or wire stands, ultimately becoming trapped (uncommon).
5. Electrocution: Electrified fence can kill or severely injure birds.
6. Barrier effect: Fences may limit flightless birds (e.g., Moulting waterfowl) from resources.

Chemical pollution from PV cleaning, if not environmentally friendly will result in either long term or short-term poisoning. Should this chemical run into the water sources it would also impact the whole bird population and not just species found in and around the PV footprint.

PV sites require the overall removal of vegetation, this is a measure that is implemented to restrict the risk of fire (Birdlife, 2017). The removal of vegetation results in the loss of habitat for a number of species in this case it would be displacing grassland, tree dwellers from the alien clumps and waterfowl.

8.2.1 Alternatives considered

No alternative was provided.

8.2.2 Loss of Irreplaceable Resources

Loss of habitat of four SCCs, Kori Bustard (*Ardeotis kori*); Black Stork (*Ciconia nigra*); Saddle-billed Stork (*Ephippiorhynchus senegalensis*), and White-backed Vulture (*Gyps africanus*).

8.3 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. More mitigations can be seen in section 9.

8.3.1 Construction Phase

The construction of the associated infrastructure and the PV site has been assessed collectively as their impacts overlap.

The following potential impacts were considered (Table 8-1 till Table 8-4):

- Destruction, fragmentation and degradation of habitats;

- Displacement of avifaunal community (Including several SCC) due to disturbance such as noise, light, dust, vibration;
- Collection of eggs and poaching;
- Roadkill.

Table 8-1 Construction activities impacts on the avifauna

Nature:		
Destruction, fragmentation and degradation of habitats;		
	Without mitigation	**With mitigation**
Extent	Regional (4)	Local Area (3)
Duration	Permanent (5)	Long term (4)
Magnitude	Very High (10)	Moderate (6)
Probability	Highly probable (4)	Highly probable (4)
Significance	**High**	**Medium**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some extent, habitat will still be lost	
Mitigation:		
• The loss of habitat in the project footprint cannot be negated but can be restricted to some extent. The loss of habitat will result in the loss of territory, feeding area, nesting sites and prey availability for numerous species. • The habitat outside the footprint can be protected by implementing the following mitigations: o Construction activity to only be within the project footprint and the area is to be well demarcated. • Areas where vegetation has been cleared must be re-vegetated within local indigenous plant species. • The affected area must be monitored for invasive plant encroachment and erosion and must be controlled. • The use of laydown areas within the development footprint must be used, to avoid habitat loss and disturbance to adjoining areas. • 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 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. • Infrastructure must be grouped to reduce the unnecessary spread of infrastructure onsite lines must be placed underground as far as possible.		
Residual Impacts:		
The loss of habitat is a residual impact that is unavoidable. The disturbance may also cause some erosion and invasive alien plant encroachment. Movement corridors will be disrupted in the area. The destruction of the large trees including protected trees such as Baobab will lead to the loss of nest sites for larger predatory bird species including possible SCCs and priority species.		

Table 8-2 Construction activities impacts on the avifauna

Nature:		
Displacement of avifaunal community (Including several SCC) due to disturbance such as noise, light, dust, vibration		
	Without mitigation	**With mitigation**
Extent	Regional (4)	Local Area (3)
Duration	Long term (4)	Short term (2)
Magnitude	High (8)	Moderate (6)

Probability	Highly probable (4)	Probable (3)
Significance	**High**	**Medium**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes, but only to a limited extent. The mitigation of noise pollution during construction is difficult to mitigate against	

Mitigation:

- Minimize disturbance impact by abbreviating construction time. Schedule the activities to avoid breeding and movement time.
- Ensure lights are kept to a minimum, lights must be red or green and not white to reduce confusion for nocturnal migrants.
- Dust management need to be done in the areas where the vegetation will be removed, this includes wetting of the soil.
- Restrict footprint of development

Residual Impacts:

Displacement of endemic and SCC avifauna species.

Table 8-3 Construction activities impacts on the avifauna

Nature:

Collection of eggs and poaching

	Without mitigation	With mitigation
Extent	Regional (4)	Footprint and surrounding areas (2)
Duration	Short term (2)	Short term (2)
Magnitude	Moderate (6)	Low (4)
Probability	Highly probable (4)	Improbable (2)
Significance	**Medium**	**Low**
Status (positive or negative)	Negative	Negative
Reversibility	Low	High
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	

Mitigation:

- All personnel should undergo environmental induction with regards to avifauna and in particular awareness about not harming, collecting or hunting terrestrial species (e.g., guineafowl and francolin), and owls, which are often persecuted out of superstition.
- Signs must be put up stating that should any person be found poaching any species they will be fined.

Residual Impacts:

There is a possibility that the eggs to be poached could be that of an SCC with decreasing numbers

Table 8-4 Construction activities impacts on the avifauna

Nature:

Roadkill

	Without mitigation	With mitigation
Extent	Local area (3)	Footprint and surrounding areas (2)

Duration	Short term (2)	Short term (2)
Magnitude	Moderate (6)	Minor (2)
Probability	Highly probable (4)	Improbable (2)
Significance	**Medium**	**Low**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	
Mitigation:		
• All construction vehicles should adhere to clearly defined and demarcated roads. No off-road driving to be allowed outside of the construction area. • All vehicles (construction or other) accessing the site should adhere to a low-speed limit on site (40 km/h max) to avoid collisions with susceptible avifauna, such as nocturnal and crepuscular species (e.g., nightjars and owls) which sometimes forage or rest on roads, especially at night.		
Residual Impacts:		
Roadkill could still occur		

8.3.2 Operational Phase

The operational phase of the impact of daily activities is anticipated to lead to collisions and electrocutions. Moving vehicles do not only cause sensory disturbances to avifauna, affecting their life cycles and movement, but will lead to direct mortalities due to collisions. The area surrounding the direct footprint will be maintained to prevent uncontrolled events such as fire, this practice will however result in the disturbance and displacement of breeding and non-breeding species.

The following potential impacts were considered (Table 8-5 to Table 8-8):

- Collisions with PV panels, and connection lines and fences;
- Electrocution with solar plant connections;
- Roadkill during maintenance procedures; and
- Habitat degradation and displacement of resident, visiting and breeding species (as well as SCCs).

Table 8-5 Operational activities impacts on the avifauna

Nature:		
Collisions with PV panels, BESS, and connection lines and fences		
	Without mitigation	With mitigation
Extent	Regional (4)	Regional (4)
Duration	Long term (4)	Long term (4)
Magnitude	High (8)	Moderate (6)
Probability	Highly probable (4)	Probable (3)
Significance	**High**	**Medium**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	No

Can impacts be mitigated?	Yes

Mitigation:

- 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.
- Infrastructure should be consolidated where possible in order to minimise the amount of ground and air space used.
- If any powerlines/connection lines are to be placed above ground, they must be marked with industry standard bird flight diverters.
- Fencing mitigations:
  - Top 2 strands must be smooth wire
  - Routinely retention loose wires
  - Minimum 30cm between wires
  - Place markers on fences

Residual Impacts:

Some collisions of SCCs might still occur regardless of mitigations

Table 8-6 Operational activities impacts on the avifauna

Nature:

Electrocution with solar plant connections

	Without mitigation	With mitigation
Extent	Regional (4)	Regional (4)
Duration	Long term (4)	Long term (4)
Magnitude	High (8)	Moderate (6)
Probability	Highly probable (4)	Improbable (2)
Significance	**High**	**Low**
Status (positive or negative)	Negative	Negative
Reversibility	Low	High
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	

Mitigation:

- 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.
- Infrastructure should be consolidated where possible/practical in order to minimise the amount of ground and air space used.
- Ensure that monitoring is sufficiently frequent to detect electrocutions reliably and that any areas where electrocutions occurred are repaired as soon as possible.
- During the first year of operation quarterly reports, summarizing interim findings should be complied and submitted to BirdLife South Africa. If the findings indicate that electrocutions have not occurred or are minimal with no red-listed species, an annual report can be submitted.

Residual Impacts:

Electrocutions might still occur regardless of mitigations

Table 8-7 Operational activities impacts on the avifauna

Nature:

Roadkill during maintenance procedures

	Without mitigation	With mitigation

Extent	Local area (3)	Local area (3)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Improbable (2)
Significance	**Medium**	**Low**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	

Mitigation:

- All personnel should undergo environmental induction with regards to avifauna and their behaviour on roads.
- All vehicles should adhere to clearly defined and demarcated roads. No off-road driving to be allowed.
- All vehicles accessing the site should adhere to a low-speed limit on site (40 km/h max) to avoid collisions with susceptible avifauna, such as nocturnal and crepuscular species (e.g., nightjars and owls) which sometimes forage or rest on roads, especially at night.
- Create and implement public awareness programmes with the aim to protect natural resources. Apply measures which include penalties to personnel if found with "bush meat".
- Implement biodiversity monitoring protocols.

Residual Impacts:

Road collisions can still occur regardless of mitigations

Table 8-8 Operational activities impacts on the avifauna

Nature:

Habitat degradation (including events such as fire, Alien Invasive plants and erosion) and displacement of resident, visiting and breeding species (as well as SCCs).

	Without mitigation	With mitigation
Extent	Regional (4)	Local area (3)
Duration	Long term (4)	Short term (2)
Magnitude	High (8)	Moderate (6)
Probability	Highly probable (4)	Probable (3)
Significance	**High**	**Medium**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	**No, the footprint has already been disturbed. The area surrounding the development can be mitigated to some extent**	

Mitigation:

- Minimising habitat destruction caused by the maintenance by demarcating the footprint so that it does not increase yearly.
- All areas where maintenance must be for example grass cutting walked through prior to any activity to ensure no nests or fauna species are found in the area. Should any Species of Conservation Concern 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.
- Compile and implement a fire management plan
- Compile and implement an erosion and stormwater management plan.
- Compile and implement an alien invasive plant control plan.

Residual Impacts:

Migratory routes of avifauna species could change, and the species composition could also change regardless of mitigations

8.3.3 Decommissioning Phase

This phase is when the scaling down of activities ahead of temporary or permanent closure is initiated. During this phase, the operational phase impacts will persist until of the activity reduces and the rehabilitation measures are implemented.

The following potential impacts were considered (Table 8-9 to Table 8-10):

- Continued fragmentation and degradation of habitats;
- Displacement of avifaunal community (including SCC) due disturbance (road collisions, noise, dust, vibration).

Table 8-9 Decommissioning activities impacts on the avifauna

Nature:		
Continued fragmentation and degradation of habitats		
	Without mitigation	With mitigation
Extent	Local area (3)	Footprint and surrounding areas (2)
Duration	Long term (4)	Very short term (1)
Magnitude	High (8)	Minor (2)
Probability	Highly probable (4)	Very improbable (1)
Significance	**Medium**	**Low**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	
Mitigation:		
• Implementation of a rehabilitation plan. • Implementation of an alien invasive management plan and monitoring on an annual basis for 3 years post construction. • There should be follow-up rehabilitation and revegetation of any remaining bare areas with indigenous flora.		
Residual Impacts:		
No significant residual risks are expected, although IAP encroachment and erosion might still occur but would have a negligible impact if effectively managed.		

Table 8-10 Decommissioning activities impacts on the avifauna

Nature:		
Displacement of avifaunal community (including SCC) due disturbance (road collisions, noise, dust, vibration).		
	Without mitigation	**With mitigation**
Extent	Regional (4)	Local area (3)
Duration	Long term (4)	Moderate term (3)
Magnitude	High (8)	Moderate (6)
Probability	Highly probable (4)	Probable (3)
Significance	**High**	**Medium**
Status (positive or negative)	Negative	Negative

Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	

Mitigation:

- Minimize disturbance impact by abbreviating construction time
- Schedule the activities to avoid breeding and movement times report
- Dust management need to be done in the areas where the vegetation will be removed, this includes wetting of the soil. This area must be rehabilitated as soon as possible.
- All construction vehicles should adhere to clearly defined and demarcated roads. No off-road driving to be allowed outside of the decommissioning area.
- All vehicles (construction or other) accessing the site should adhere to a low-speed limit on site (40 km/h max) to avoid collisions with susceptible avifauna, such as nocturnal and crepuscular species (e.g., nightjars and owls) which sometimes forage or rest on roads, especially at night.

Residual Impacts:

If this is mitigated and monitored correctly no residual impacts should be present

8.4 Cumulative Impacts

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. This is similar to the concept of shifting baselines, which describes how the environmental baseline at a point in time may represent a significant change from the original state of the system. This section describes the potential impacts of the project that are cumulative for terrestrial fauna and flora.

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 the nearby existing solar facility and the existing powerlines). 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 the large number of development close by (Section 8.3) can lead to the loss of endemic and threatened species, loss of habitat and vegetation types and even degradation of well conserved areas. A number of solar plants and powerlines can already be found in the project area, this combination of obstacles increases the risk of bird collisions and habitat loss as well as territorial disputes (species forced out of the one area to just again be forced out) (Table 8-11). In the light of all above, the expected cumulative impact is expected to be highly detrimental.

Table 8-11 Cumulative impact of the solar facility

The development of the proposed infrastructure will contribute to cumulative habitat loss within CBAs/ ESAs and thereby impact the ecological processes in the region.		
	Overall impact of the proposed development considered in isolation	**Cumulative impact of the project and other projects in the area**
Extent	Local area (3)	Local area (3)
Duration	Moderate term (3)	Long term (4)
Magnitude	Low (4)	Moderate (6)
Probability	Probable (3)	Probable (3)
Significance	**Medium**	**Medium**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low

Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation:		
• This impact cannot be mitigated as the loss of vegetation is unavoidable.		
Residual Impacts:		
Will result in the loss of: • ESA1 • Endemic species; • Protected trees, especially Baobab that could be used as nesting locations for predatory birds; • SCC avifauna species (especially the species listed in the Pachnoda (2018) report; • Portions of the Vhembe Biosphere Reserve; and • Niche habitats.		

9 Specialist Management Plan

The aim of the management outcomes 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. The mitigations listed below are a combination of the ones listed above and some additional ones.

Table 9-1 presents the recommended mitigation measures and the respective timeframes, targets, and performance indicators for the avifaunal study.

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
Management outcome: Habitats				
Areas 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.	Life of operation	Project manager, Environmental Officer	Areas of indigenous vegetation	Ongoing
The development footprint must be used for storage and the contractors' camps as well. This may not be outside the direct project area to ensure the disturbance area is as small as possible.	Construction	Project manager, Environmental Officer	Project footprint	During Stage
Where possible, existing access routes and walking paths must be made use of.	Construction/Operational Phase	Environmental Officer & Design Engineer	Roads and paths used	Ongoing
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.	Closure Phase/Rehabilitation phase	Environmental Officer & Contractor	Assess the state of rehabilitation and encroachment of alien vegetation	Quarterly for up to two years after the closure
Any woody material removed can be shredded and used in conjunction with the topsoil to augment soil moisture and prevent further erosion.	Closure Phase/ Post Closure Phase	Environmental Officer & Contractor	Road edges and project area footprint	During Phase
Rehabilitation of the disturbed areas existing in the project area must be made a priority. Topsoil must also be utilised, and any disturbed area must be re-vegetated with plant and grass species which are endemic to this vegetation type.	Operational/Closure Phase	Environmental Officer & Contractor	Road edges and footprint	During Phase
Erosion control and alien invasive management plan must be compiled.	Life of operation	Environmental Officer & Contractor	Erosion and alien invasive species	Ongoing
Environmentally friendly dust suppressants need to be utilised	Operational phase	Environmental Officer & Contractor	Water pollution	During Phase

A fire management plan needs to be compiled and implemented to restrict the impact fire might have on the surrounding areas.	Life of operation	Environmental Officer & Contractor	Fire Management	During Phase
Management outcome: Avifauna				
Impact Management Actions	**Implementation**		**Monitoring**	
	Phase	Responsible Party	Aspect	Frequency
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.	Construction/Operational Phase	Project manager, Environmental Officer	Infringement into these areas	Ongoing
All personnel should undergo environmental induction with regards to avifauna and in particular awareness about not harming, collecting, or hunting terrestrial species (e.g., guineafowl and francolin), 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 & Design Engineer	Construction/Closure Phase	During Phase
Outside lighting should be designed and limited to minimize impacts on fauna. All outside lighting should be directed away from highly sensitive areas. Fluorescent and mercury vapor lighting should be avoided, and sodium vapor (red/green) lights should be used wherever possible.	Construction/Operational Phase	Project manager, Environmental Officer & Design Engineer	Light pollution and period of light.	During Phase
All construction and maintenance motor vehicle operators should undergo an environmental induction that includes instruction on the need to comply with speed limit (30km/h), to respect all forms of wildlife. Speed limits must still be enforced to ensure that road killings and erosion is limited.	Life of operation	Health and Safety Officer	Compliance to the training.	Ongoing
Schedule or limit (where feasible) activities and operations during least sensitive periods (June – August), to avoid migration, nesting and breeding seasons	Construction/Operational Phase	Project manager, Environmental Officer & Design Engineer	Activities should take place during the day in winter.	During Phase
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	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	Planning, Construction and Decommissioning	Project manager, Environmental Officer	Presence of Nests and faunal species	During Phase

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.				
The design of the proposed PV 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 *et al.,* 2015).	Planning and construction	Environmental Officer & Contractor, Engineer	Presence of electrocuted birds or bird strikes	During Phase
Infrastructure should be consolidated where possible in order to minimise the amount of ground and air space used.	Planning and construction	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	Presence of chemicals in and around the project area	During phase
Fencing mitigations: • Top 2 strands must be smooth wire • Routinely retention loose wires • Minimum 30cm between wires • Place markers on fences	Planning, construction, and operation	Environmental Officer & Contractor, Engineer	Presence of birds stuck /dead in fences Monitor fences for slack wires	During phase
As far as possible power cables within the project area should be thoroughly insulated and preferably buried.	Planning and construction	Environmental Officer & Contractor, 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
White strips should be placed along the edges of the panels, to reduce similarity to water and deter birds and insects (Horvath *et al,* 2010). Consider the use of bird deterrent devices to limit collision risk.	Planning and construction	Environmental Officer & Contractor, Engineer	Presence of dead birds in the project area	During phase

10 Monitoring

Should the development be authorised SCC monitoring must be done to determine the effect of the development on these species, this would also allow for more available data for future projects.

Monitoring must be done prior to the construction phase (in the summer/rainy season), at time of construction and for 3 consecutive years after construction. Standard methods as per the species protocols must be followed.

11 Recommendations

The following recommendations are proposed for the project:

- As very little is known about the impacts of solar facilities on birds in South Africa, a construction monitoring regime is recommended for the proposed project area to document any impacts and this data must be used for improving mitigation measures to reduce the impact on biological resources, particularly avifauna;
- A follow-up assessment on avian biodiversity and species abundance within the project area and surrounding areas must be conducted within one year after the facility has been in operation and should be repeated every 3-5 years; and
- This report must be read in conjunction with the Pachnoda (2018) report as that survey was conducted in the summer and is likely a more realistic representation of the SCCs found in the area, thereby increasing the overall sensitivity of the project area.

12 Conclusion

Based on the desktop assessment the project area falls within an ESA1, Vhembe Biosphere Reserve, the Musina Mopane Bushveld vegetation type and have a known occurrence of avifauna SCCs found in and around the project area.

The field assessment was conducted in the winter season and is regarded as a follow up survey that was performed by Pachnoda (2018) in the summer. During this survey fifty-seven (57) bird species were recorded, none of which were an SCC, four species were however identified that is regarded as risk species due to collisions and electrocutions by PV plants and associated infrastructure. They are Southern Pale Chanting Goshawk (*Melierax canorus*), Helmeted Guineafowl (*Numida meleagris*), African Harrier-Hawk (*Polyboroides typus*) and Pied Crow (Corvus albus). Four SCCs, Kori Bustard (*Ardeotis kori*); Black Stork (*Ciconia nigra*); Saddle-billed Stork (*Ephippiorhynchus senegalensis*), and White-backed Vulture (Gyps africanus) were recorded by Pachnoda (2018) which does increase the overall sensitivity of the area.

The main impacts identified are the loss of habitat, this includes the loss of nest sites in larger trees such as the Baobabs that will be lost in the area, collision and electrocution risk. These impacts all are expected that should they not be mitigated successfully to have a large impact on the avifauna community and more specifically the SCCs that has been found and could likely occur in the area. The mitigations, management and associated monitoring regarding these impacts will be the most important factor of this project and must be considered by the issuing authority.

12.1 Impact Statement

The main expected impacts of the proposed PV and infrastructure will include the following:

- Habitat loss and fragmentation;
- Electrocutions; and
- Collisions resulting in mortalities of amongst other SCCs.

Mitigation measures as described in this report can be implemented to reduce the significance of the risk but there is still a possibility of impacts. Considering that this 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 opinions of the specialists that the project, may be favourably considered, should on condition all prescribed mitigation measures and supporting recommendations are implemented.

13 References

Bathusi Environmental Consulting cc (2018). Terrestrial Biodiversity EIA assessment for the proposed Mutsho Power Project near Makhado, Limpopo Province. Reference Number SVE – MPS – 2018/07, Version 2018.04.12.03.

BirdLife International. 2015a. Afrotis afra. The IUCN Red List of Threatened Species 2015: e.T22691975A93331501. http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22691975A93331501.en.

BirdLife South Africa. (2017). Important Bird Areas Factsheet. http://www.birdlife.org

Birdlife South Africa (2017b). Birds and Solar Energy Best Practice Guidelines. https://www.birdlife.org.za/wp-content/uploads/2020/03/BLSA-Guidelines-Solar-and-Energy.pdf

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/

Coordinated Avifaunal Roadcounts (CAR) (2020). http://car.birdmap.africa/index.php

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.

Eskom. (2015). Taylor, M.R., Peacock, F. & Wanless, R.M. (Eds).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

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

Pachnoda Consulting (2018). Avifaunal aspects of the receiving environment, avifaunal impact assessment, mitigation recommendations and EMPr contributions. In: Bathusi Environmental Consulting cc (2018). Terrestrial Biodiversity EIA assessment for the proposed Mutsho Power Project near Makhado, Limpopo Province. Reference Number SVE – MPS – 2018/07, Version 2018.04.12.03.

SADAP (South Africa Protected Areas Database) and SACAD (South Africa Conservation Areas Database) (2021). http://egis.environment.gov.za

SANBI-BGIS. 2017. Technical guidelines for CBA Maps: Guidelines for developing a map of Critical Biodiversity Areas & Ecological Support Areas using systematic biodiversity planning.

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.

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.

14 Appendix Items

14.1 Appendix A – 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

June 2022

14.2 Appendix A: Avifaunal species expected in the area.

Species	Common Name	Conservation Status	
		Regional (SANBI, 2016)	IUCN (2021)
Accipiter minullus	Sparrowhawk, Little	Unlisted	LC
Acridotheres tristis	Myna, Common	Unlisted	LC
Acrocephalus palustris	Warbler, Marsh	Unlisted	LC
Actitis hypoleucos	Sandpiper, Common	Unlisted	LC
Actophilornis africanus	Jacana, African	Unlisted	LC
Alopochen aegyptiaca	Goose, Egyptian	Unlisted	LC
Amadina fasciata	Finch, Cut-throat	Unlisted	Unlisted
Anaplectes rubriceps	Weaver, Red-headed	Unlisted	LC
Anas erythrorhyncha	Teal, Red-billed	Unlisted	LC
Andropadus importunus	Greenbul, Sombre	Unlisted	LC
Anhinga rufa	Darter, African	Unlisted	LC
Anthoscopus caroli	Penduline-tit, Grey	Unlisted	LC
Anthus cinnamomeus	Pipit, African	Unlisted	LC
Apalis flavida	Apalis, Yellow-breasted	Unlisted	LC
Apalis thoracica	Apalis, Bar-throated	Unlisted	LC
Apus affinis	Swift, Little	Unlisted	LC
Apus apus	Swift, Common	Unlisted	LC
Apus caffer	Swift, White-rumped	Unlisted	LC
Aquila rapax	Eagle, Tawny	EN	VU
Aquila spilogaster	Hawk-eagle, African	Unlisted	LC
Aquila verreauxii	Eagle, Verreaux's	VU	LC
Ardea cinerea	Heron, Grey	Unlisted	LC
Ardea melanocephala	Heron, Black-headed	Unlisted	LC
Ardeotis kori	Bustard, Kori	NT	NT
Batis molitor	Batis, Chinspot	Unlisted	LC
Bostrychia hagedash	Ibis, Hadeda	Unlisted	LC
Brunhilda erythronotos	Waxbill, Black Cheecked	Unlisted	LC
Bubalornis niger	Buffalo-weaver, Red-billed	Unlisted	LC
Bubo africanus	Eagle-owl, Spotted	Unlisted	LC
Bubo lacteus	Eagle-owl, Verreaux's	Unlisted	LC
Bubulcus ibis	Egret, Cattle	Unlisted	LC
Bucorvus leadbeateri	Ground-hornbill, Southern	EN	VU
Buphagus erythrorynchus	Oxpecker, Red-billed	Unlisted	Unlisted
Burhinus capensis	Thick-knee, Spotted	Unlisted	LC
Burhinus vermiculatus	Thick-knee, Water	Unlisted	LC
Buteo buteo	Buzzard, Common (Steppe)	Unlisted	LC

Butorides striata	Heron, Green-backed	Unlisted	LC
Calamonastes fasciolatus	Wren-warbler, Barred	Unlisted	LC
Calendulauda africanoides	Lark, Fawn-coloured	Unlisted	LC
Calendulauda sabota	Lark, Sabota	Unlisted	LC
Camaroptera brachyura	Camaroptera, Green-backed	Unlisted	LC
Camaroptera brevicaudata	Camaroptera, Grey-backed	Unlisted	Unlisted
Campephaga flava	Cuckoo-shrike, Black	Unlisted	LC
Campethera abingoni	Woodpecker, Golden-tailed	Unlisted	LC
Caprimulgus fossii	Nightjar, Square-tailed	Unlisted	LC
Caprimulgus pectoralis	Nightjar, Fiery-necked	Unlisted	LC
Caprimulgus rufigena	Nightjar, Rufous-cheeked	Unlisted	LC
Cecropis abyssinica	Swallow, Lesser Striped	Unlisted	LC
Cecropis semirufa	Swallow, Red-breasted	Unlisted	LC
Centropus burchellii	Coucal, Burchell's	Unlisted	Unlisted
Cercotrichas leucophrys	Scrub-robin, White-browed	Unlisted	LC
Cercotrichas paena	Scrub-robin, Kalahari	Unlisted	LC
Ceryle rudis	Kingfisher, Pied	Unlisted	LC
Chalcomitra amethystina	Sunbird, Amethyst	Unlisted	LC
Chalcomitra senegalensis	Sunbird, Scarlet-chested	Unlisted	LC
Charadrius tricollaris	Plover, Three-banded	Unlisted	LC
Chlorocichla flaviventris	Greenbul, Yellow-bellied	Unlisted	LC
Chlorophoneus sulfureopectus	Bush-Shrike, Orange-breasted	Unlisted	LC
Chloropicus namaquus	Woodpecker, Bearded	Unlisted	LC
Chrysococcyx caprius	Cuckoo, Diderick	Unlisted	LC
Chrysococcyx klaas	Cuckoo, Klaas's	Unlisted	LC
Ciconia ciconia	Stork, White	Unlisted	LC
Ciconia nigra	Stork, Black	VU	LC
Cinnyricinclus leucogaster	Starling, Violet-backed	Unlisted	LC
Cinnyris mariquensis	Sunbird, Marico	Unlisted	LC
Cinnyris talatala	Sunbird, White-bellied	Unlisted	LC
Circaetus cinereus	Snake-eagle, Brown	Unlisted	LC
Circaetus pectoralis	Snake-eagle, Black-chested	Unlisted	LC
Cisticola aridulus	Cisticola, Desert	Unlisted	LC
Cisticola chiniana	Cisticola, Rattling	Unlisted	LC
Cisticola erythrops	Cisticola, Red-faced	Unlisted	LC
Cisticola fulvicapilla	Neddicky, Neddicky	Unlisted	LC
Cisticola juncidis	Cisticola, Zitting	Unlisted	LC
Clamator glandarius	Cuckoo, Great Spotted	Unlisted	LC
Clamator jacobinus	Cuckoo, Jacobin	Unlisted	LC

Clamator levaillantii	Cuckoo, Levaillant's	Unlisted	LC
Colius striatus	Mousebird, Speckled	Unlisted	LC
Columba guinea	Pigeon, Speckled	Unlisted	LC
Coracias caudatus	Roller, Lilac-breasted	Unlisted	LC
Coracias garrulus	Roller, European	NT	LC
Coracias naevius	Roller, Purple	Unlisted	LC
Corvus albus	Crow, Pied	Unlisted	LC
Cossypha humeralis	Robin-chat, White-throated	Unlisted	LC
Cossypha natalensis	Robin-chat, Red-capped	Unlisted	LC
Creatophora cinerea	Starling, Wattled	Unlisted	LC
Crinifer concolor	Go-away-bird, Grey	Unlisted	LC
Crithagra mozambica	Canary, Yellow-fronted	Unlisted	LC
Cuculus clamosus	Cuckoo, Black	Unlisted	LC
Cuculus gularis	Cuckoo, African	Unlisted	LC
Cuculus solitarius	Cuckoo, Red-chested	Unlisted	LC
Curruca subcoerulea	Tit-babbler, Chestnut-vented	Unlisted	Unlisted
Cursorius temminckii	Courser, Temminck's	Unlisted	LC
Cypsiurus parvus	Palm-swift, African	Unlisted	LC
Delichon urbicum	House-martin, Common	Unlisted	LC
Dendroperdix sephaena	Francolin, Crested	Unlisted	LC
Dendropicos fuscescens	Woodpecker, Cardinal	Unlisted	LC
Dicrurus adsimilis	Drongo, Fork-tailed	Unlisted	LC
Dryoscopus cubla	Puffback, Black-backed	Unlisted	LC
Elanus caeruleus	Kite, Black-shouldered	Unlisted	LC
Emberiza flaviventris	Bunting, Golden-breasted	Unlisted	LC
Emberiza impetuani	Bunting, Lark-like	Unlisted	LC
Emberiza tahapisi	Bunting, Cinnamon-breasted	Unlisted	LC
Ephippiorhynchus senegalensis	Stork, Saddle-billed	EN	LC
Eremomela icteropygialis	Eremomela, Yellow-bellied	Unlisted	LC
Eremomela usticollis	Eremomela, Burnt-necked	Unlisted	LC
Eremopterix leucotis	Sparrowlark, Chestnut-backed	Unlisted	LC
Estrilda astrild	Waxbill, Common	Unlisted	LC
Euplectes albonotatus	Widowbird, White-winged	Unlisted	LC
Eurocephalus anguitimens	Shrike, Southern White-crowned	Unlisted	LC
Falco amurensis	Falcon, Amur	Unlisted	LC
Falco peregrinus	Falcon, Peregrine	Unlisted	LC
Glaucidium capense	Owlet, African Barred	Unlisted	LC
Glaucidium perlatum	Owlet, Pearl-spotted	Unlisted	LC
Granatina granatina	Waxbill, Violet-eared	Unlisted	LC

Gymnoris superciliaris	Petronia, Yellow-throated	Unlisted	LC
Gyps africanus	Vulture, White-backed	CR	CR
Halcyon albiventris	Kingfisher, Brown-hooded	Unlisted	LC
Halcyon chelicuti	Kingfisher, Striped	Unlisted	LC
Halcyon senegalensis	Kingfisher, Woodland	Unlisted	LC
Haliaeetus vocifer	Fish-eagle, African	Unlisted	LC
Hieraaetus wahlbergi	Eagle, Wahlberg's	Unlisted	LC
Hirundo dimidiata	Swallow, Pearl-breasted	Unlisted	LC
Hirundo rustica	Swallow, Barn	Unlisted	LC
Hirundo smithii	Swallow, Wire-tailed	Unlisted	LC
Indicator indicator	Honeyguide, Greater	Unlisted	LC
Indicator minor	Honeyguide, Lesser	Unlisted	LC
Ispidina picta	Pygmy-Kingfisher, African	Unlisted	LC
Kaupifalco monogrammicus	Buzzard, Lizard	Unlisted	LC
Lagonosticta rhodopareia	Firefinch, Jameson's	Unlisted	LC
Lagonosticta rubricata	Firefinch, African	Unlisted	LC
Lagonosticta senegala	Firefinch, Red-billed	Unlisted	LC
Lamprotornis chalybaeus	Starling, Greater Blue-eared	Unlisted	LC
Lamprotornis mevesii	Starling, Meves's	Unlisted	LC
Lamprotornis nitens	Starling, Cape Glossy	Unlisted	LC
Laniarius atrococcineus	Shrike, Crimson-breasted	Unlisted	LC
Laniarius ferrugineus	Boubou, Southern	Unlisted	LC
Lanius collaris	Fiscal, Common (Southern)	Unlisted	LC
Lanius collurio	Shrike, Red-backed	Unlisted	LC
Lanius minor	Shrike, Lesser Grey	Unlisted	LC
Lophoceros nasutus	Hornbill, African Grey	Unlisted	LC
Lophotis ruficrista	Korhaan, Red-crested	Unlisted	LC
Lybius torquatus	Barbet, Black-collared	Unlisted	LC
Malaconotus blanchoti	Bush-shrike, Grey-headed	Unlisted	LC
Melaenornis mariquensis	Flycatcher, Marico	Unlisted	LC
Melaniparus niger	Tit, Southern Black	Unlisted	Unlisted
Melierax canorus	Goshawk, Southern Pale Chanting	Unlisted	LC
Melierax metabates	Goshawk, Dark Chanting	Unlisted	LC
Merops apiaster	Bee-eater, European	Unlisted	LC
Merops bullockoides	Bee-eater, White-fronted	Unlisted	LC
Merops nubicoides	Bee-eater, Southern Carmine	Unlisted	LC
Merops pusillus	Bee-eater, Little	Unlisted	LC
Microcarbo africanus	Cormorant, Reed	Unlisted	LC
Micronisus gabar	Goshawk, Gabar	Unlisted	LC

Milvus aegyptius	Kite, Yellow-billed	Unlisted	Unlisted
Mirafra africana	Lark, Rufous-naped	Unlisted	LC
Mirafra passerina	Lark, Monotonous	Unlisted	LC
Motacilla capensis	Wagtail, Cape	Unlisted	LC
Muscicapa striata	Flycatcher, Spotted	Unlisted	LC
Myioparus plumbeus	Tit-flycatcher, Grey	Unlisted	LC
Nilaus afer	Brubru	Unlisted	LC
Numida meleagris	Guineafowl, Helmeted	Unlisted	LC
Nycticorax nycticorax	Night-Heron, Black-crowned	Unlisted	LC
Oena capensis	Dove, Namaqua	Unlisted	LC
Oenanthe familiaris	Chat, Familiar	Unlisted	LC
Onychognathus morio	Starling, Red-winged	Unlisted	LC
Oriolus auratus	Oriole, African Golden	Unlisted	LC
Oriolus larvatus	Oriole, Black-headed	Unlisted	LC
Oriolus oriolus	Oriole, Eurasian Golden	Unlisted	LC
Passer diffusus	Sparrow, Southern Grey-headed	Unlisted	LC
Passer domesticus	Sparrow, House	Unlisted	LC
Passer melanurus	Sparrow, Cape	Unlisted	LC
Phalacrocorax lucidus	Cormorant, White-breasted	Unlisted	LC
Phoeniculus purpureus	Wood-hoopoe, Green	Unlisted	LC
Phylloscopus trochilus	Warbler, Willow	Unlisted	LC
Pinarocorys nigricans	Lark, Dusky	Unlisted	LC
Plocepasser mahali	Sparrow-weaver, White-browed	Unlisted	LC
Ploceus cucullatus	Weaver, Village	Unlisted	LC
Ploceus intermedius	Masked-weaver, Lesser	Unlisted	LC
Ploceus ocularis	Weaver, Spectacled	Unlisted	LC
Ploceus velatus	Masked-weaver, Southern	Unlisted	LC
Pogoniulus chrysoconus	Tinkerbird, Yellow-fronted	Unlisted	LC
Poicephalus cryptoxanthus	Parrot, Brown-headed	Unlisted	LC
Poicephalus meyeri	Parrot, Meyer's	Unlisted	LC
Polemaetus bellicosus	Eagle, Martial	EN	EN
Polyboroides typus	Harrier-Hawk, African	Unlisted	LC
Prinia flavicans	Prinia, Black-chested	Unlisted	LC
Prinia subflava	Prinia, Tawny-flanked	Unlisted	LC
Prionops plumatus	Helmet-shrike, White-crested	Unlisted	LC
Prionops retzii	Helmet-Shrike, Retz's	Unlisted	LC
Pternistis natalensis	Spurfowl, Natal	Unlisted	LC
Pternistis swainsonii	Spurfowl, Swainson's	Unlisted	LC
Pterocles bicinctus	Sandgrouse, Double-banded	Unlisted	LC

Pycnonotus tricolor	Bulbul, Dark-capped	Unlisted	Unlisted
Pytilia melba	Pytilia, Green-winged	Unlisted	LC
Quelea quelea	Quelea, Red-billed	Unlisted	LC
Rhinopomastus cyanomelas	Scimitarbill, Common	Unlisted	LC
Rhinoptilus chalcopterus	Courser, Bronze-winged	Unlisted	LC
Rhinoptilus cinctus	Courser, Three-banded	LC	LC
Sarkidiornis melanotos	Duck, Comb	Unlisted	LC
Scopus umbretta	Hamerkop, Hamerkop	Unlisted	LC
Spermestes cucullata	Mannikin, Bronze	Unlisted	LC
Spilopelia senegalensis	Dove, Laughing	Unlisted	LC
Sporopipes squamifrons	Finch, Scaly-feathered	Unlisted	LC
Streptopelia capicola	Turtle-dove, Cape	Unlisted	LC
Streptopelia semitorquata	Dove, Red-eyed	Unlisted	LC
Struthio camelus	Ostrich, Common	Unlisted	LC
Sylvietta rufescens	Crombec, Long-billed	Unlisted	LC
Tachybaptus ruficollis	Grebe, Little	Unlisted	LC
Tchagra australis	Tchagra, Brown-crowned	Unlisted	LC
Tchagra senegalus	Tchagra, Black-crowned	Unlisted	LC
Terathopius ecaudatus	Bateleur, Bateleur	EN	EN
Terpsiphone viridis	Paradise-flycatcher, African	Unlisted	LC
Thamnolaea cinnamomeiventris	Cliff-chat, Mocking	Unlisted	LC
Tockus leucomelas	Hornbill, Southern Yellow-billed	Unlisted	LC
Tockus rufirostris	Hornbill, Southern Red-billed	Unlisted	Unlisted
Torgos tracheliotos	Vulture, Lappet-faced	EN	EN
Trachyphonus vaillantii	Barbet, Crested	Unlisted	LC
Treron calvus	Green-pigeon, African	Unlisted	LC
Tricholaema leucomelas	Barbet, Acacia Pied	Unlisted	LC
Tringa glareola	Sandpiper, Wood	Unlisted	LC
Tringa nebularia	Greenshank, Common	Unlisted	LC
Turdoides bicolor	Babbler, Southern Pied	Unlisted	LC
Turdoides jardineii	Babbler, Arrow-marked	Unlisted	LC
Turdus libonyana	Thrush, Kurrichane	Unlisted	Unlisted
Turdus litsitsirupa	Thrush, Groundscraper	Unlisted	Unlisted
Turtur chalcospilos	Wood-dove, Emerald-spotted	Unlisted	LC
Tyto alba	Owl, Barn	Unlisted	LC
Upupa africana	Hoopoe, African	Unlisted	LC
Uraeginthus angolensis	Waxbill, Blue	Unlisted	LC
Urocolius indicus	Mousebird, Red-faced	Unlisted	LC
Urolestes melanoleucus	Shrike, Magpie	Unlisted	LC

Vanellus armatus	Lapwing, Blacksmith	Unlisted	LC
Vanellus coronatus	Lapwing, Crowned	Unlisted	LC
Vidua chalybeata	Indigobird, Village	Unlisted	LC
Vidua macroura	Whydah, Pin-tailed	Unlisted	LC
Vidua paradisaea	Paradise-whydah, Long-tailed	Unlisted	LC
Vidua regia	Whydah, Shaft-tailed	Unlisted	LC

14.3 Appendix B: Avifauna species recorded in the survey

Species	Common Name	Local listing	IUCN (2021)	Relative abundance	Frequency	Guild
Anthus cinnamomeus	Pipit, African	Unlisted	LC	0,0034	4,5455	CGD
Apus affinis	Swift, Little	Unlisted	LC	0,0034	4,5455	CGD
Batis molitor	Batis, Chinspot	Unlisted	LC	0,0134	18,182	CWD
Bubalornis niger	Buffalo-weaver, Red-billed	Unlisted	LC	0,0201	18,182	FFD
Cercotrichas leucophrys	Scrub-robin, White-browed	Unlisted	LC	0,0302	22,727	FFD
Chalcomitra amethystina	Sunbird, Amethyst	Unlisted	LC	0,0101	13,636	GGD
Cinnyris talatala	Sunbird, White-bellied	Unlisted	LC	0,0134	18,182	GGD
Cisticola juncidis	Cisticola, Zitting	Unlisted	LC	0,0034	4,5455	GGD
Clamator levaillantii	Cuckoo, Levaillant's	Unlisted	LC	0,0034	4,5455	GGD
Crinifer concolor	Go-away-bird, Grey	Unlisted	LC	0,0503	54,545	GGD
Crithagra mozambica	Canary, Yellow-fronted	Unlisted	LC	0,0268	22,727	GGD
Dendroperdix sephaena	Francolin, Crested	Unlisted	LC	0,0034	4,5455	GGD
Dendropicos fuscescens	Woodpecker, Cardinal	Unlisted	LC	0,0067	9,0909	GGD
Dicrurus adsimilis	Drongo, Fork-tailed	Unlisted	LC	0,0369	50	GGD
Emberiza capensis	Bunting, Cape	Unlisted	LC	0,0101	13,636	GGD
Emberiza flaviventris	Bunting, Golden-breasted	Unlisted	LC	0,0235	13,636	GGD
Emberiza tahapisi	Bunting, Cinnamon-breasted	Unlisted	LC	0,0034	4,5455	GGD
Estrilda astrild	Waxbill, Common	Unlisted	LC	0,0201	18,182	GGD
Eurocephalus anguitimens	Shrike, Southern White-crowned	Unlisted	LC	0,0537	27,273	IAD
Halcyon albiventris	Kingfisher, Brown-hooded	Unlisted	LC	0,0034	4,5455	IAD
Indicator minor	Honeyguide, Lesser	Unlisted	LC	0,0034	4,5455	IAD
Lagonosticta senegala	Firefinch, Red-billed	Unlisted	LC	0,0034	4,5455	IGD
Lamprotornis nitens	Starling, Cape Glossy	Unlisted	LC	0,0168	18,182	IGD
Lanius collaris	Fiscal, Common (Southern)	Unlisted	LC	0,0168	22,727	IGD
Lophoceros nasutus	Hornbill, African Grey	Unlisted	LC	0,0101	9,0909	IGD
Mandingoa nitidula	Twinspot, Green	Unlisted	LC	0,0067	4,5455	IGD
Melierax canorus	Goshawk, Southern Pale Chanting	Unlisted	LC	0,0134	13,636	IGD
Nilaus afer	Brubru	Unlisted	LC	0,0067	9,0909	IGD
Numida meleagris	Guineafowl, Helmeted	Unlisted	LC	0,0705	13,636	IGD
Oriolus larvatus	Oriole, Black-headed	Unlisted	LC	0,0034	4,5455	IGD
Passer melanurus	Sparrow, Cape	Unlisted	LC	0,0067	9,0909	IGD
Phoeniculus purpureus	Wood-hoopoe, Green	Unlisted	LC	0,0067	9,0909	IGD
Ploceus velatus	Masked-weaver, Southern	Unlisted	LC	0,0805	22,727	IGD
Polyboroides typus	Harrier-Hawk, African	Unlisted	LC	0,0034	4,5455	IGD
Prinia subflava	Prinia, Tawny-flanked	Unlisted	LC	0,0134	18,182	IGD
Prionops plumatus	Helmet-shrike, White-crested	Unlisted	LC	0,0201	9,0909	IGD

Pternistis natalensis	Spurfowl, Natal	Unlisted	LC	0,0067	4,5455	IGD
Pternistis swainsonii	Spurfowl, Swainson's	Unlisted	LC	0,0067	4,5455	IGD
Pycnonotus tricolor	Bulbul, Dark-capped	Unlisted	Unlisted	0,0034	4,5455	IGD
Spilopelia senegalensis	Dove, Laughing	Unlisted	LC	0,0034	4,5455	IGD
Streptopelia capicola	Turtle-dove, Cape	Unlisted	LC	0,0570	54,545	NFD
Streptopelia semitorquata	Dove, Red-eyed	Unlisted	LC	0,0034	4,5455	NFD
Sylvia subcaerulea	Tit-Babbler, Chestnut-vented	Unlisted	Unlisted	0,0067	9,0909	OMD
Sylvietta rufescens	Crombec, Long-billed	Unlisted	LC	0,0134	13,636	OMD
Tchagra australis	Tchagra, Brown-crowned	Unlisted	LC	0,0134	9,0909	OMD
Tockus leucomelas	Hornbill, Southern Yellow-billed	Unlisted	LC	0,0503	45,455	OMD
Tockus rufirostris	Hornbill, Southern Red-billed	Unlisted	Unlisted	0,0067	9,0909	OMD
Trachyphonus vaillantii	Barbet, Crested	Unlisted	LC	0,0034	4,5455	OMD
Tricholaema leucomelas	Barbet, Acacia Pied	Unlisted	LC	0,0168	22,727	OMD
Turdoides jardineii	Babbler, Arrow-marked	Unlisted	LC	0,0268	9,0909	OMD
Turtur chalcospilos	Wood-dove, Emerald-spotted	Unlisted	LC	0,0201	22,727	OMD
Upupa africana	Hoopoe, African	Unlisted	LC	0,0034	4,5455	OMD
Uraeginthus angolensis	Waxbill, Blue	Unlisted	LC	0,0940	40,909	OMD
Urocolius indicus	Mousebird, Red-faced	Unlisted	LC	0,0369	13,636	OMD
Vidua funerea	Indigobird, Dusky	Unlisted	LC	0,0034	4,5455	OMD
Zosterops virens	White-eye, Cape	Unlisted	LC	0,0034	4,5455	OMD

14.4 CV of Specialist

Lindi Steyn

PhD Biodiversity and Conservation

(*Pr Sci Nat*)

Cell: +27 72 129 3759

Email: Lindi@thebiodiversitycompany.com

Identity Number: 8805250059080

Date of birth: 25 May 1988

Profile Summary

Working experience throughout South Africa and neighbouring countries.

Specialist experience with mining, road development, engineering, renewable energy, protected areas, and biodiversity offsets.

Specialist guidance, support and facilitation for the compliance with legislative processes, for in-country requirements.

Specialist expertise include Avifauna and Terrestrial Ecology.

Areas of Interest

Mining, Oil & Gas, Renewable Energy & Bulk Services Infrastructure Development, Sustainability and Conservation.

Key Experience

- Environmental Impact Assessment
- Terrestrial Ecological Assessments
- Rehabilitation Plans and Monitoring
- Avifaunal Conservation Surveys
- Conservation Management Plans
- Laboratory analysis
- The use of avifaunal species as indicators of pollution.

Countries worked in

South Africa

Swaziland

Zimbabwe

Lesotho

Nationality

South African

Languages

English – Proficient

Afrikaans – Proficient

Qualifications

- PhD Biodiversity and Conservation, University of Johannesburg, South Africa.
- MSc Biodiversity and Conservation, University of Johannesburg, South Africa.
- BSc Hons Biodiversity and Conservation.
- BSc Botany and Zoology.
- Certificate in Field Guiding, Damelin.

Research publication with a conservation influence.	• Certificate in Ecotraining.
Birding	• Field Guiding FGASA level 1 certificate (2007).

SELECTED PROJECT EXPERIENCE

Project Name:

Client: African Grass-owl (*Tyto Capensis*) Study

Personal position / role on project: Avifauna Specialist

Location: Ventersdorp North West (2021)

Main project features: Conduct a Grass Owl screening study for the presence of Grass Owls or habitat in a 10 km area in the Ventersdorp area.

Project Name: Biodiversity baseline, impact review and offset for the proposed Lanseria waste water treatment works

Client: Zitholele

Personal position / role on project: Terrestrial Ecologist/Project Manager

Location: Lanseria Gauteng (2020)

Main project features: Compile a Biodiversity offset plan for the proposed development.

Project Name: Avifauna baseline and impact assessment for the proposed Kwamhlanga to Gemsbok Powerline.

Client: WSP

Personal position / role on project: Terrestrial Ecologist/Avifaunal specialist

Location: Kwamhlanga Mpumalanga (2020)

Main project features: To conduct a terrestrial and avifaunal environmental and impact assessment for the expected impact footprint area.

Project Name: A terrestrial specialist baseline and impact assessment for the Beitbridge Border Crossing upgrade, in the Beitbridge Town, Zimbabwe.

Client: Kongiwe.

Personal position / role on project: Avifaunal specialist

Location: Zimbabwe (Beitbridge) – October 2019

Main project features: To conduct a dry season (winter) ecological baseline and impact assessment for the proposed project. The study was required to meet national and IFC requirements, including a Critical Habitat assessment.

Project Name: The Environmental and Social Impact Assessment (ESIA) the proposed Nondvo Dam

Personal position / role on project: Terrestrial Ecologist

Location: Swaziland (2019)

Main project features: To conduct a dual season terrestrial and aquatic ecological baseline and impact assessment for the proposed dam. The study was required to meet national and IFC requirements, including a Critical Habitat assessment.

Project Name: An environmental and impact assessment for the proposed Jozini (N2) road expansion for SANRAL, KwaZulu Natal, South Africa.

Personal position / role on project: Terrestrial Ecologist.

Location: KwaZulu Natal, South Africa (2018).

Main project features: To conduct a terrestrial environmental and impact assessment for the expected impact footprint area.

Project Name: Biodiversity Assessment associated with Greylingstad Waste Water Treatment work and reticulation network, Mpumalanga, South Africa.

Personal position / role on project: Terrestrial Ecologist

Location: South Africa (2018).

Main project features: Conduct a detailed terrestrial ecology basic assessment for the expected impact footprint area.

Project Name: An Environmental and impact assessment for the proposed Kalabasfontein Coal Mining Expansion Project, Mpumalanga, South Africa.

Personal position / role on project: Terrestrial Ecologist/ Avifaunal specialist

Location: Mpumalanga, South Africa (2018)

Main project features: To conduct a terrestrial environmental and impact assessment for the expected impact footprint area.

OVERVIEW

An overview of the specialist technical expertise includes the following:

- Terrestrial Ecological Assessments.
- Faunal surveys which includes mammals, birds, amphibians and reptiles.
- Conservation Plans and Monitoring for terrestrial component.
- Avifaunal surveys.
- Biodiversity offset plans.
- Bioaccumulation assessments for birds
- Toxicity analysis of air dust samples, sediment, water and biota.

EMPLOYMENT EXPERIENCE

- **CURRENT EMPLOYMENT: The Biodiversity Company (May 2018 – Present)**
- I started working at The Biodiversity Company in mid-2018.
- The team at The Biodiversity Company have conducted stand-alone specialist studies and provided overall guidance of studies with a pragmatic approach for the management of biodiversity that takes into account all the relevant stakeholders, most importantly the environment that is potentially affected. We manage risks to the environment to reduce impacts with practical, relevant and measurable methods.
- My roles include:
- Faunal and Floral surveys for baseline, basic or impact assessments
- Report writing
- GIS map work
- Project management
- Management Plan compilations
- Technical assistant for fieldwork for the aquatics and wetland departments
- Specialist inputs to the above-mentioned services.
-
- **EMPLOYMENT: University of Johannesburg (January 2012 – July 2018)**
- UJ assigned me to the role of laboratory assistant and assistant lecture.
- Research

- Report writing
- Performed toxicity testing on biota, sediment, water and air dust samples.
- Completed day to day administration of the laboratory.
- Assisted with field work involving all the different specialist work which includes mammalogy, aquatics and botany.
- Lectured courses, including parasitology and Biology for teachers
-
- **ACADEMIC QUALIFICATIONS**

University of Johannesburg, Johannesburg, South Africa (2018): PHILOSOPHIAE DOCTOR (PhD) – Biodiversity and Conservation

Title: *The effect of DDT on the histology, reproductive success and overall health of the House Sparrow in designated areas.*

University of Johannesburg, Johannesburg, South Africa (2013): MAGISTER SCIENTIAE (MSc)- Biodiversity and Conservation

Title: Comparative determination of the numbers of four garden bird species, the House Sparrow, *Passer domesticus*, the Cape Glossy Starling, *Lamprotornis nitens*, the Cape Turtle Dove, *Streptopelia capicola* and the Laughing Dove, *Streptopelia senegalensis* in the Johannesburg and Vaalwater areas with study into possible causes of expected declines.

University of Johannesburg, Johannesburg, South Africa (2011): BACCALAUREUS SCIENTIAE CUM HONORIBUS (Hons) – Zoology

Title: The influence of agriculture on selected Mpumalanga Pans.

University of Johannesburg, Johannesburg, South Africa (2010): BACCALAUREUS SCIENTIAE IN NATURAL AND ENVIRONMENTAL SCIENCES. Majors: Zoology and Botany.

Damelin, Bramley, Johannesburg: National Certificate in Field Guiding (Lodge Management) (2007)

Damelin, Bramley, Johannesburg: Field guiding FGASA level 1 certificate (2007)

Damelin, Bramley, Johannesburg: Ecotraining- Karongwe & Selati (2007)

PUBLICATIONS

Steyn, L., Bouwman, H., Maina, J.N. (2018). Associations between DDT and egg parameters of the House Sparrow *Passer domesticus* from the Thohoyandou area of South Africa, Chemosphere.

Steyn, L., Bouwman, H., Maina, J.N. (2018). The effect of DDT and its metabolites on the structure of the shells of the eggs of the House Sparrow, *Passer domesticus*: A morphometric study. 7th International Toxicology Symposium in Africa.

Steyn, L., Bouwman, H., Maina, A.W, Hoffman, J., Maina, J.N. (2018). Bone density and asymmetry are not related to DDT in House Sparrows: insights from micro-focus X-ray computed tomography. Chemosphere.

Steyn, L., Maina, J.N. (2016). Comparison of the numbers of three species of birds in an urban- and a rural area of South Africa and possible relationship to the numbers of free (surface) macrophages in the respiratory systems. Journal of Ornithology

Willoughby, B., Steyn, L., Maina, J.N. (2015). X-ray microcomputed tomography study of the microstructure and the morphometry of the shell of the ostrich, *Struthio camerus*, egg. Anatomical record

Steyn, L., Maina, J.N. (2013). Die verwagte afname van die getalle van vier voël spesie, die Huismossie, Kleinglansspreeu, Gewone Tortelduif en die Rooiborsduifie in Gauteng en Limpopo provinsies en moontelike oorsake van die dalings. Die Suid-Afrikaanse akademie vir wetenskap en kuns afdeling biologiese wetenskappe, Pretoria.