PROPOSED POWER LINE FOR THE GROOTPOORT SOLAR POWER PLANT

SPECIALIST AVIFAUNAL ASSESSMENT- OCTOBER 2021

Draft Report

Prepared For: Environamics

Prepared By: Agreenco Environmental Projects (Pty) Ltd

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PROJECT INFORMATION

Project Title	Specialist avifaunal assessment for the proposed power line for the Grootpoort Solar Power Plant
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Project Number	C0217
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Document reviewed by:	
Submission Dates	Preliminary Draft- 30 July 2021 Second Draft Report- 7 October 2021

1 SPECIALIST INFORMATION AND LEGAL REQUIREMENTS

National Environmental Management Act (NEMA, Act 107 of 1998) and GNR982 Appendix 6 compliance requirements:

The details of-	
○ the specialist who prepared the report; and	SPECIALIST DETAILS, CURRICULUM VITAE AND DECLARATION, pg. 10
○ the expertise of that specialist to compile a specialist report including a curriculum vitae;	SPECIALIST DETAILS, CURRICULUM VITAE AND DECLARATION, pg. 10
A declaration that the specialist is independent in a form as may be specified by the competent authority;	DECLARATION BY THE SPECIALIST, pg. 15
An indication of the scope of, and the purpose for which, the report was prepared;	TERMS OF REFERENCE, pg. 9
○ An indication of the quality and age of base data used for the specialist report;	BASELINE DESCRIPTION OF THE AVIFAUNAL COMMUNITY, pg. 29
○ A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	REGIONAL SOLAR ENERGY DEVELOPMENT**,** pg. 27
The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	METHODS pg. 37
A description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	METHODS pg. 37
Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	IMPACT ASSESSMENT RATINGS, pg. 45
An identification of any areas to be avoided, including buffers;	NO-GO AREAS, BUFFERS AND ALTERNATIVES, pg. 55
A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	NO-GO AREAS, BUFFERS AND ALTERNATIVES, pg. 55
A description of any assumptions made and any uncertainties or gaps in knowledge;	STUDY LIMITATIONS, pg. 9
A description of the findings and potential implications of such findings on the impact of the proposed activity, or activities;	METHODS pg. 37
Any mitigation measures for inclusion in the EMPr;	MITIGATION REQUIREMENTS, pg. 52
Any conditions for inclusion in the environmental authorisation;	CONCLUSION AND RECOMMENDATIONS, pg. 60
Any monitoring requirements for inclusion in the EMPr or environmental authorisation;	CONCLUSION AND RECOMMENDATIONS, pg. 60

A reasoned opinion-	CONCLUSION AND RECOMMENDATIONS, pg. 60
○ whether the proposed activity, activities or portions thereof should be authorised;	CONCLUSION AND RECOMMENDATIONS, pg. 60
▪ regarding the acceptability of the proposed activity or activities; and	CONCLUSION AND RECOMMENDATIONS, pg. 60
○ if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	CONCLUSION AND RECOMMENDATIONS, pg. 60
A description of any consultation process that was undertaken during the course of preparing the specialist report;	N/A
A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A
Any other information requested by the competent authority.	N/A

2 EXECUTIVE SUMMARY

Project background

The authorised Grootpoort Photovoltaic Solar Power Plant (SPP) is planned to be developed approximately 17 km south-west from the town of Luckhoff in the Free State Province. The project is intended to consist of a 132 kV single-circuit power line (with service road) to connect the Grootpoort SPP to the national grid network via the existing Canal Substation.

A grid connection corridor, 8 km long and 200 m wide, was surveyed for avifauna (late winter and Spring of 2021) and evaluated in relation to the potential impacts arising from the proposed power line infrastructure. Only one power line route was provided and evaluated. A substation at the start of the power line, at the authorised SPP field, was also considered.

Avifaunal community

The proposed power line of the Grootpoort SPP is situated in an area of relatively low avifaunal diversity, however much of the habitat is intact and harbours some endemic and conservation priority species (the site is within an Ecological Support Area and is just outside an Important Bird Area). A relatively poor SABAP2 dataset exists for the pentad in which the proposed power line will be built (73 species vs the 91 species recorded during site surveys). Secretarybird (Vulnerable), Karoo Korhaan and Kori Bustard (both Near-Threatened) are power line-sensitive species that were recorded in the corridor. Furthermore, there are many endemic species recorded in the corridor (Fairy Flycatcher, Fiscal Flycatcher, Sickle-winged Chat, Layard's Warbler, Grey Tit, Cape Weaver, Namaqua Warbler, South African Cliff Swallow) or in the wider pentad (Large-billed Lark, African Rock Pipit). There are hotspots of high diversity, particularly around the waterbodies and drainage lines.

Impacts and mitigations for the proposed power line

There are avifaunal impacts associated with the power line infrastructure (to be confirmed in formal site surveys), however, most of these can be adequately mitigated if sufficiently implemented and monitored:

- **Displacement of priority avian species from important habitats**. Rated Medium-Negative but can be reduced to Low-Negative with effective implementation and ongoing monitoring of required mitigations as specified;
- **Displacement of resident avifauna through increased disturbance**. Rated Medium-Negative but can be reduced to Low-Negative with effective implementation and ongoing monitoring of required mitigations as specified;
- **Loss of important avian habitats**. Rated Medium-Negative but can be reduced to Low-Negative with effective implementation and ongoing monitoring of required mitigations as specified;
- **Cumulative impacts of the above**. Rated High-Negative to Medium-Negative but cumulative displacement of resident avifauna can be reduced to Low-Negative with effective implementation and ongoing monitoring of required mitigations as specified. However, cumulative displacement of priority avifauna and cumulative loss of important avian habitats remain Medium-Negative even after reasonable mitigation controls can be implemented and are thus a lasting anticipated impact of the development of this project.

- **Collisions when flying into power line infrastructure**. Rated Very High-Negative but can be reduced to Medium-Negative with effective implementation and ongoing monitoring of required mitigations as specified.
- **Electrocution when perched on power line infrastructure**. Rated High-Negative but can be reduced to Medium-Negative with effective implementation and ongoing monitoring of required mitigations as specified.
- **Cumulative impacts of flying into power line infrastructure and electrocution risk**. Rated Very High-Negative but can be reduced to Medium-Negative with effective implementation and ongoing monitoring of required mitigations as specified. These are thus residual impacts that cannot be entirely addressed and are thus a lasting anticipated impact of the development of this project.
- The residual impacts should be given special attention, with consideration of proposed offset concepts introduced in this report for residual and cumulative impacts, specifically relating to collision impacts, The no-go avifaunal areas around the wetland/dam, the canal crossings and the drainage line habitat should be avoided for siting pylons and the actual lines should run as close to the tarred road as possible in those sections. The entire power line will need markers due to very high frequency of powerline-sensitive species; however additional visibility markers will be required at the four no-go zones to improve visibility to avifauna, especially in low light.

Impact statement

Despite some residual and cumulative impacts, there is no objection, from an avifaunal perspective, to the development of the proposed SPP development. The overall impact of the project on avifauna can be effectively mitigated, should the controls prescribed in this report be adequately followed, with sufficient monitoring of mitigation effectiveness.

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3 DECLARATION OF INDEPENDENCE AND QUALITY

This report is free of any external prejudice or influence and is dedicated to accurately and precisely assessing the avifaunal community (at a preliminary desktop level) at the proposed power line of the authorised Grootpoort Solar Power Plant site near Luckhoff in the Free State Province of South Africa, in relation to the impacts associated. All the work herein has been conducted by Agreenco Environmental Projects.

4 TERMS OF REFERENCE

Agreenco Environmental Projects (Pty) Ltd. (Agreenco) was requested to provide a quotation to assist Environamics in undertaking a specialist avifaunal assessment towards their pursuit of obtaining the requisite environmental authorisations for the proposed power line. The site details provided were that the EIA assessment corridor is approximately 8 km long and 200 m wide. Numerous properties will be affected. No further details were provided before project initiation. Agreenco proposed an initial winter assessment (of repeat surveys) and then an early summer assessment (also repeat surveys) to align with project timeline constraints.

5 STUDY LIMITATIONS

- We relied entirely on Environamics, as the EAP, to supply correct information on the site locality and extent, as well as project details. We assume that these are correct.
- A late winter survey was conducted (consisting of detailed surveys and numerous corridor traverses) in early August 2021, followed by a spring survey (end September 2021). Although these two survey periods do represent different seasons and did record different species, they were undertaken relatively close together. The SABAP2 dataset is not extensive, with only 2 cards for the pentad that covers the corridor. The site surveys noted 17 species not previously recorded. It is considered likely that a high-summer (December-February) survey would record additional species, especially long-distance palearctic migrants, that would not have been recorded during the survey periods. These species include some Swallows and Martins, Shrikes, Warblers, Terns, Raptors, Bee-Eaters, Cuckoos, Swifts and Storks, however, most have been recorded during previous SABAP2 assessments and are, as such, accounted for in the impact evaluations.
- The impacts of solar developments on avifauna are not completely understood in South Africa and are hampered by good monitoring data to evaluate the effectiveness of proposed mitigations.
- The cumulative assessment was based on information supplied by Environamics for similar projects within a 30 km radius of the project site.

6 SPECIALIST DETAILS, CURRICULUM VITAE AND DECLARATION

The surveys and assessment will be undertaken by Adrian Haagner.
He is the current Technical Director for Agreenco Environmental Projects and carries registration as a Professional Natural Scientist with SACNASP (400136/13) since 2013. He has been undertaking structured avifaunal assessments since 2003 for a diversity of conservation, mining, energy, and industrial projects across South Africa. His work relating to avifauna has involved both research work and consulting work and he has presented on this work at local conferences. He is further involved in biodiversity planning and assessment for the mining sector.
Adrian completed a B.Tech in Game Ranch Management and Conservation in 2004, after working in private game reserves in the fields of reserve management and ecotourism. Thereafter he worked as a researcher for the University of Pretoria studying ecosystem recovery of coastal dune forests and grasslands following mining. He then furthered his studies, undertaking a B.Sc.(Hons) and an M.Sc. degree in Environmental Sciences. His career led him to work as an environmental project manager, whereafter he co-founded Agreenco in 2010 and has been involved in a diversity of environmental and ecological projects for industry, with a keen focus on avifauna.

Solar Power Plant specialist avifaunal assessments

1. 2011. Specialist avifaunal assessment for the proposed SASOL ChemCity hybrid concentrated solar-natural gas plant. WSP Environment and Energy. Sasolburg, Free State, South Africa.
2. 2012-2013. Specialist avifaunal assessment for the proposed SASOL Solis I concentrated solar plant. WSP Environment and Energy, Upington, Northern Cape South Africa.
3. 2013. Specialist avifaunal assessment for the proposed SASOL Solis I concentrated solar plant expansion. WSP Environment and Energy, Upington, Northern Cape South Africa.
4. 2013-2014. Specialist avifaunal assessment for the proposed SASOL Solis II concentrated solar plant. Savanna Environmental, Upington, Northern Cape South Africa.
5. 2021. Specialist avifaunal assessment for the proposed Siyanda Photovoltaic Solar Power Plant and associated power lines. Environamics- Subsolar, Viljoenskroon, Free State, South Africa.
6. 2021. Specialist avifaunal assessment for the proposed Paleso Photovoltaic Solar Power Plant and associated power lines. Environamics- Subsolar, Viljoenskroon, Free State, South Africa.
7. 2021. Specialist avifaunal assessment for the proposed Sediba Photovoltaic Solar Power Plant and associated power lines. Environamics- Subsolar, Parys, Free State, South Africa.
8. 2021. Specialist avifaunal assessment for the proposed Springbok Photovoltaic Solar Power Plant and associated power lines. Environamics- Subsolar, Welkom, Free State, South Africa.
9. 2021. Specialist avifaunal assessment for the proposed Boitumelo Photovoltaic Solar Power Plant and associated power lines. Environamics- Subsolar, Lichtenburg, North West Province, South Africa.
10. 2021. Specialist avifaunal assessment for the proposed Lerato Photovoltaic Solar Power Plant and associated power lines. Environamics- Subsolar, Lichtenburg, North West Province, South Africa.

11. 2021. Specialist avifaunal assessment for the proposed Kutlwano Photovoltaic Solar Power Plant and associated power lines. Environamics- Subsolar, Lichtenburg, North West Province, South Africa.
12. 2021. Specialist avifaunal assessment for the proposed Impala Photovoltaic Solar Power Plant and associated power lines. Environamics- Subsolar, Vryburg, North West Province, South Africa.
13. 2021. Specialist avifaunal assessment for the proposed Protea Photovoltaic Solar Power Plant expansion. Environamics- Subsolar, Vryburg, North West Province, South Africa.
14. 2021. Specialist avifaunal assessment for the proposed Ingwe Photovoltaic Solar Power Plant and associated power lines. Environamics- Subsolar, Makhado, Limpopo Province, South Africa.

Other specialist avifaunal assessments and studies

1. 2003. Avifaunal surveys for the Welgevonden Private Game Reserve (36,000 Ha). WLOA, Vaalwater, Limpopo, South Africa.
2. 2003. Blue Crane population census and ringing. Waterberg District. Limpopo, South Africa.
3. 2004-2006. Avifaunal population monitoring across rehabilitating dune forests following open-cast mining (7,500 Ha). Rio Tinto. Richards Bay, KwaZulu-Natal, South Africa.
4. 2004-2006. Avifaunal breeding and nest site selection surveys in rehabilitating dune forests (7,500 Ha. Rio Tinto. Richards Bay, KwaZulu-Natal, South Africa.
5. 2005-2006. Seed dispersal by birds in the Zululand coastal dune forest system. Rio Tinto. Richards Bay, KwaZulu-Natal, South Africa.
6. 2004-2006. Monthly population monitoring of waterbirds at Thulazihleka Pan, Casuarinas Beach, Lake Nhlabane and Richards Bay Southern Sanctuary and Harbour. BirdLife Zululand, Richards Bay, KwaZulu-Natal, South Africa.
7. 2006. Avifaunal assessments of the proposed Zulti South mining lease area (3,100 Ha). Rio Tinto. Richards Bay, KwaZulu-Natal, South Africa.
8. 2010. Assessment of heavy metal accumulation in the eggs and tissues of birds breeding in waterbodies affected by gold mining. First Uranium. Stilfontein, North West, South Africa.
9. 2010. Assessment of avifaunal populations on the Chemwes Gold Mine. First Uranium. Stilfontein, North West, South Africa.
10. 2011. Avifaunal baseline assessment for the Rustenburg Operations mineral lease (33,000 Ha). Impala Platinum. Phokeng, North West, South Africa.
11. 2013-2021. Bi-annual avifaunal assessments for the Rustenburg Operations mineral lease (33,000 Ha). Impala Platinum. Phokeng, North West, South Africa.
12. 2013. Biodiversity action and management plan for the Rustenburg Operations mineral lease, including avifaunal conservation planning. Impala Platinum. Phokeng, North West, South Africa.
13. 2014. Investigation into mortalities of Greater and Lesser Flamingos. Undisclosed site and client.
14. 2016. Assessment and management plan for indigenous and exotic bird pests at the Rustenburg Mineral Processing Operations. Impala Platinum. Phokeng, North West, South Africa.

15. 2011. Avifaunal baseline assessment for the Rhovan Operations mineral lease (16,000 Ha). Xstrata Alloys. Bethanie, North West, South Africa.
16. 2012-2021. Bi-annual avifaunal assessments for the Rhovan Operations mineral lease (16,000 Ha). Glencore Alloys. Bethanie, North West, South Africa.
17. 2015. Avifaunal assessment for the Lovedale mineral lease (800 Ha). Lafarge Holcim. Lichtenburg, North West, South Africa.
18. 2015. Avifaunal assessment for the Eerstelingfontein Colliery (180 Ha). Sumo Coal. Wonderfontein, Mpumalanga, South Africa.
19. 2015. Biodiversity action and management plan for the Karee and Marikana Operations mineral leases, including avifaunal conservation planning. Lonmin Platinum. Marikana, North West, South Africa.
20. 2013. Avifaunal specialist assessment for the proposed TD8 Tailings Storage Facility. Lonmin Platinum. Marikana, North West, South Africa.
21. 2016. Specialist avifaunal assessment for the prospecting rights applications for the Kookfontein Operations. Nuco Chrome. Phokeng, North West, South Africa.
22. 2016. Specialist avifaunal assessment for the mining rights applications for the Kookfontein Operations. Nuco Chrome. Phokeng, North West, South Africa.
23. 2019. Specialist avifaunal assessment for the proposed Balgray Colliery. Buffalo Coal. Dundee, KwaZulu-Natal, South Africa.
24. 2019. Investigations into mortalities of Greater and Lesser Flamingos. Undisclosed site and client.
25. 2020. Specialist avifaunal assessment for the Klipfontein re-mining site. Sibanye-Stillwater Platinum. Bleskop, North West, South Africa.
26. 2020. Specialist avifaunal assessment for the Rustenburg ACP Plant. Anglo American Platinum. Rustenburg, North West, South Africa.

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

6.1 DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

Proposed Power Line for the Grootpoort Photovoltaic Solar Power Plant

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
3. A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
4. All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
5. All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

Postal address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

SPECIALIST INFORMATION

Specialist Company Name:	Agreenco Environmental Projects (Pty) Ltd			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	1	Percentage Procurement recognition	135%
Specialist name:	Adrian Haagner			
Specialist Qualifications:	Master's degree (M.Sc.)			
Professional affiliation/registration:	SACNASP- 400136/13			
Physical address:	38 General van Reyneveld Street, Persequor Park, Pretoria			
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Postal code:	2522	Cell:	082 214 3738	
Telephone:	012-807 7223	Fax:	n/a	
E-mail:	Adrian.haagner@agreencogroup.com			

DECLARATION BY THE SPECIALIST

I, __Adrian Haagner_____, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and

- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the Specialist

Agreenco Environmental Projects

Name of Company:

2021/10/07

Date

UNDERTAKING UNDER OATH/ AFFIRMATION

I, Adrian Haagner, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

Agreenco Environmental Projects

Name of Company

2021/10/07

Date

Signature of the Commissioner of Oaths

Date

7 INTRODUCTION

Environamics has been appointed to undertake the environmental authorisation applications for the proposed power line for the authorised Grootpoort Photovoltaic Solar Power Plant (SPP) and has retained the services of Agreenco to undertake the avifaunal specialist assessment. There are Listed Activities that are triggered by the proposed development, which are contained in the Project Description and Scoping documents, respectively.

7.1 Project description

The project is intended to consist of a 132 kV single-circuit power line (with service road) to connect the Grootpoort SPP to the national grid network via the existing Canal Substation.
A grid connection corridor, 8 km long and 200 m wide, will be surveyed for avifauna and evaluated in relation to the potential impacts arising from the proposed power line infrastructure. Numerous properties will be affected along the corridor, which runs from the authorised Grootpoort SPP near the town of Luckhoff (Free State Province), along a district road in a south-easterly direction and will feed into the existing Canal Substation (Figure 1).

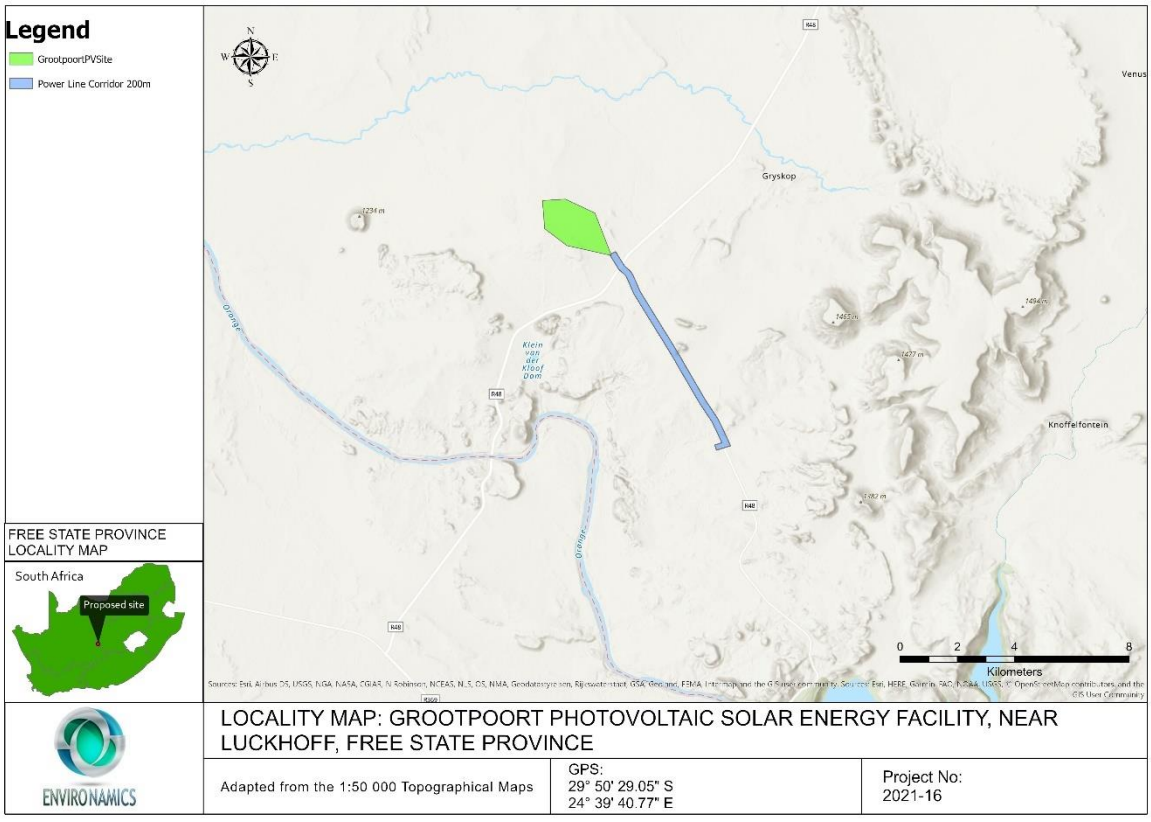

Figure 1. Locality of the proposed power line for the Grootpoort SPP

No alternative sites were identified or assessed; however, the no-go alternative was evaluated. Only one power-line route was provided and assessed.

7.2 Site description

As indicated above, the power line corridor runs from the Grootpoort SPP south-east to the Canal Substation in the Free State Province (Figure 1). It is surrounded by predominantly intact natural habitats. Along the route the power line corridor will cross the R48 provincial road, a railway line, a canal and a non-perennial drainage line.

Climate

A summary diagram of the climate encountered within the Northern Upper Karoo (which dominates the proposed power line corridor) is shown in Figure 2 below. The climate is strongly seasonal and semi-arid, with an average rainfall volume of 275 mm/annum, falling between November and March. The summers are dry and hot, with summer temperatures ranging typically between 17-30°C. The winters are cold and dry, with wintertime temperatures ranging typically between -1 to 21°C. An average of 37 frost days occur each winter. The soils are perpetually moisture stressed, with mean annual evaporation of 2,615 mm, resulting in 83% of days where the soils lose more moisture than they receive from precipitation.

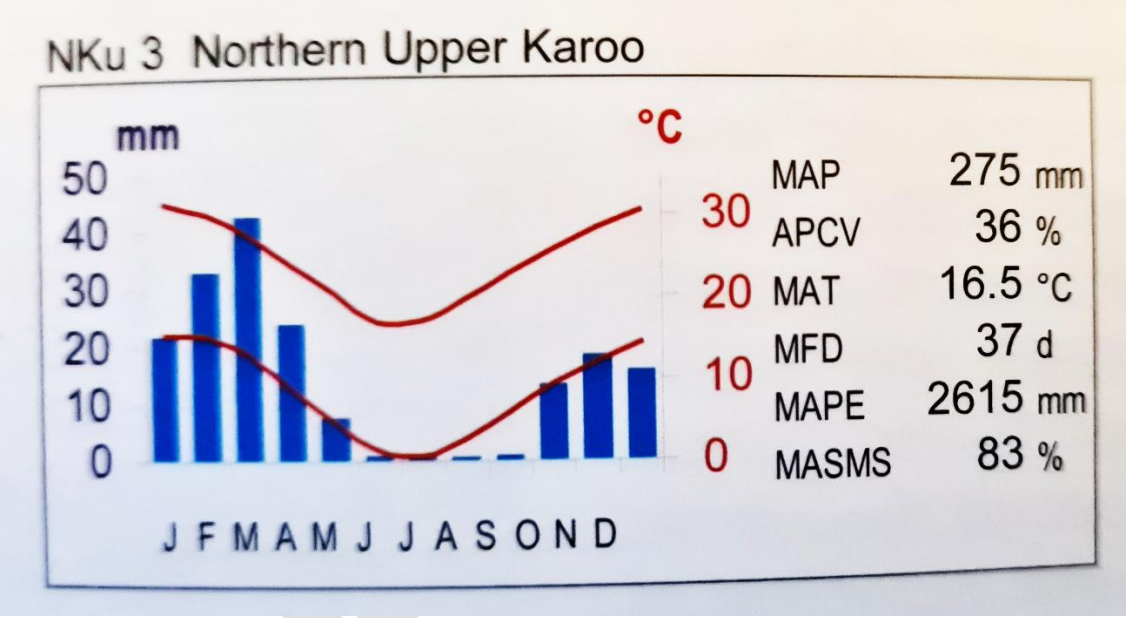

Figure 2. Climatic diagram representative of the proposed power line corridor for the Grootpoort SPP (Mucina & Rutherford, 2007)

Geology and soils

Most of the corridor is underlain by Ecca and Dwyka shales with shallow Glenrosa and Mispah-type soils, with some intrusions of Aeolian Kalahari sands. Roughly in the centre of the corridor, there is a Dolerite koppie.

Vegetation

There are two vegetation types present, namely the Besemkaree Koppies Shrubland (Gh04) classified as Least Concern, and the Northern Upper Karoo (NKu03), also classified as Least Concern.

Gh04 areas are shrubland dominated, with some dwarf karoo shrubs plants present. Gh04 presents predominantly sparse grassland and some small-leaved trees/shrubs. There are two drainage lines, dominated by microphyllous species near the end of the power line corridor.

Land-use
The land-use is predominantly extensive livestock grazing with mostly intact natural vegetation.

7.3 Why would a significant bird population occur in this area?

The general area in which the proposed power line for the Grootpoort SPP site occurs does not harbour especially high numbers of bird species, nor large populations of endemic, range-restricted or protected species. There is an Important Bird Area (IBA) 3.7 km to the south-west (Platberg-Karoo Conservancy) and much of the landscape retains it's natural character and vegetation.
The habitat is reasonably diverse, comprising a mixture of intact sparse grassland with patches of shrubland.
Notwithstanding the above, the DFFE screening tool outputs (Figure 3) provided an animal species theme sensitivity ranking of Medium, due to the presence of Ludwig's Bustard (Endangered), although none were recorded on site (although Kori Bustard and Karoo Korhaan were, both Near-Threatened species). The corridor area also falls within a terrestrial ecology risk ranking of High Sensitivity. This is due to the corridor crossing Ecological Support areas.
The ecosystems that the site crosses are not of conservation importance, both being classified as Least Concern.

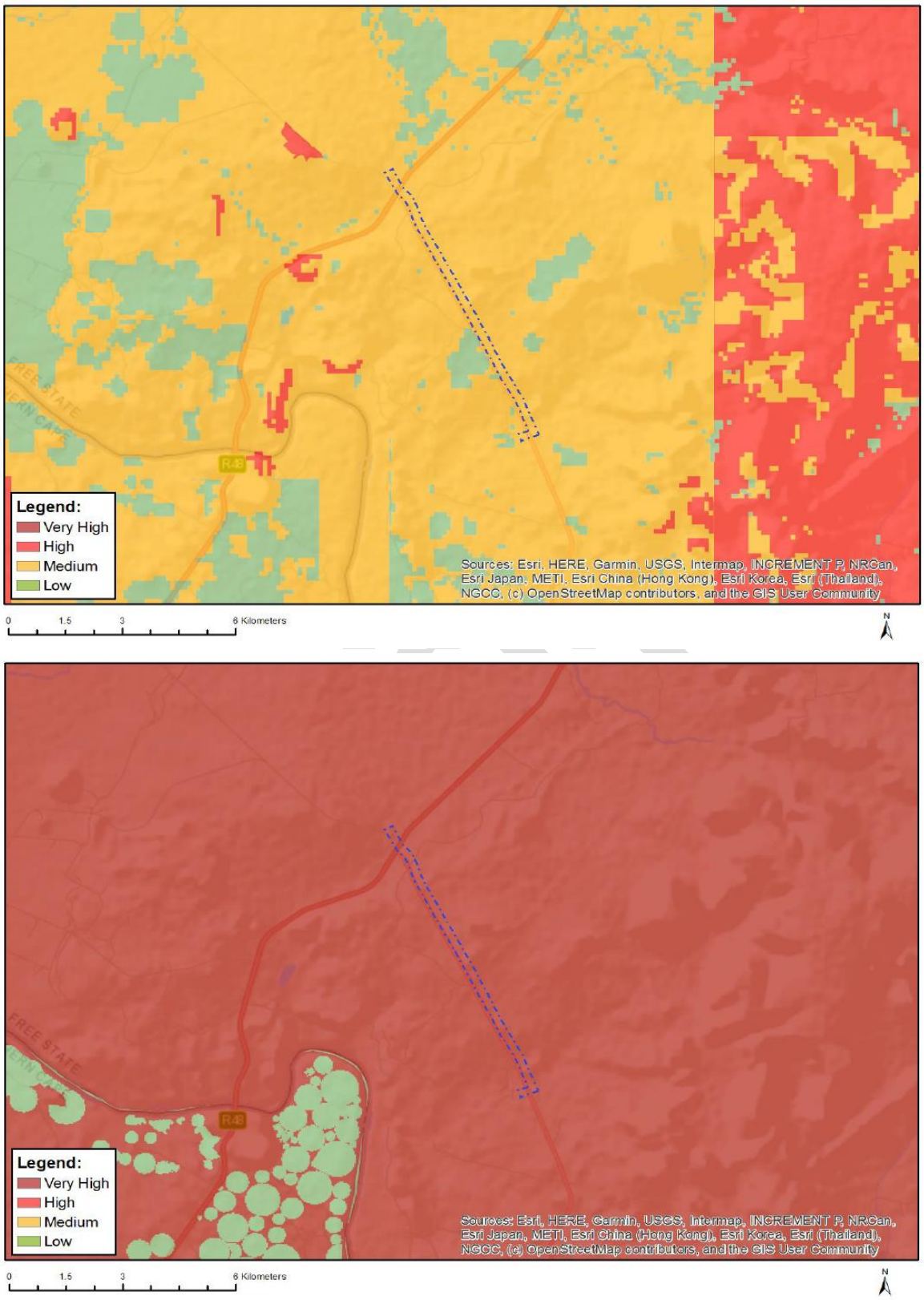

Figure 3. DFFE screening tool outputs of animal species and terrestrial ecological sensitivity for the proposed power line for the Grootpoort SPP

7.4 The use of birds as indicators of wider ecosystem impacts

Wild birds are a conspicuous part of any ecosystem, whether man-made or natural. Their diversity, presence and abundance vary greatly over time and between seasons due to their high mobility. It is because of this high mobility that birds have been the focus of much debate in their use as bio-indicators of ecosystem effects. Proponents for the use of birds as bio-indicators state that specific functional groupings of birds are particularly suitable due to their wide distribution, relative abundance, position in the food chain, diet specificity, and the ease with which they can be sampled (Mora, 1991; Siegfried, 1971).

Detractors from the use of birds as bio-indicators state highly variable movement patterns and abundance, spatially disconnected resource-utilisation patterns, unproven sensitivity levels to many environmental pollutants, and problems with sampling (Eeva and Lehikoinen, 1995).

Notwithstanding either of the above arguments for or against the use of birds as indicators for assessing ecosystem damage as a result of development, there will be impacts on the extant avifaunal population of the immediate region by the proposed development, and this must be accurately assessed. However, in this case the avifaunal impacts are not representative of the wider ecosystem and thus no direct inferences can be drawn to other taxonomic groups. This is due to the highly mobile nature of birds and their wide geographical distributions that vary seasonally and annually, as opposed to plant populations that are rather more finite.

7.5 Assessments of avifauna in general terms in South Africa

Assessments of avian community structure and composition are best described at regional or habitat scales due to their high mobility and the vastly different movement and migration patterns exhibited between species. Added to these temporal fluctuations in the species that may be present at any given time, there is also a distinctive spatial fluctuation where large numbers of birds may unaccountably be present or absent in otherwise suitable habitat. This is as a result of the high mobility of birds and the relative distances covered by different functional groups in any given day. The drivers of these spatio-temporal fluctuations are:

- Seasonality- some birds are Palaearctic, Nearctic, intra-African or local migrants and will only be present in any area during a given season;
- Abundance of prey- many birds are nomadic within large ranges and move about in response to irruptions of prey items such as locusts, other birds, etc.;
- Temporary habitat changes- stochastic disturbances such as fires attract large numbers of some species, whilst displacing others;
- Rainfall- a large suite of species is most abundant in seasonal wetlands and flooded areas that only exist after periods of above-average rainfall and will move around in search of such ephemeral conditions.

The only true means of accurately assessing the avifaunal community structure is by repeated surveys over a number of years, across different seasonal conditions and at different times of day and night. Unfortunately, even then the majority of species recorded will have very low reporting rates, with a few species showing high reporting rates over time. Further compounding the issue is that many species are highly cryptic, nocturnal or rare, making them far more difficult to survey.

It is these species that will form the 'resident' avifauna, which will be supplemented seasonally and as conditions change, by a larger selection of more mobile species. Typically, these resident species will exhibit territorial behaviour and would be likely to breed in the area. Although roosting in the non-breeding season and feeding may occur elsewhere, a certain degree of residency can be declared based on the temporal site fidelity displayed. Given the relatively small area (approximately 160 Ha), the number of resident birds will also be obscured, as many birds have territories and home ranges greater than this area.

Despite the constraints in accurately reflecting avifaunal community structures (and predicting what the impacts of habitat transformations will be), local knowledge of habitat conditions and fluctuations, as well as familiarity with the life-history characteristics of bird species does allow for a relatively accurate appraisal.

8 LEGAL FRAMEWORK RELATING TO AVIFAUNA AND DEVELOPMENT

8.1 International law and conventions

There has been an increased synergy on a global scale regarding environmental matters. The UN *Conference on the Human Environment* (1972) was the first major emergence of international environmental law. The importance of sustainable development and the protection of environmental resources have since then become a driving factor globally in the construction of new legislation governing industrial practices and their impact on the environment. South Africa has signed and ratified a number of global treaties, protocols and conventions, agreeing to implement the policies, which endorse sustainable development and promote a positive environmental legacy for future generations. A substantial agreement that South Africa ratified regarding biodiversity, is the Convention on Biodiversity (CBD), signed in 1998. This agreement highlights the loss of biodiversity as "a common concern of humankind". The most relevant international summit related to environmental management for South Africa is arguably the "Johannesburg World Summit of 2002", which developed a number of policies and standards and built on previous international meetings. The two main points which arose from this summit was "Sustainable development" and "reducing the rate at which biodiversity is being lost". Other agreements include "The Convention on the Conservation of Migratory Species of Wild Animals", "the African-Eurasian Waterbird Agreement", "The Convention to Combat desertification", and "SADC Protocol on Wildlife Conservation and Law Enforcement in the Southern African Development Community". South Africa is also an active member of NEPAD (The New Partnership for Africa's Development), which drives for the sustainable development and associated conservation, with the wise use of biodiversity resources.

8.2 South African Constitution

Environmental law is broadly distributed, across multiple disciplines in South Africa's legal framework. The foundation of South Africans Environmental law is set in the Constitution of the Republic of South Africa (1996), specifically "Chapter 2- The Bill of Rights: section 24". This has allowed for the rapid development of environmentally based legislations which guard, enforce and guide all parties to maintain the human rights granted in the Constitution. These rights include "the right to an environment that is not harmful to their health or well-being and to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that prevent pollution and ecological degradation; promote conservation; and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development". Although South Africa's environmental issues are found at various levels (domestic, regional and national), the majority of the legislation regulating these issues is at a national level.

8.3 NEMA

The major environmental legislation which aims to strengthen the rights granted in the Constitution and incorporate international agreements is the National Environmental Management Act (NEMA), Act 107 of 1998. This act is the cornerstone of environmental law in South Africa and has set the

framework for additional legislation to build on. NEMA was drafted by incorporating earlier environmental legislation, such as Environmental Conservation Act of 1989, as well as standards and policies in international agreements ratified by South Africa. The Act establishes principles for decision-making on environmental matters, as well as providing motive for institutions which promote cooperative governance, and which can coordinate environmental action plans. The principles within NEMA provide the formula from which environmental management plans are synthesised. Section 2(4) specifies that sustainable development requires the consideration of all relevant factors. With regard to biodiversity, development should not result in the disturbance of ecosystems and loss of biological diversity, if not possible, these effects must be minimised and remedied. A low-risk, cautious approach should always be applied, considering limits of current knowledge concerning consequences and actions. Always anticipate possible negative impacts on the environment and people's environmental rights, identified impacts should be prevented and where they cannot be altogether prevented, are minimised and remedied. The "polluter pays principle" is applied with regard to the cost of remedying negative impacts on the environment or effected parties, meaning liability lies with the party responsible for the impact (Section 2(4)p). Vulnerable or fundamental ecosystems require specific consideration in management and planning procedures, particularly where they are the focus of significant human resource usage and development pressure. NEMA reconfirms that the state acts as trustees on behalf of the country's inhabitants, which allows for cooperative governance of environmental issues and the establishment of governmental institutes. These institutes ensure proper enforcement of environmental protection; provide fair decision making and conflict arbitration. Environmental crimes are contained in the schedules to the Acts.

NEMA principles of particular relevance to biodiversity (from the Mining Biodiversity guideline)

1. Section 2(4)(a)(i): the disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied;
2. Section 2(4)(a)(ii): pollution and degradation of the environment are avoided, or, where they cannot be altogether avoided, are minimised and remedied;
3. Section 2(4)(a)(vi): the development, use and exploitation of renewable resources and the ecosystems of which they are part do not exceed the level beyond which their integrity is jeopardised;
4. Section 2(4)(a)(vii): a risk-averse and cautious approach is applied, which considers the limits of current knowledge about the consequences of decisions and actions;
5. Section 2(4)(e): responsibility for the environmental health and safety consequences of a policy, programme, project, product, process, service or activity exists throughout its life cycle.
6. Section 2(4)(o): The environment is held in public trust for the people, the beneficial use of environmental resources must serve the public interest and the environment must be protected as the people's common heritage;
7. Section 2(4)(p): The costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimising further pollution, environmental damage or adverse health effects must be paid for by those responsible for harming the environment; and
8. Section 2(4)(r): Sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal habitats including dunes, beaches and estuaries, reefs, wetlands, and similar ecosystems require

specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure.

8.4 NEMBA

The National Environmental Management of Biodiversity Act (NEMBA) Act 10 of 2004 was specifically designed to provide a management and conservation outline for biological diversity, drafted under the NEMA. This Act deals with the management and conservation of biodiversity, with its relevant components, which includes the use of indigenous biological resources in a sustainable manner, the fair and equitable sharing of benefits arising from bio-prospecting, cooperative governance in biodiversity management and conservation within the structures of NEMA. The Act, in protecting biodiversity, deals with the protection of threatened ecosystems and species, the control of alien invasive species, genetically modified organisms and regulates bio-prospecting. As with NEMA, NEMBA incorporates and gives effect to international agreements relating to biodiversity. The Act gives the Minister of Environmental Affairs, Forestry and Fisheries the power to categorise any process or activity in a listed ecosystem, as a threatening process, thereafter, be regarded as an activity contemplated in Section 24(2) (b) of NEMA which states that: Specified activities may not be commenced without prior authorisation from the Minister or MEC and specify such activities. The Act also allows any person or party to contribute to the management of biodiversity. For a biodiversity management plan to be implemented a draft must be submitted to the Minister for approval and an agreement entered into regarding the plan's implementation. The Minister also has the authority to set standards and norms (published in the Gazette) and provide indicators which must be measured as proof of conformance. NEMBA gives a number of bodies of state the power to police and enforce the minimum standards set out in the act. NEMBA has also established the South African National Biodiversity Institute (SANBI) with mandate in dealing with the monitoring, advising and co-ordinating of biodiversity issues in South Africa. In order for the NEMBA to better the management and conservation of biodiversity the standards, norms and indicators are continuously reviewed, and amendments or additions are published by the Minister in the Government Gazette. These publications should always be referred to when planning on undertaking a listed activity, in order to ensure that the minimum standards are considered, and guidelines followed.

NEMBA TOPS Regulations

The NEMBA Regulations on Threatened or Protected Species (TOPS, 2007) list all of the species (including avian) that are threatened with extinction and therefore, nationally protected under an approach to sustainable use and development. Periodically, Red Data books are published, and the data used to update these lists of protected species.

8.5 Norms, Guidelines & Standards

South Africa has structured a number of policies and guidelines to promote conservation and management of biodiversity. The National Spatial Biodiversity Assessment (NSBA) was constructed to help meet targets set by the NEMBA, in reducing the loss of biodiversity on a global, regional and national scale, while also attending to poverty alleviation. The National Biodiversity Strategy and Action Plan (NBSAP) has also been drafted in order to begin the process of construction a National Biodiversity Framework, as called for in NEMBA (chapter 3). NBSAP has identified a

number of key points to implement in order for biodiversity to be conserved and benefit both current and future generations. One point is that biodiversity cannot be conserved through protected areas only. All stakeholders, including private industry, must be involved in biodiversity management.

BirdLife South Africa (Jenkins *et al*., 2017) compiled the Best Practice Guidelines on Birds and Solar Energy to guide the assessment and monitoring of the impact of solar generating facilities on birds in South Africa. This guideline has been followed as far as possible in the compilation of this report.

9 REGIONAL SOLAR ENERGY DEVELOPMENT

The regional setting of existing or planned solar energy developments is required to undertake an assessment of the cumulative impacts that avifauna experience. This is in addition to other forms of habitat transformation that have taken place.

Environamics, as the project EAP, specified the similar projects within a 30 km radius (Figure 4) with their project descriptions (Table 1).

The temporal parameters for this cumulative effects analysis are the anticipated lifespan of the Proposed Project, beginning in 2022 and extending out at least 20 years, which is the minimum expected project life of the proposed project.

It is unclear whether other projects, not related to renewable energy, are being or have been constructed in this area. In general, development activity in the area is focused on pastoral grazing. It is quite possible that future solar farm development may take place within the general area.

Table 1. A summary of similar projects within a 30 km radius of the proposed power line for the Grootpoort SPP

No	EIA Reference No	Classification	Status of application
1	14/12/16/3/3/2/612	Proposed renewable energy farm on portion 5 of farm Kleinplaas No. 193, Phillipstown within Renosterberg Local Municipality, Northern cape	Withdrawn/Lapsed
2	14/12/16/3/3/2/431	Proposed Keren Holdings Renosterfontein Solar plant on remainder of Farm Renosterfontein NR194, Renosterberg Local Municipality, Northern Cape	Withdrawn/Lapsed
3	14/12/16/3/3/2/739	Proposed 70 - 100 MW Solar Power Plant in Petrusville	In process
4	14/12/16/3/3/2/612	Proposed renewable energy farm on portion 5 of farm Kleinplaas No. 193, Phillipstown within Renosterberg Local Municipality, Northern Cape	In process

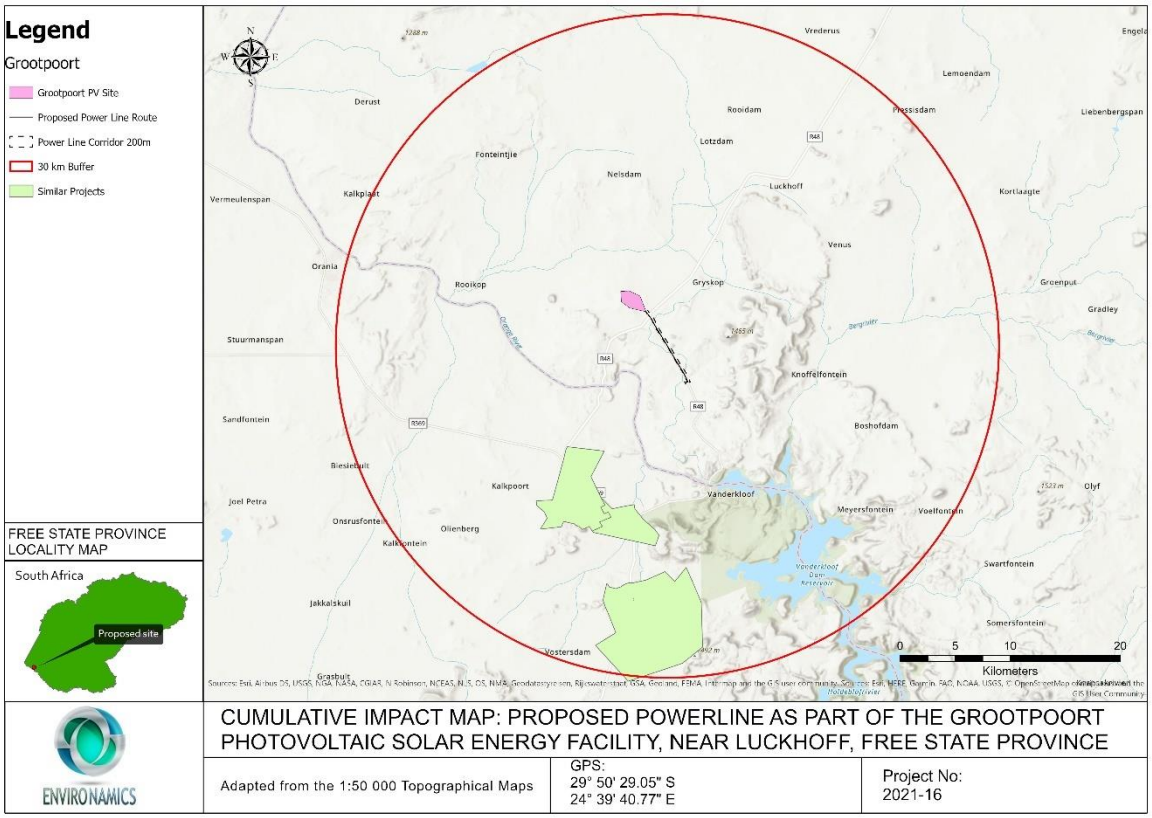

Figure 4. Geographic extent of existing power lines and similar solar projects within a 30 km radius of the Grootpoort SPP

10 BASELINE DESCRIPTION OF THE AVIFAUNAL COMMUNITY

10.1 SABAP2 data

The Second South African Bird Atlas Project (SABAP2), an initiative of the Animal Demography Unit of the University of Cape Town, was consulted or data collected for the pentad in which the site is situated. There is one pentad through which the power line corridor runs, namely:

I. 2950_2440 (which has 2 atlas assessments recording 73 species between 2010 and 2017);

The pentad is shown in Figure 5. The pentad occupies approximately 7,700 Ha, whereas the total corridor is 160 Ha. The pentad covers much greater habitat diversity and comprise riverine habitats as well, which will substantially increase the species counts. These species counts should not necessarily be expected for the proposed power line corridor.

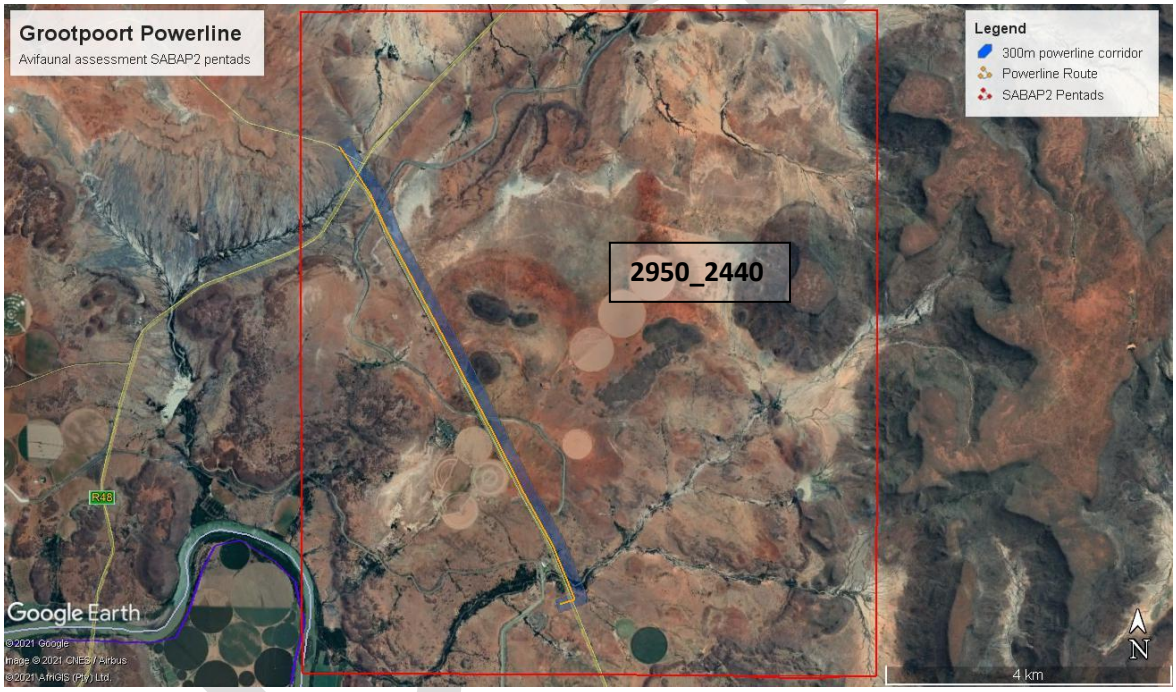

Figure 5. Location and extent of SABAP2 pentad 2950_2440 relative to the proposed power line for the Grootpoort SPP

The total list of species recorded during SABAP2 surveys from 2010-2017 for the pentad is shown in Table 2 along with on-site records from Winter and Spring surveys. The table shows the Red Data status (regionally for Southern Africa and then globally), endemic status and whether the species is considered to be at threat from the proposed power line development through either collision with the infrastructure or via electrocutions when perched.

A total of 73 species was recorded during the combined SABAP2 surveys from 2010-2017 for the pentad. The site surveys recorded 91 species, which added an additional 18 species not previously recorded during SABAP2 assessments. It is considered likely that a high-summer (December-February) survey would record additional species, especially long-distance palearctic migrants, that would not have been recorded during the survey periods. These species include some Swallows

and Martins, Shrikes, Warblers, Terns, Raptors, Bee-Eaters, Cuckoos, Swifts and Storks, although most expected missing species were recorded during prior SABAP2 surveys.

10.2 All avifaunal records for the proposed Grootpoort power line corridor and surrounds

Table 2. List of avifaunal species recorded during SABAP2 assessments for the wider pentads (EN= endangered, VU=vulnerable, NT=near-threatened, LC=least concern, NE=near-endemic, BNE=breeding near-endemic, SLS=endemic to RSA, Lesotho & Eswatini)

No	Species	Recorded on site?	RD status (Regional, Global)	Endemic	Collision sensitive	Electrocution sensitive
1	Acacia Pied Barbet	1	-	-	-	-
2	African Pipit	1	-	-	-	-
3	African Quailfinch	0	-	-	-	-
4	African Red-eyed Bulbul	1	-	-	-	-
5	***African Rock Pipit***	***0***	***NT, LC***	***SLS***	***-***	***-***
6	Ant-eating Chat	1	-	-	-	-
7	Ashy Tit	1	-	-	-	-
8	Barn Swallow	0	-	-	-	-
9	Black-chested Prinia	1	-	-	-	-
10	Black-faced Waxbill	1	-	-	-	-
11	Black-throated Canary	1	-	-	-	-
12	Black-winged Kite	1	-	-	Yes	Yes
13	Bokmakierie	1	-	-	-	-
14	Brown-crowned Tchagra	0	-	-	-	-
15	Brown-hooded Kingfisher	1	-	-	-	-
16	Brown-throated Martin	1	-	-	-	-
17	Brubru	1	-	-	-	-
18	Cape Bunting	1	-	-	-	-
19	Cape Robin-chat	1	-	-	-	-
20	Cape Sparrow	1	-	-	-	-
21	Cape Starling	1	-	-	-	-
22	Cape Teal	1	-	-	Yes	-
23	Cape Wagtail	1	-	-	-	-
24	*Cape Weaver*	*1*	-	*NE*	-	-
25	Cardinal Woodpecker	0	-	-	-	-
26	Chat Flycatcher	1	-	-	-	-
27	Chestnut-vented Warbler	1	-	-	-	-
28	Common Fiscal	0	-	-	-	-
29	Common Waxbill	1	-	-	-	-
30	Crested Barbet	1	-	-	-	-
31	Desert Cisticola	1	-	-	-	-
32	Diederik Cuckoo	0	-	-	-	-
33	Dusky Sunbird	1	-	-	-	-

No	Species	Recorded on site?	RD status (Regional, Global)	Endemic	Collision sensitive	Electrocution sensitive
34	Eastern Clapper Lark	1	-	-	-	-
35	Egyptian Goose	1	-	-	Yes	Yes
36	European Bee-eater	0	-	-	-	-
37	*Fairy Flycatcher*	*1*	-	*NE*	-	-
38	Familiar Chat	1	-	-	-	-
39	Fawn-coloured Lark	1	-	-	-	-
40	*Fiscal Flycatcher*	*1*	-	*NE*	-	-
41	Golden-tailed Woodpecker	1	-	-	-	-
42	Greater Striped Swallow	1	-	-	-	-
43	*Grey Tit*	*1*	-	*NE*	-	-
44	Grey-backed Cisticola	1	-	-	-	-
45	Grey-backed Sparrow-Lark	1	-	-	-	-
46	Hadeda Ibis	1	-	-	Yes	Yes
47	Hamerkop	1	-	-	Yes	Yes
48	Helmeted Guineafowl	1	-	-	Yes	Yes
49	Horus Swift	1	-	-	-	-
50	House Sparrow	0	-	-	-	-
51	Kalahari Scrub Robin	0	-	-	-	-
52	**Karoo Korhaan**	**1**	**NT, LC**	**-**	**Yes**	**-**
53	Karoo Scrub Robin	1	-	-	-	-
54	**Kori Bustard**	**1**	**NT, NT**	**-**	**Yes**	**Yes**
55	*Large-billed Lark*	*0*	-	*NE*	-	-
56	Lark-like Bunting	1	-	-	-	-
57	Laughing Dove	1	-	-	-	-
58	*Layard's Warbler*	*1*	-	*NE*	-	-
59	Lesser Honeyguide	1	-	-	-	-
60	Little Swift	1	-	-	-	-
61	Long-billed crombec	1	-	-	-	-
62	Mountain Wheatear	0	-	-	-	-
63	Namaqua Dove	0	-	-	-	-
64	Namaqua Sandgrouse	1	-	-	Yes	-
65	*Namaqua Warbler*	*1*	-	*NE*	-	-
66	Neddicky	1	-	-	-	-
67	Northern Black Korhaan	1	-	-	Yes	-
68	Orange River White-eye	1	-	-	-	-
69	Pale Chanting Goshawk	1	-	-	Yes	Yes
70	Pale-winged Starling	0	-	-	-	-
71	Pied Crow	1	-	-	Yes	Yes
72	Pied Kingfisher	1	-	-	-	-
73	Pririt Batis	1	-	-	-	-

No	Species	Recorded on site?	RD status (Regional, Global)	Endemic	Collision sensitive	Electrocution sensitive
74	Red-billed Quelea	1	-	-	-	-
75	Red-eyed Dove	1	-	-	-	-
76	Red-faced Mousebird	1	-	-	-	-
77	Red-headed Finch	1	-	-	-	-
78	Reed Cormorant	1	-	-	Yes	Yes
79	Ring-necked Dove	1	-	-	-	-
80	Rock Martin	1	-	-	-	-
81	Rufous-eared Warbler	1	-	-	-	-
82	Sabota Lark	1	-	-	-	-
83	Scaly-feathered Weaver	1	-	-	-	-
84	**Secretarybird**	**1**	**VU, EN**	**-**	**Yes**	**Yes**
85	Short-toed Rock Thrush	1	-	-	-	-
86	*Sickle-winged Chat*	*1*	-	*NE*	-	-
87	*South African Cliff Swallow*	*1*	-	*BNE*	-	-
88	South African Shelduck	1	-	-	Yes	-
89	Southern Grey-headed Sparrow	1	-	-	-	-
90	Southern Masked Weaver	1	-	-	-	-
91	Southern Red Bishop	1	-	-	-	-
92	Speckled Pigeon	1	-	-	-	-
93	Spike-heeled Lark	1	-	-	-	-
94	Spur-winged Goose	1	-	-	Yes	Yes
95	Swallow-tailed Bee-eater	1	-	-	-	-
96	Western Cattle Egret	1	-	-	Yes	Yes
97	White-backed Mousebird	1	-	-	-	-
98	White-breasted Cormorant	1	-	-	Yes	Yes
99	White-browed Sparrow-Weaver	1	-	-	-	-
100	White-fronted Bee-eater	1	-	-	-	-
101	White-rumped Swift	1	-	-	-	-
102	White-throated Swallow	1	-	-	-	-
103	Willow Warbler	0	-	-	-	-
104	Yellow Canary	1	-	-	-	-
105	Yellow-bellied Eremomela	1	-	-	-	-
106	Zitting Cisticola	1	-	-	-	-

**Italics denotes endemic species*

***Bold denotes Red Data species**

Table 2 above shows that there are 18 of the species recorded on site or previously for the wider pentad that have potential risk for collisions with the power line cables. These are mostly fast-flying species, heavy-bodied species, birds that tend to fly higher above the ground and those that may migrate at night. Those species not recorded during surveys all have reasonable chances of at least occasionally crossing the proposed power line corridor, hence all 18 species are considered at risk and should be mitigated for.

Table 2 also shows the bird species that are potentially influenced by electrocution whilst perched, particularly through sitting on the ground rail or having earth contact by touching multiple wires. These are bird species that are large-bodied, have wide wingspans, or are known to perch or roost on power lines (especially against pylon infrastructure). 13 species recorded on site and during prior SABAP2 surveys for the wider pentads are considered vulnerable to electrocution on the power line, of which all 13 were recorded during site surveys. All 13 of the species need to be mitigated for.

10.3 General species description

The mix of species recorded previously during SABAP2 assessments for the wider pentad comprised a wide diversity of species, with waterfowl, gamebirds, raptors, insectivores and granivores all well represented. The total species count and diversity of functional groups was expected to be much lower for the site surveys, due to the shorter survey timeframes and vastly smaller assessment area with lower habitat diversity, however the site surveys recorded more species.

The species recorded within the power line corridor are representative of all of the habitats. The northern corridor portions are on shallower soils and subject to more overgrazing by livestock but still have typical Nama-Karoo and semi-arid grassland species, including Karoo Korhaan and Kori Bustard, both Red Data species (listed as regionally Near-Threatened). The R48 tarred road is relatively busy and does reduce the activity of birds somewhat, however typical semi-arid zone Larks, Chats, Scrub-Robins, Cisticolas and Canaries were present. A wetland/farm dam occurs near the northern canal crossing, which held water in winter (not in spring) and drew a high number of species (22 in winter and 20 in spring) representing waterbirds, seedeaters, insectivores and raptors. The northern canal crossing also had numerous Swifts, Swallows and Martins attending, whilst it appeared that the canal is a flyway used by waterbirds such as South African Shelduck, White-breasted Cormorant, Reed Cormorant and Egyptian Goose, all of which are sensitive to collisions with power lines.

The central grasslands and shrublands also showed typical semi-arid zone Larks, Chats, Scrub-Robins, Cisticolas and Canaries, but also held the Vulnerable Secretarybird and numerous endemic species. The southern canal crossing was almost identical to the northern one.

The outlier habitat was the drainage line, of which two cross the power line corridor near the southern edge. The upper drainage line held water in winter and spring, whereas the lower (main) drainage line was dry in both the winter and spring surveys. The species richness was very high in the drainage line (14 in winter and 32 in spring) and comprised semi-arid zone birds, as well as typical thornveld species.

10.4 Species of conservation importance

The IUCN uses 9 categories of conservation status to apply across taxa (IUCN, 2001). These are summarised in Table 3. The assessment of Red Data status follows Taylor (2015) and the ESKOM Red Data Book of Birds of South Africa, Lesotho and Swaziland.

Table 3. *IUCN red-list conservation criteria.*

Extinct	A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), and throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
Extinct in the Wild	A taxon is extinct in the wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed extinct in the wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), and throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
Critically Endangered	A taxon is critically endangered when the best available evidence indicates that it meets any of the criteria for critically endangered, and it is therefore considered to be facing an extremely high risk of extinction in the wild.
Endangered	A taxon is endangered when the best available evidence indicates that it meets any of the criteria for endangered, and it is therefore considered to be facing a very high risk of extinction in the wild.
Vulnerable	A taxon is vulnerable when the best available evidence indicates that it meets any of the criteria for vulnerable, and it is therefore considered to be facing a high risk of extinction in the wild.
Near Threatened	A taxon is near threatened when it has been evaluated against the criteria but does not qualify for critically endangered, endangered or vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.
Least Concern	A taxon is least concern when it has been evaluated against the criteria and does not qualify for critically endangered, endangered, vulnerable or near threatened. Widespread and abundant taxa are included in this category.
Data Deficient	A taxon is data deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate.

Not Evaluated	A taxon is not evaluated when it is has not yet been evaluated against the criteria.

There are Red Data species that could possibly occur on site, even as vagrants and the likelihood of their occurrence must be assessed. The potential red data species for the proposed power line for the Grootpoort SPP, along with probability estimates and notes are presented below.

- ***Secretarybird-*** Vulnerable. Recorded during site surveys, thus has confirmed presence on site.
- *Lanner Falcon*- Vulnerable. Not recorded in the pentads but has moderate likelihood of occasionally occurring on site.
- *Cape Vulture*- Endangered. Not recorded in the pentads, very low likelihood of occasionally occurring on site if animal carcases are present.
- *Martial Eagle*- Endangered. Not recorded in the pentads, very low likelihood of occasionally occurring on site.
- *Black Harrier*- Endangered. Not recorded in the pentads but has moderate likelihood of occasionally occurring on site.
- *Ludwig's Bustard*- Vulnerable. Not recorded in the pentads and has moderate likelihood of sporadic occurrence.
- ***Kori Bustard***- Near-Threatened. Recorded during site surveys, thus has confirmed presence on site.
- ***Karoo Korhaan***- Near-Threatened. Recorded during site surveys, thus has confirmed presence on site.
- *Burchell's Courser*- Vulnerable. Not recorded in the pentads but has moderate likelihood of occasionally occurring on site.
- *African Rock Pipit*- Near-Threatened. Recorded during SABAP2 surveys for the wider pentad. Confirmed presence in the general area.
- *Blue Crane*- Near-Threatened. Not recorded in the pentads but has moderate likelihood of occasionally occurring on site.
- *Verreaux's Eagle*- Vulnerable. Not recorded in the pentads but has moderate likelihood of occasionally occurring on site.
- *Abdim's Stork*- Near-Threatened. Not recorded in the pentads but has low likelihood of occasionally occurring on site.
- *Black Stork*- Vulnerable. Not recorded in the pentads but has low likelihood of occasionally occurring on site.

The Red Data species listed above as occurring in the wider area or having reasonable likelihood of even occasional occurrence will be considered in the impact assessment and the methodology for mitigations.

10.5 Range-restricted or endemic species

South Africa has a rich diversity of nationally and regionally endemic species that are found nowhere else on earth and, therefore, warrant consideration for assessment of sensitivity to potential developments.

The following endemic or near-endemic (most of the global range is within South Africa's borders) species were recorded during prior SABAP2 assessments for the wider pentad:

- *Fairy Flycatcher*- Near-endemic, also confirmed as present on site.
- *Fiscal Flycatcher*- Endemic, also confirmed as present on site.
- *African Rock Pipit*- Endemic to South Africa, Lesotho and Swaziland.
- *South African Cliff Swallow*- Breeding Near-endemic, also confirmed as present on site.
- *Large-billed Lark*- Near-endemic.
- *Namaqua Warbler*- Near-endemic, also confirmed as present on site.

In addition, the following endemic or near-endemic species were recorded on site but not during prior SABAP2 assessments:

- Cape Weaver- Near-endemic, also confirmed as present on site.
- Grey Tit- Near-endemic, also confirmed as present on site.
- Layard's Warbler- Near-endemic, also confirmed as present on site.
- Sickle-winged Chat- Near-endemic, also confirmed as present on site.

Apart from African Rock Pipit (which is also Near-Threatened), all of the endemic or near-endemic species listed above that have been confirmed during past SABAP2 assessments have wide distributional ranges and reportedly healthy populations and should not present and substantial threats as a result of development of this site.

11 METHODS

11.1 Methodology

The field methodology for assessing the impact of the proposed power line on the extant avifaunal population involves establishing what the extant avifaunal population is, as this will have bearing on the species that will be displaced by construction activities and habitat impacts.

11.1.1 Assessing the resident avifaunal population for the proposed Grootpoort power line corridor

As indicated, a combination of late winter (August 8 and 9 of 2021) and spring (29 & 30 September 2021) surveys were undertaken to record the extant avifaunal population across the proposed Grootpoort power line corridor.

The corridor was stratified into distinct avifaunal habitat units, and each was assessed via line transect replicates in the proportion in which each habitat occurred.

The bird community structure was assessed using conventional line transect methodology. This method consists of walking a fixed-length transect within a given time and recording all bird species seen or heard within a specified transect width. A standardised length of approximately 500 m was used for survey, as multiple repeat surveys of similar habitats have revealed that to be the optimal for adequately covering species presence. The time allowed for each 500 m transect was 10 minutes, thus at a pace of 1.2 seconds per metre, allowing for a steady and deliberate pace, increasing the chances of detecting all birds within the transect. The transect width was set at 200 m to cover the entire corridor width.

The line transect counts were conducted between 05h50 and 10h25 in the morning, and traverses of the power line to record additional species sensitive to collisions or electrocutions were undertaken between 15h30 and 18h15.

Furthermore, wherever good observation areas were encountered, extensive scanning with a field telescope was undertaken in an attempt to detect larger terrestrial birds and raptors that may not otherwise have been detected during the line-transect methodology. Driving to and from the survey sites before sunrise was also undertaken in an attempt to locate any nocturnal birds, which would be absent from the diurnal survey schedule. No dedicated night-drive counts were attempted.

All data were analysed on a matrix basis, giving total abundance per site and species richness per site and reporting rates. Data were then further analysed using similarity matrices and diversity scoring. This would form the basis of the spatial risk rating, along with GIS maps of species richness and avifaunal community sensitivity in terms of red data species.

The data were then used to tabulate and rate avifaunal impact according to the impact rating procedure provided by Environamics (Appendix A: Method of Environmental Assessment).

12 RESULTS OF AVIFAUNAL POPULATION ASSESSMENT

Line transect surveys were undertaken at ten locations to cover the eight habitat types, shown in Figure 6 and Table 4. All habitat types were extensively covered.

Table 4. Habitat types and avifaunal survey transects for the Grootpoort power line

Transect	Habitat type	Length	Orientation	Vegetation type
1	Road disturbed	500	NW-SE	Northern Upper Karoo
2	Disturbed grassland	500	NW-SE	Northern Upper Karoo
3	Wetland	500	NW-SE	Northern Upper Karoo
4	Open grassland 1	500	NW-SE	Northern Upper Karoo
5	Open shrubland 1	500	NW-SE	Northern Upper Karoo
6	Karee shrubland	500	NW-SE	Besemkaree Koppies Shrubland
7	Canal	500	NW-SE	Northern Upper Karoo
8	Open shrubland 2	500	NW-SE	Northern Upper Karoo
9	Shrubland 1	500	NW-SE	Northern Upper Karoo
10	Drainage line	500	NW-SE	Northern Upper Karoo

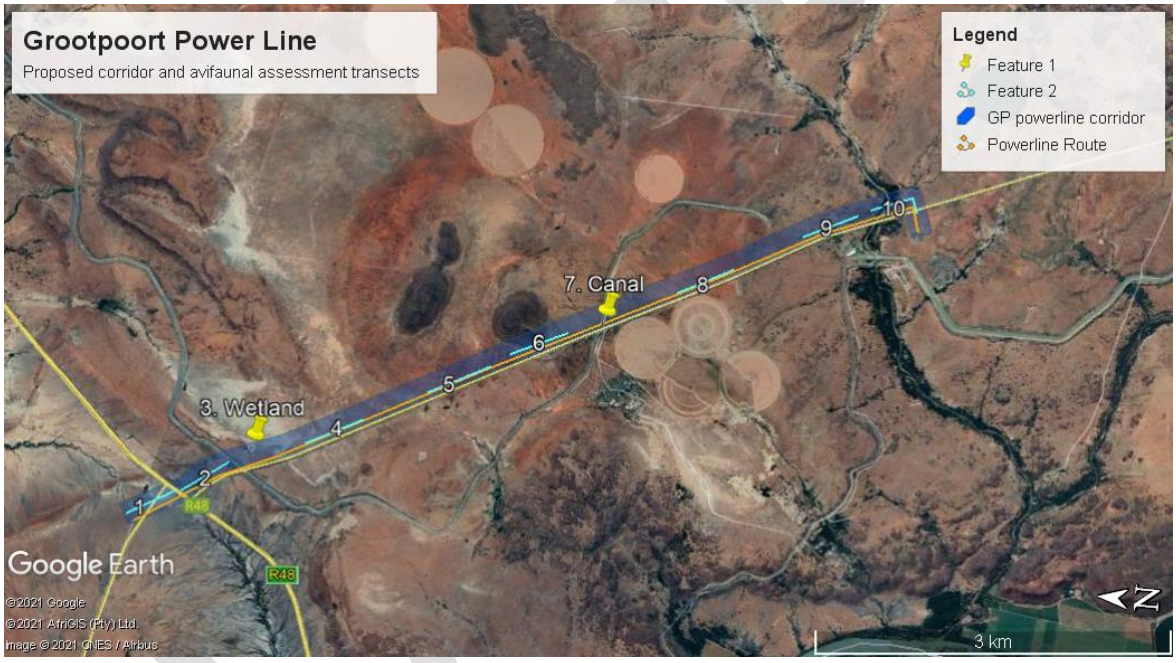

Figure 6. Locations of avifaunal survey transects along the Grootpoort power line corridor

The species data per site were analysed for similarity using the Bray-Curtis similarity index, reflected in Table 5 for winter surveys and in Table 6 for spring surveys. 100% similarity indicates sites that are identical in bird abundance and species richness. Overall, the transects showed relatively low similarity to one another, and between seasons. Figure 7 shows a non-metric multidimensional scaling (N-MDS) ordination of the winter avifaunal assemblage grouping at 20% similarity based on habitat disturbance. Figure 8 shows the N-MDS for spring, which has broadly similar groupings, although it is evident that the disturbed roadside habitat generally improved in quality in spring and more closely resembles the natural veld.

Table 5. Bray-Curtis similarity matrix for Grootpoort power line winter 2021 avifaunal transects

Winter	Road disturbed	Disturbed grassland	Wetland	Open grassland 1	Open shrubland 1	Karee shrubland	Canal	Open shrubland 2	Shrubland 1	Drainage line
Road disturbed										
Disturbed grassland	14.41									
Wetland	17.39	33.90								
Open grassland 1	1.82	3.54	13.68							
Open shrubland 1	2.63	10.13	19.28	5.13						
Karee shrubland	2.56	9.88	14.12	0.00	13.04					
Canal	7.79	5.00	9.52	7.59	22.22	8.51				
Open shrubland 2	7.89	2.53	4.82	25.64	22.73	8.70	26.67			
Shrubland 1	1.98	9.62	22.22	1.94	14.49	25.35	20.00	2.90		
Drainage line	6.96	11.86	26.23	0.00	19.28	16.47	16.67	9.64	16.67	

Table 6. Bray-Curtis similarity matrix for Grootpoort power line spring 2021 avifaunal transects

Spring	Road disturbed	Disturbed grassland	Wetland	Open grassland 1	Open shrubland 1	Karee shrubland	Canal	Open shrubland 2	Shrubland 1	Drainage line
Road disturbed										
Disturbed grassland	29.17									
Wetland	26.67	27.40								
Open grassland 1	18.18	30.19	20.00							
Open shrubland 1	8.00	8.22	14.00	22.50						
Karee shrubland	21.43	44.44	32.10	19.67	14.81					
Canal	3.85	21.57	9.30	7.34	27.91	3.64				
Open shrubland 2	7.30	11.85	9.88	25.35	11.11	13.99	0.00			
Shrubland 1	6.74	13.79	19.30	4.26	8.77	21.05	6.99	9.09		
Drainage line	3.77	15.38	18.32	1.80	6.11	19.64	7.50	8.29	57.93	

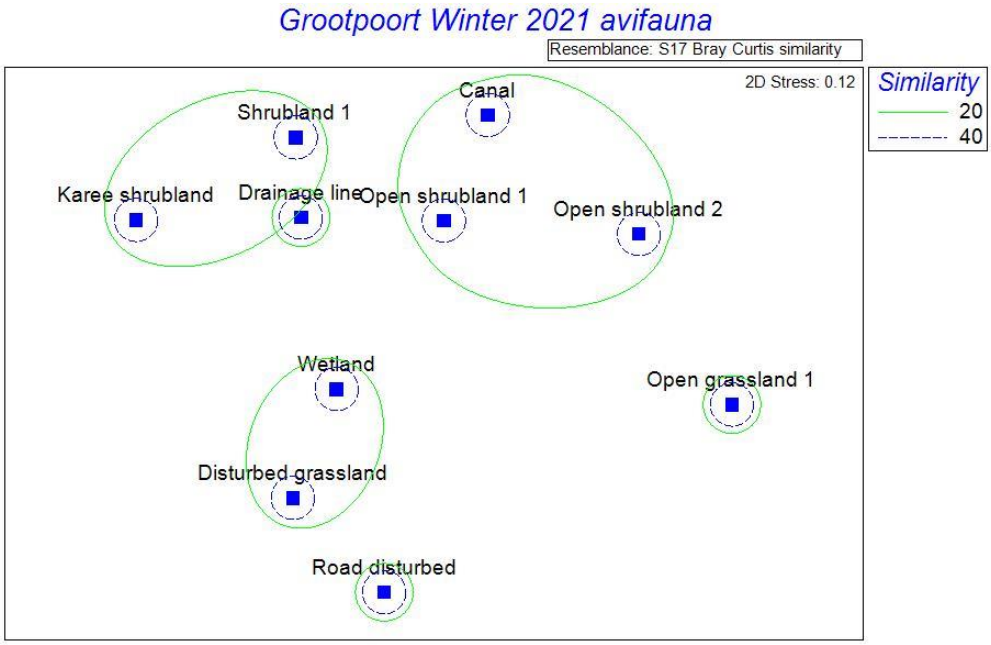

Figure 7. N-MDS diagram of the proposed Grootpoort power line corridor winter avifaunal assemblage

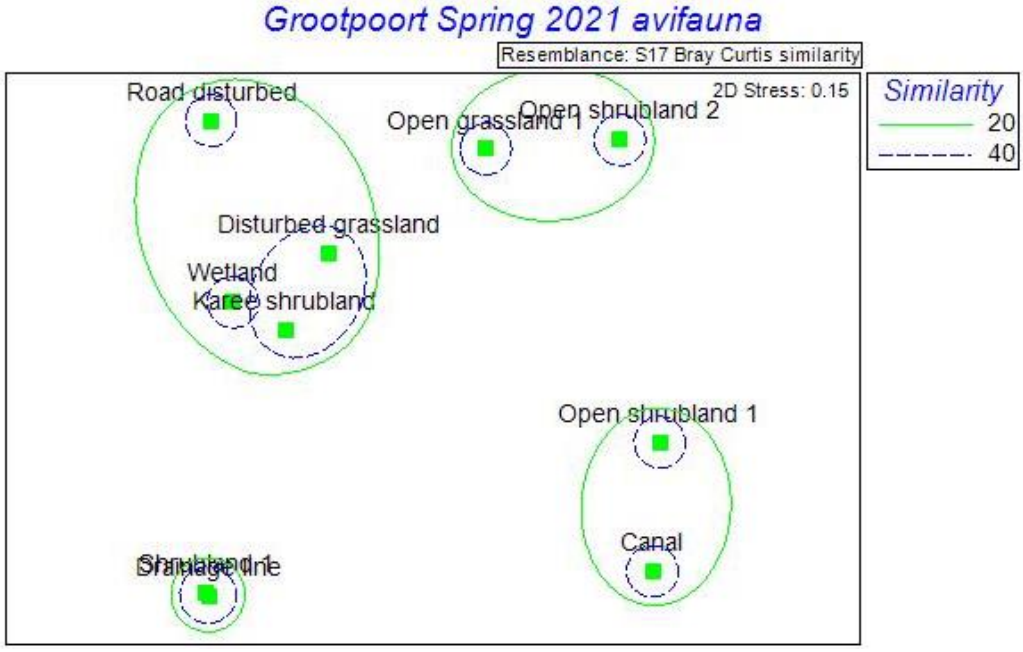

Figure 8. N-MDS diagram of the proposed Grootpoort power line corridor spring avifaunal assemblage

The bird community in winter was generally characterised by lower numbers of species and individuals, which is to be expected in semi-arid regions where birds wander widely during the dry season. In spring, some species pair off to breed and stake territories and this was reflected in a greater species richness (augmented by migrant species) and greater overall abundances (Table 7).

Absolute species richness shows the total number of species recorded within any transect. The overall species richness (S in the table below) is considered relatively high for the transect survey time and distance.

The abundance of birds (N in the table below) varied substantially between sites. The more open habitats, such as the grassland and shrubland habitats, yielded the fewest birds, whereas those with water and a denser woody component harboured more birds.

Species Evenness reflects how similar the sites were in terms of their total composition and abundance, thus how equal the avifaunal community is in numerical terms. Table 7 also shows Pielou's Evenness, with a value of 0 indicating complete unevenness and a value of 1 indicating complete evenness. Again, the more intact habitats showed greater evenness and more stable populations are expected.

Table 7. Avifaunal species richness, abundance and diversity recorded for the proposed Grootpoort power line corridor

		Total species	Total individuals	Evenness	Shannon D	Simpson D
		S	*N*	*J'*	*H'(loge)*	*1-Lambda'*
Winter	Road disturbed	8	54	0.45	0.93	0.39
Winter	Disturbed grassland	16	57	0.85	2.36	0.89
Winter	Wetland	22	61	0.92	2.84	0.94
Winter	Open grassland 1	15	56	0.68	1.83	0.70
Winter	Open shrubland 1	9	22	0.93	2.05	0.90
Winter	Karee shrubland	11	24	0.89	2.14	0.89
Winter	Canal	13	23	0.95	2.43	0.94
Winter	Open shrubland 2	10	22	0.88	2.03	0.87
Winter	Shrubland 1	11	47	0.71	1.71	0.70
Winter	Drainage line	14	61	0.87	2.31	0.88
Spring	Road disturbed	11	25	0.90	2.17	0.90
Spring	Disturbed grassland	10	23	0.85	1.95	0.83
Spring	Wetland	20	50	0.90	2.70	0.93
Spring	Open grassland 1	9	30	0.94	2.06	0.89
Spring	Open shrubland 1	11	50	0.65	1.56	0.65
Spring	Karee shrubland	18	31	0.97	2.80	0.97
Spring	Canal	7	79	0.73	1.42	0.70
Spring	Open shrubland 2	14	112	0.59	1.57	0.62
Spring	Shrubland 1	24	64	0.86	2.73	0.91
Spring	Drainage line	32	81	0.94	3.25	0.96

An important means of quantifying the actual status of the bird populations is by considering a diversity index. Here we focus on the Shannon-Wiener (SW) diversity index that attempts to give a true index of diversity by relating the number of species present in relation to the total abundance of all species present. Essentially, it has the same intention as the Simpson Index but expresses the data differently and can be considered a more specialised index. The Shannon-Wiener Index values appear to reflect the situation on site better in this case, as sites with high species richness and high

number of species have ranked higher. SW index values mostly range between 1.5-3.5. In winter, the disturbed roadway site had comparatively low diversity values (<1), whereas the wetland, drainage line and disturbed grassland habitat (near the wetland and canal) had the greatest diversity. In spring, no sites had very low diversity values (<1), whereas the wetland, Karee shrubland, Driedoring shrubland and drainage line habitats had relatively high diversity values.
The maximum score for the Simpson's Diversity is 1, therefore the nearer to 1 the higher the true diversity of each transect, accounting for the total number of species present, relative to their abundance. Again, the more intact habitats showed greater Diversity.

13 IMPACTS OF POWER LINES ON AVIFAUNA

BirdLife South Africa has a strong position statement on the impacts of solar power generation and distribution/transmission on birds but favours the technology and methodology above wind and fossil fuels. Their main concerns involve the displacement and exclusion of globally or nationally threatened bird species, endemic or range-restricted species, or rare species from important habitats. The issues stemming from their position statement and contemporary studies are as follows:

1. Displacement of threatened species from important habitats;
2. Loss of habitat for resident species, especially where cumulative impacts exist;
3. Disturbance of resident species throughout construction, operation and maintenance;
4. Collisions with photovoltaic panels;
5. Reflective surfaces of panels creating a mirror affect and possibly attracting waterbirds;
6. Electrocution and collision at power line infrastructure;
7. New power line construction.

They suggest the following course of actions in terms of mitigating the impacts on birds:

- Undertaking sufficient pre-construction monitoring to determine the presence of threatened, rare, endemic or range-restricted species. SABAP2 data is recommended to supplement adequate field surveys.
- Constructing PV plants close to existing power lines and, if new lines are required, motivate the need for lines to be adequately marked with anti-collision devices and bird-friendly designs to prevent electrocution.
- Not constructing PV plants in formally or informally protected areas or Important Bird Areas (IBAs), but in areas of low relevance for nature conservation.
- Constructing PV plants in already degraded areas.
- Avoiding construction near drainage lines with trees where birds will be concentrated (e.g., in Karoo where most PV plant are likely to be constructed).
- Avoiding construction near large trees (e.g., in the Karoo) which serve as nesting and roosting sites for raptors and vultures.
- Building solar arrays outside known waterbird flight paths.
- Not using chemicals/pesticides for the maintenance of land/vegetation and rather use mowing or grazing to retard vegetation growth.

- Constructing new power lines in such a way that they have minimal impact on birds (i.e., bird-friendly designs, appropriate wire marking devices).
- Deconstruction of the plant after the expected economic life span

The impacts that were considered relevant to the proposed power lines for the Grootpoort SPP and that have been included in the impact assessment for scoring are shown in Table 8.

Table 8. Avifaunal impacts specific to the proposed power lines for the Grootpoort SPP as used in the impact ratings

Avifaunal impacts specific to the proposed power line	
Displacement of priority avian species from important habitats.	The area is not within an IBA (but the Platberg-Karoo Conservancy IBA is very near); however, it has been identified as 'Very High Sensitivity' and 'High Sensitivity' by DFFE's screening tool for terrestrial ecology and animal species (Ludwig's Bustard). Four priority species was recorded for the wider SABAP2 pentad or o site during surveys **(Kori Bustard, Karoo korhaan, Secretarybird,** and ***African Rock Pipit*)**, but others have a reasonable chance of at least occasional occurrence based on habitat and distribution (**Lanner Falcon, Black Harrier, Ludwig's Bustard, Burchell's Courser, Blue Crane, Verreaux's Eagle**).
	These impacts are expected to start during the construction phase, but will reduce through the operational phase, and be eliminated after decommissioning. The habitats are likely to be directly impacted/disturbed and the increased disturbance is likely to deter protected species from accessing the area.
	These impacts are also considered as cumulative due to other planned solar developments in a 30 km radius.
Displacement of resident avifauna through increased disturbance.	There are numerous endemic or near-endemic species that have been recorded during prior SABAP2 assessments for the wider pentads or during site surveys (*Fairy Flycatcher, Fiscal Flycatcher,* ***African Rock Pipit****, South African Cliff Swallow, Large-billed Lark, Namaqua Warbler, Sickle-winged Chat, Cape Weaver, Grey Tit, Layard's Warbler*).
	These impacts are expected to start during the construction phase, and will decline through the operational phase, disappearing after decommissioning. Many of the resident species are expected to be displaced, either temporarily or permanently, due to the habitat transformation and ongoing human presence and disturbance.
	These impacts are also considered as cumulative due to the other planned solar developments in a 30 km radius.
Loss of important avian habitats	The site contains no threatened habitat types. However, the area is within an ecological support area.
	These impacts are expected to start during the construction phase, may last through the operational phase, into and after decommissioning. The transformation of some of the avian habitats will be permanent

Avifaunal impacts specific to the proposed power line	
	These impacts are also considered as cumulative due to the large number of planned solar developments in a 30 km radius.
Electrocutions when perched on power line infrastructure	Some species that are sensitive to power line collisions have been recorded during SABAP2 assessments or during site surveys (**Secretarybird, Kori Bustard, Karoo Korhaan,** Egyptian Goose, Hadeda Ibis, Hamerkop, Helmeted Guineafowl, Pale Chanting Goshawk, Black-winged Kite, Pied Crow, Spur-winged Goose, Reed Cormorant, White-breasted Cormorant, Western Cattle Egret) or have a reasonable chance of occurring on site (**Lanner falcon, Black Harrier, Verreaux's Eagle**).
Collisions with power line infrastructure leading to injury or loss of avian life	The 132 kV power lines are expected to be quite high and some species that are sensitive to power line collisions occur on site (**Secretarybird, Kori Bustard, Karoo Korhaan,** Egyptian Goose, Hadeda Ibis, Hamerkop, Helmeted Guineafowl, Pale Chanting Goshawk, Black-winged Kite, Cape Teal, Spur-winged Goose, South African Shelduck, Pied Crow, Namaqua Sandgrouse, Northern Black Korhaan, Pied Crow, Reed Cormorant, White-breasted Cormorant, Western Cattle Egret) or have a reasonable chance of occurring on site (**Ludwig's Bustard, Black Harrier, Verreaux's Eagle, Blue Crane, Lanner falcon**).
	These impacts are expected to start during the construction phase, will last through the operational phase, but will cease upon decommissioning and demolition.
	These impacts are also considered as cumulative due to the planned solar developments in a 30 km radius.

**Italics denotes endemic or near-endemic species*

***Bold denotes Red Data species**

14 IMPACT ASSESSMENT RATINGS

The methodology for assessing the impact ratings was supplied by Environamics as the EAP for the proposed SPP project.

The methodology is included as Appendix A: Method of Environmental Assessment at the end of this report. The rating rankings are as shown in Table 9 below.

The findings of the impact assessment ratings are shown in the table below (Table 9).

Table 9. Impact rating scoring used for the avifaunal impact assessment at the proposed power lines for the Grootpoort SPP

Rating	Rating explanation
6-28	Low- negative
29-50	Medium- negative
51-73	High- negative
74-96	Very high- negative

Table 10. Avifaunal impact ratings for the power lines at the proposed power lines for the Grootpoort SPP

PROPOSED POWER LINE IMPACT RATING FOR GROOTPOORT SPP **Description of risk and suggested mitigation**	**Applicable project phase**	**Probability**	**Duration**	**Extent**	**Reversibility**	**Irreplaceability**	**Cumulative effects**	**Total**	**Intensity/**	**Significance (unmitigated)**	**Significance (mitigated)**	**Before mitigation**	**After mitigation**
Displacement of priority avian species from important habitats	Construc-tion	3	1	2	2	2	3	13	3	39		Medium-negative	
Mitigated displacement: limit construction footprint and retain indigenous vegetation wherever possible, limit access to remainder of area, avoid breeding season (summer), lay-down areas on only disturbed zones, construct in shortest timeframe, control noise to minimum. Maintain single access and maintenance road within power line servitude		1	1	2	2	2	1	9	2		18		Low-negative
Displacement of resident avifauna through increased disturbance	Construc-tion	2	1	2	2	2	2	11	2	22		Low-negative	
Mitigated displacement: none required due to low significance								0			22		Low-negative
Loss of important avian habitats	Construc-tion	2	1	2	3	2	2	12	2	24		Low-negative	
Mitigated displacement: none required due to low significance								0			24		Low-negative
Displacement of priority avian species from important habitats	Operation	1	3	2	3	2	1	12	3	36		Medium-negative	

PROPOSED POWER LINE IMPACT RATING FOR GROOTPOORT SPP **Description of risk and suggested mitigation**	**Applicable project phase**	**Probability**	**Duration**	**Extent**	**Reversibility**	**Irreplaceability**	**Cumulative effects**	**Total**	**Intensity/**	**Significance (unmitigated)**	**Significance (mitigated)**	**Before mitigation**	**After mitigation**
Mitigated displacement: maintain natural vegetation and single access and maintenance road within power line servitude		1	3	2	3	2	1	12	2		24		Low-negative
Displacement of resident avifauna through increased disturbance	Operation	1	3	2	2	2	1	11	2	22		Low-negative	
Mitigated displacement: none required due to low significance								0			22		Low-negative
Collision when flying into power line infrastructure	Operation	4	3	2	4	3	4	20	4	80		Very high-negative	
Mitigated collision: require walk-through after pole positions are determined to demarcate sections requiring bird deterrents/flappers, install flappers on all required sections of power lines (as directed by avifaunal specialist) on or directly adjacent to site, quarterly fatality monitoring		1	3	2	2	2	2	12	3		36		Medium-negative
Electrocution when perched on power line infrastructure	Operation	2	3	2	4	3	4	18	4	72		High-negative	
Pole designs to discourage bird perching and to be signed-off by avifaunal specialist, quarterly fatality monitoring		1	3	2	1	2	2	11	3		33		Medium-negative
Displacement of priority avian species from important habitats	Decom-missioning	2	1	1	2	2	1	9	1	9		Low-negative	
Mitigated displacement: none required due to low significance								0			9		Low-negative
Displacement of resident avifauna through increased disturbance	Decom-missioning	2	1	1	2	2	1	9	1	9		Low-negative	
Mitigated displacement: none required due to low significance								0			9		Low-negative

PROPOSED POWER LINE IMPACT RATING FOR GROOTPOORT SPP **Description of risk and suggested mitigation**	**Applicable project phase**	**Probability**	**Duration**	**Extent**	**Reversibility**	**Irreplaceability**	**Cumulative effects**	**Total**	**Intensity/**	**Significance (unmitigated)**	**Significance (mitigated)**	**Before mitigation**	**After mitigation**
Cumulative displacement of priority avian species from important habitats	Throughout	3	3	2	3	3	4	18	3	54		High-negative	
Mitigate displacement: limit disturbance footprint and habitat transformation, limit ongoing human activity to the minimum required for ongoing operation, control noise to minimum, rehabilitate with native vegetation and retain indigenous vegetation throughout as far as possible, limit roadways and vehicle speeds; rehabilitate thoroughly post-decommissioning with locally native species		2	3	2	2	2	3	13	3		39		Medium-negative
Cumulative displacement of resident avifauna	Throughout	3	3	2	3	2	3	16	2	32		Medium-negative	
Mitigate displacement: limit disturbance footprint and habitat transformation, limit ongoing human activity to the minimum required for ongoing operation, control noise to minimum, rehabilitate with native vegetation and retain indigenous vegetation throughout as far as possible, limit roadways and vehicle speeds; rehabilitate thoroughly post-decommissioning with locally native species		2	3	2	2	2	2	13	2		26		Low-negative
Cumulative collisions when flying into power line infrastructure	Operation	4	4	3	4	3	4	22	4	88		Very high-negative	
Engage avifaunal specialist to conduct walk-through of regional lines (within 30 km) and mark areas where bird deterrents/flappers are required, commit to engage the ESKOM-EWT Strategic Partnership to investigate and fund		2	4	2	2	2	3	15	3		45		Medium-negative

PROPOSED POWER LINE IMPACT RATING FOR GROOTPOORT SPP **Description of risk and suggested mitigation**	**Applicable project phase**	**Probability**	**Duration**	**Extent**	**Reversibility**	**Irreplaceability**	**Cumulative effects**	**Total**	**Intensity/**	**Significance (unmitigated)**	**Significance (mitigated)**	**Before mitigation**	**After mitigation**
installing/partly installing deterrents in relation to percentage of cumulative impact contribution													
Cumulative electrocutions when perched on power line infrastructure	Operation	3	4	3	4	3	4	21	4	84		Very high-negative	
Engage avifaunal specialist to conduct walk-through of regional lines (within 30 km) and mark areas where perch deterrents/retro-fitted insulator attachments are required, commit to engage the ESKOM-EWT Strategic Partnership to investigate and fund installing/partly installing perch deterrents or risers in relation to percentage of cumulative impact contribution		1	4	2	2	2	2	13	3		39		Medium-negative

The pre-mitigation impact rating average is Medium-Negative, however with mitigations it can be reduced to Low-Negative.

Table 11. Summary of avifaunal impact ratings for the proposed power lines for the Grootpoort SPP

	Average impact rating	***Significance class***	***Average mitigated impact***	***Significance class***
Avifaunal impacts of the SPP power lines	44	Medium-negative	27	Low-negative

Mitigations are required to bring the following power line-associated risks within acceptable levels (Low-Negative impact rating, below 28 score):

- Displacement of priority avian species from important habitats during the construction and operational phases- This scored Medium-Negative due to priority species being involved, that have high irreplaceability, low reversibility, relatively high probability of suffering impacts and a relatively severe intensity or consequence multiplier. Priority species (Red Data species in this instance) are threatened with extinction to some degree and extremely sensitive to disturbance and habitat loss. Both of these are expected to occur during the construction of the power line. It is expected that priority species have at least a medium chance of being displaced from habitat that they would otherwise have utilised, albeit occasionally. Some of these species (refer to Table 8) were either recorded during SABAP2 surveys for the surrounding pentads (filtered by habitat) or are protected species that have not yet been recorded but have a reasonable likelihood of occurring (section 10.4 and 10.5 earlier in this report).
- Collision when flying into power line infrastructure- This impact scored Very High-Negative due to the large number of power line-sensitive species that have been recorded during the transect surveys for this project and during the SABAP2 assessments. These were determined using the recommendations by Jenkins et al (2010) and essentially cover the waterfowl, waders, game birds, raptors, larger bodied birds (bustards, egrets, herons) and smaller, fast-flying birds (terns). The full list is shown in Table 2. When not mitigated, power line collisions are a significant threat to birds (Van Rooyen, 2004) and has been very well documented through ongoing monitoring by the ESKOM-EWT Strategic Partnership. This has the potential to begin as soon as the power lines are erected in the construction phase and to continue throughout the life of the SPP project, and potentially beyond, if the power lines are not decommissioned and removed.
- Electrocution when perched on power line infrastructure- This impact scored High-Negative due to the large number of big birds that do roost on power line infrastructure and have been recorded during SABAP2 assessments for the wider pentads. The full list of susceptible species is shown in Table 2 and essentially consists of the raptors, herons and some gamebirds that are large enough to bridge the air gap between lines and thus risk electrocution. The planned line is reportedly 132 kV, and this would generally exclude

electrocution risk for smaller birds, however the electrical hardware (which determines electrocution risk) has not yet been finalised. This impact begins as soon as the power lines are commissioned and charged and will continue throughout the life of the project, and potentially beyond if the power line is not decommissioned.

- Cumulative impacts- the same impacts as described above were ranked for cumulative impacts and all ranked higher due the high prevalence of solar projects in a 30 km radius (Section 9: **REGIONAL SOLAR ENERGY DEVELOPMENT**). Cumulative impacts associated with displacement of priority avian species from important habitats scored High-Negative, whilst the cumulative displacement of resident avifauna scored Medium-Negative. Cumulative impacts associated with power line collisions and electrocutions scored Very High-Negative.

15 MITIGATION REQUIREMENTS

As shown in the risk assessment ratings (Table 10), many of the avifaunal impacts are considered Medium-Negative or higher and, therefore, warrant intervention to decrease the risks to an acceptable level (Low-Negative rating). The mitigations required for the power line infrastructure is shown in Table 12.

Table 12. Mitigations required for the proposed power lines for the Grootpoort SPP avifaunal impacts to achieve acceptable impact ratings

	Significance reduction	*Before mitigation*	*After mitigation*
Displacement of priority avian species from important habitats during construction phase		Medium-negative	
Mitigated displacement: limit construction footprint and retain indigenous vegetation wherever possible, limit access to remainder of area, avoid breeding season (summer), lay-down areas on only disturbed zones, construct in shortest timeframe, control noise to minimum. Maintain single access and maintenance road within power line servitude	54%		Low-negative
Displacement of priority avian species from important habitats during operational phase		Medium-negative	
Mitigated displacement: maintain natural vegetation and single access and maintenance road within power line servitude	33%		Low-negative
Collision when flying into power line infrastructure during operational phase		Very high-negative	
Mitigated collision: require walk-through after pole positions are determined to demarcate sections requiring bird deterrents/flappers, install flappers on all required sections of power lines (as directed by avifaunal specialist) on or directly adjacent to site, quarterly fatality monitoring	55%		Medium-negative
Electrocution when perched on power line infrastructure during operational phase		High-negative	
Pole designs to discourage bird perching and to be signed off by avifaunal specialist, quarterly fatality monitoring	54%		Medium-negative
Cumulative displacement of priority avian species from important habitats, throughout project life		High-negative	
Mitigate displacement: limit disturbance footprint and habitat transformation, limit ongoing human activity to the minimum required for ongoing operation, control noise to minimum, rehabilitate with native vegetation and retain indigenous vegetation throughout as far as possible, limit roadways and vehicle speeds; rehabilitate thoroughly post-decommissioning with locally native species	28%		Medium-negative

	Significance reduction	*Before mitigation*	*After mitigation*
Cumulative displacement of resident avifauna, throughout project life		Medium-negative	
Mitigate displacement: limit disturbance footprint and habitat transformation, limit ongoing human activity to the minimum required for ongoing operation, control noise to minimum, rehabilitate with native vegetation and retain indigenous vegetation throughout as far as possible, limit roadways and vehicle speeds; rehabilitate thoroughly post-decommissioning with locally native species	19%		Low-negative
Cumulative collisions when flying into power line infrastructure during operational phase		Very high-negative	
Engage avifaunal specialist to conduct walk-through of regional lines (within 30 km) and mark areas where bird deterrents/flappers are required, commit to engage the ESKOM-EWT Strategic Partnership to investigate and fund installing/partly installing deterrents in relation to percentage of cumulative impact contribution	49%		Medium-negative
Cumulative electrocutions when perched on power line infrastructure during operational phase		Very high-negative	
Engage avifaunal specialist to conduct walk-through of regional lines (within 30 km) and mark areas where perch deterrents/retro-fitted insulator attachments are required, commit to engage the ESKOM-EWT Strategic Partnership to investigate and fund installing/partly installing perch deterrents or risers in relation to percentage of cumulative impact contribution	54%		Medium-negative

The majority of the mitigations listed in Table 12 above for the power line infrastructure are quite standard, involving minimising impact footprints during construction, limiting site access beyond direct disturbance zones, reducing noise and constructing in winter (avoiding breeding season), trying to stick to existing roads. Implementing these mitigations reduces the significance by 39% and results in acceptable Low-Negative impact ratings.

Minimising impacts along the power line route should be relatively straightforward. Fortunately, the beginning and end stretches of the power line route run parallel and close to existing power lines, which automatically lessens the potential impact.

Perhaps less straightforward will be mitigating collisions with power lines, which is the single greatest impact for the SPP project, an indeed any solar project. Power line markers, such as flappers or large PVC spiral-type bird flight diverters at least every 5 m on earth and live wires are an absolute requirement. Another possibility is the avoidance of earth wires, where possible.

It is suggested that the entire power line length be fitted with bird flight diverters. Implementing this mitigation should reduce the collision impact by 55% and achieve an anticipated Medium-Negative impact rating.

For electrocutions, the risk is largely associated with the technology used (which is yet to be decided), however the presence of a wide diversity of large birds that utilise power lines to roost and/nest does warrant intervention. It is suggested that the electrocution mitigation designs associated with the pole technology options are presented to the avifaunal specialist for sign-off prior to implementation. Implementing low-risk electrocution technology conservatively should achieve at least a 54% impact reduction but still resulting in a Medium-Negative impact rating. This is the same mitigation that is suggested for cumulative impacts relating to minimising electrocution risk.

It is the cumulative impacts, when considering the existing transformation of the threatened habitats to croplands and mining, in addition to the prevalence of planned solar developments, that increase the cumulative risks and, therefore, warrant mitigations.
Mitigating the cumulative impacts would require limiting the impact of Grootpoort SPP's power lines to an absolute minimum, which is not necessarily feasible but should be pursued. The mitigations to reduce cumulative impacts involve limiting the disturbance footprint (overall size), focussing the development on already disturbed zones, limiting human activity and noise throughout the project life, disturbing as little natural vegetation as possible, retaining the natural vegetation beneath the panels and around infrastructure, limiting the extent and width of roadways, reducing the speeds that vehicles travel, and then thoroughly rehabilitating the entire footprint back to natural grassland representing the Vaal-Vet Sandy Grassland after decommissioning.
Implementing successful mitigations along the power line should reduce the impact rating for cumulative displacement resident avifauna by 19% down to an acceptable Low-Negative score, however cumulative displacement of priority avian species would reduce by 28% but would still be in the Medium-Negative category.

16 RESIDUAL IMPACTS POST-MITIGATION

Collision when flying into power lines/infrastructure, electrocutions, and cumulative displacement of priority avifauna- project-specific and cumulative impacts will remain, even after mitigations are implemented. These should be balanced against the gains made in displacing fossil fuels with solar energy. The residual impacts are on the low side of the Medium-Negative scale. Due to the expected residual impacts, monitoring is recommended. This preliminary desktop study has been supplemented by SABAP2 data and changes in bird presence, abundance and species richness should be noted on a bi-annual basis (winter and summer) by an avifaunal specialist and compared over time. Monitoring electrocution and collision impacts can be undertaken by trained site staff on a quarterly basis.

These residual impacts will be difficult, if not impossible, and expensive to mitigate to Low-Negative levels. Offsetting, as a last resort, with effective monitoring controls or effectiveness, could be considered, should the overall project environmental impact be considered too great, and should other specialists require additional mitigations or offsets.

17 NO-GO AREAS, BUFFERS AND ALTERNATIVES

There are three habitats that harbour greater species richness than any other, or are flyways utilised by species that are prone to power line collisions, and thus have the potential for the greatest impacts if extensive disturbances take place (Figure 9).

These are:

- The two canal crossings (north and south) (Figure 10 and Figure 11)
- The wetland/farm dam, which is also near the northern canal crossing (Figure 12 and Figure 13)
- The drainage line (Figure 14 and Figure 15).

Figure 9. No-go areas where particular attention must be given to pylon placement and marking

The combination of the canals, which serve as 'arteries' into he otherwise dry habitats, as well as the presence of a seasonal dam and the high-diversity drainage lines harbour situations where more than acceptable impacts could occur if left unmitigated, or if mitigations are not extraordinary. The biggest concern is collision impacts, which should be mitigated additionally with large ball-diverters to mark the power lines here, in addition to the smaller PVC-spirals required for the remainder of the line. The second major concern is the siting of pylons, which should not be sited within the drainage line and wetland no-go sites.

Figure 10. Photographs of the canal crossings (north on left and south on right) where additional markers, visible in low light conditions, are required

Figure 11. Canal crossing no-go areas where the power line should hug the tarred road and pylons should be placed as far from the actual canals as is feasibly possible (with additional line markers)

Figure 12. Photograph of the farm dam where additional markers are required, visible in low light conditions

Figure 13. Location of the farm dam no-go zone where the power line and pylons should hug the tarred road to avoid direct proximity to the dam

Figure 14. Photograph of the drainage line where pylons should be situated outside of the wooded zone and where additional markers are required, particularly visible n low light

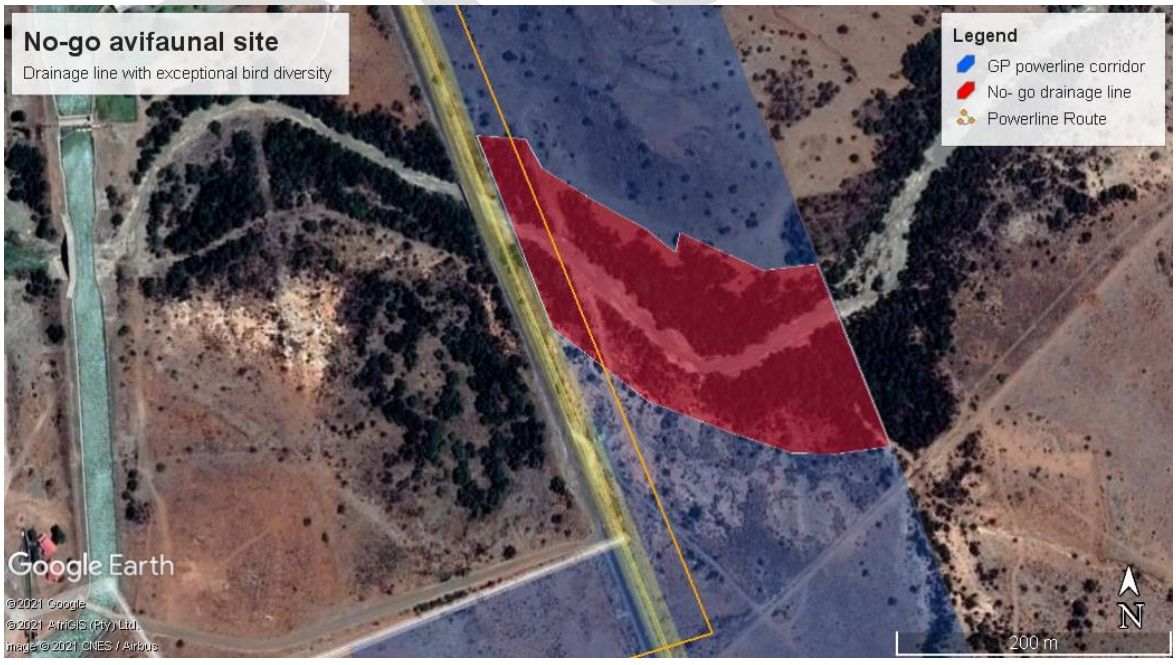

Figure 15. Location of the drainage line no-go zone where the power line should hug the tarred road and pylon placement must be carefully considered

No alternative site locations or power line routes have been provided.

18 CONCLUSION AND RECOMMENDATIONS

The proposed power line for the Grootpoort SPP is situated in an area of moderate avifaunal diversity, but has the potential to impact many large, fast-flying and otherwise power line-sensitive species, as well as Red Data and endemic species.

There are individual impacts that are relatively high, however most can be effectively mitigated through the controls prescribed in this report. The overall mitigated impacts can result in the project having an overall Low-Negative impact rating on avifauna, although the collision with power lines remains residually at least Medium-Negative.

It is largely the cumulative impacts on avifauna, as a result of loss of important habitats, the displacement of priority and resident birds and the continued and growing powerline collision impacts that are concerns. Due the large number of priority powerline-sensitive species, it is recommended that the entire powerline length be marked with bird deterrents, and that the developer commits to engaging the ESKOM-EWT Strategic Partnership to investigate funding marking and bird deterrents/bird-safe technology on existing powerlines that cross the site, together with appointing an avifaunal specialist to assess and indicate which areas of existing powerlines within the 30 km cumulative impact zone need additional bird deterrents/markers/safe technology installed, and then to engage the ESKOM -EWT Strategic Partnership to investigate funding these in relation to the contribution to cumulative impacts.

Additionally, more prominent power line markers are required at the four no-go avifaunal sites to ensure that the power lines are visible, especially in low light conditions. The siting of pylons and alignment of the actual lines should also be heeded to hug the tarred road and not run in the centre of the proposed corridor in these sections.

An ideal situation would be the upgrading of the existing power line that runs along much of the proposed power line route, so that its impacts can be mitigated together with the proposed power line.

<u>Impact statement</u>

Despite some residual and cumulative impacts, there is no objection, from an avifaunal perspective, to the development of the proposed SPP development. The overall impact of the project on avifauna can be effectively mitigated, should the controls prescribed in this report be adequately followed, with sufficient monitoring of mitigation effectiveness.

<u>Specific conditions recommended for the EA from an avifaunal perspective</u>

1. Implement mitigation controls during the construction phase as specified in Section 15: MITIGATION REQUIREMENTS. Monitor and report on their effectiveness.
2. Implement mitigation controls during the operational phase as specified in Section 15: MITIGATION REQUIREMENTS. Monitor and report on their effectiveness.
3. Consult with the avifaunal specialist regarding the positions and designs of bird perching/nesting deterrents and power line markers as per Section 15: NO-GO AREAS, BUFFERS AND ALTERNATIVES.
4. Adhere to avifaunal specialist's recommendations on controls for no-go avifaunal sites.
5. Monitoring of implementation of mitigation controls, along with reporting, should be undertaken at least quarterly throughout the construction phase, and bi-annually during the operational phase. Monitoring, at the minimum, should consist of:

   a. quarterly monitoring of power line route for evidence of collisions or electrocutions;
   b. bi-annual monitoring of the resident avifaunal population, including priority species, to compare the impacts to the baseline avifaunal community description in this report.
6. As much of the natural habitat as possible should be preserved during construction and operation to lessen the operational impacts and to reduce the irreversibility of impacts.
7. Effective restoration of the natural habitats that were intact before the development should be implemented and reported on after decommissioning.

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20 APPENDICES

20.1 Appendix A: Method of Environmental Assessment

The environmental assessment aims to identify the various possible environmental impacts that could results from the proposed activity. Different impacts need to be evaluated in terms of its significance and in doing so highlight the most critical issues to be addressed.
Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale i.e., site, local, national or global whereas intensity is defined by the severity of the impact e.g., the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence. Significance is calculated as shown in the Table below.
Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

Impact Rating System

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

- planning
- construction
- operation
- decommissioning

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

Table 1: The rating system

NATURE		
Include a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity.		
GEOGRAPHICAL EXTENT		
This is defined as the area over which the impact will be experienced.		
1	Site	The impact will only affect the site.
2	Local/district	Will affect the local area or district.
3	Province/region	Will affect the entire province or region.
4	International and National	Will affect the entire country.
PROBABILITY		
This describes the chance of occurrence of an impact.		

1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
DURATION		
This describes the duration of the impacts. Duration indicates the lifetime of the impact as a result of the proposed activity.		
1	Short term	The impact will either disappear with mitigation or will be mitigated through natural processes in a span shorter than the construction phase (0 – 1 years), or the impact will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development but will be mitigated by direct human action or by natural processes thereafter (10 – 30 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered indefinite.
INTENSITY/ MAGNITUDE		
Describes the severity of an impact.		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/ component, and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.

4	Very high	Impact affects the continued viability of the system/component, and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired. Rehabilitation and remediation often impossible. If possible, rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.
REVERSIBILITY		
This describes the degree to which an impact can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures.
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible, and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
CUMULATIVE EFFECT		
This describes the cumulative effect of the impacts. A cumulative impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.		
1	Negligible cumulative impact	The impact would result in negligible to no cumulative effects.
2	Low cumulative impact	The impact would result in insignificant cumulative effects.
3	Medium cumulative impact	The impact would result in minor cumulative effects.
4	High cumulative impact	The impact would result in significant cumulative effects
SIGNIFICANCE		
Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The calculation of the significance of an impact uses the following formula: (Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity.		

The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.		
Points	Impact significance rating	Description
6 to 28	Negative low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive medium impact	The anticipated impact will have moderate positive effects.
51 to 73	Negative high impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 to 73	Positive high impact	The anticipated impact will have significant positive effects.
74 to 96	Negative very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
74 to 96	Positive very high impact	The anticipated impact will have highly significant positive effects.

20.2 Appendix B: Photographs of avifaunal survey transects

Figure 16. Grootpoort power line avifaunal survey transect 1, disturbed grassland adjacent to the busy road

Figure 17. Grootpoort power line avifaunal survey transect 2, disturbed grassland

Figure 18. Grootpoort power line avifaunal survey transect 3, the farm dam/wetland

Figure 19. Grootpoort power line avifaunal survey transect 4, the open grassland

Figure 20. Grootpoort power line avifaunal survey transect 5, the open Driedoring grassy shrubland

Figure 21. Grootpoort power line avifaunal survey transect 6, the Besemkaree koppies shrubland

Figure 22. Grootpoort power line avifaunal survey transect 7, the southern canal crossing

Figure 23. Grootpoort power line avifaunal survey transect 8, the open grassy shrubland

Figure 24. Grootpoort power line avifaunal survey transect 9, the open shrubland

Figure 25. Grootpoort power line avifaunal survey transect 10, the drainage line

20.3 Appendix C: Abundance matrices of 2021 winter avifaunal transects for Grootpoort corridor

Grootpoort Winter 2021	Road disturbed	Disturbed grassland	Wetland	Open grassland 1	Open shrubland 1	Karee shrubland	Canal	Open shrubland 2	Shrubland 1	Drainage line
Acacia Pied Barbet	0	0	0	0	0	1	0	0	0	0
African Pipit	0	0	0	2	0	0	0	0	0	0
African Red-eyed Bulbul	0	0	0	0	0	0	3	0	5	0
Ant-eating Chat	0	0	0	0	0	0	0	1	0	0
Ashy Tit	0	0	0	0	0	0	0	0	0	0
Black-chested Prinia	0	0	0	0	0	2	0	0	2	2
Black-faced Waxbill	0	0	0	0	0	0	0	0	0	0
Black-throated Canary	0	0	0	0	0	0	0	0	0	0
Black-winged Kite	0	1	0	0	2	0	0	0	0	0
Bokmakierie	2	0	0	0	0	0	0	0	0	0
Brown-hooded Kingfisher	0	0	0	0	0	0	0	0	0	0
Brown-throated Martin	0	0	0	1	0	0	1	0	0	0
Brubru	0	0	1	0	0	0	0	0	0	0
Cape Bunting	0	0	3	0	0	1	1	0	0	0
Cape Robin-Chat	0	0	0	0	0	0	1	0	0	0
Cape Sparrow	0	0	2	0	0	0	0	0	0	2
Cape Starling	0	0	0	0	2	0	0	2	0	0
Cape Teal	0	0	5	0	0	0	0	0	0	0
Cape Wagtail	0	0	1	0	0	0	1	0	0	0
Cape Weaver	0	0	0	0	0	0	4	4	0	5
Chat Flycatcher	1	0	0	0	0	0	0	1	0	0
Chestnut-vented Warbler	0	0	0	0	0	0	0	0	0	0
Common Waxbill	0	0	0	0	0	0	0	0	0	17

Grootpoort Winter 2021	Road disturbed	Disturbed grassland	Wetland	Open grassland 1	Open shrubland 1	Karee shrubland	Canal	Open shrubland 2	Shrubland 1	Drainage line
Crested Barbet	0	0	0	0	0	0	0	0	0	0
Desert Cisticola	1	0	3	1	1	0	1	1	0	0
Dusky Sunbird	0	0	0	0	0	0	0	0	0	2
Eastern Clapper Lark	0	1	0	1	0	0	0	0	0	0
Egyptian Goose	0	14	0	0	0	0	0	0	0	0
Fairy Flycatcher	0	0	0	0	0	0	0	0	0	0
Familiar Chat	2	0	0	0	0	0	3	0	0	2
Fawn-coloured Lark	0	1	0	0	0	0	0	0	0	0
Fiscal Flycatcher	0	0	0	0	0	0	0	0	2	0
Golden-tailed Woodpecker	0	0	0	0	0	0	0	0	0	0
Greater Striped Swallow	0	0	0	0	0	0	0	0	0	0
Grey Tit	0	0	1	0	0	0	0	0	0	0
Grey-backed Cisticola	0	0	0	0	0	0	0	0	0	0
Grey-backed Sparrow-Lark	0	0	0	30	0	0	0	7	0	0
Hadeda Ibis	0	0	0	0	0	0	0	0	0	0
Hamerkop	0	0	0	0	0	0	0	0	0	0
Helmeted Guineafowl	0	0	0	0	0	0	0	0	0	0
Horus Swift	0	0	0	0	0	0	0	0	0	0
Karoo Korhaan	0	0	0	0	0	0	0	0	0	0
Karoo Scrub-Robin	1	0	0	0	0	1	0	2	1	0
Kori Bustard	0	0	0	0	0	0	0	0	0	0
Lark-like Bunting	0	10	5	0	0	0	0	0	0	0
Laughing Dove	0	0	2	0	3	0	1	0	2	1
Layard's Warbler	0	1	0	0	0	1	0	0	1	0
Lesser Honeyguide	0	0	0	0	0	0	0	0	0	0
Little Swift	0	0	0	0	0	0	0	0	0	0

Grootpoort Winter 2021	Road disturbed	Disturbed grassland	Wetland	Open grassland 1	Open shrubland 1	Karee shrubland	Canal	Open shrubland 2	Shrubland 1	Drainage line
Long-billed Crombec	1	0	0	0	0	0	0	0	0	0
Namaqua Sandgrouse	0	0	4	0	0	0	0	0	0	0
Namaqua Warbler	0	1	1	0	0	0	0	0	2	0
Neddicky	0	1	1	0	0	0	0	0	0	0
Northern Black Korhaan	0	0	0	0	0	0	0	0	0	0
Orange River White-eye	0	0	9	0	3	2	0	0	25	6
Pale Chanting Goshawk	0	0	0	0	1	1	2	1	0	0
Pied Crow	4	3	2	0	0	0	0	0	0	2
Pied Kingfisher	0	0	1	0	0	0	0	0	0	0
Pririt Batis	0	0	0	0	0	0	0	0	0	0
Red-billed Quelea	42	5	7	0	0	0	0	0	0	0
Red-eyed Dove	0	0	0	0	0	0	0	0	0	0
Red-faced Mousebird	0	0	0	0	0	5	0	0	3	0
Red-headed Finch	0	0	0	0	0	0	0	0	0	0
Reed Cormorant	0	0	3	4	0	0	0	0	0	0
Ring-necked Dove	0	2	0	0	0	0	0	0	0	0
Rock Martin	0	3	0	0	0	0	2	0	3	0
Rufous-eared Warbler	0	1	0	1	1	0	0	2	0	0
Sabota Lark	0	0	1	2	0	0	0	1	0	0
Scaly-feathered Weaver	0	0	0	0	0	0	0	0	0	8
Secretarybird	0	0	0	1	0	0	0	0	0	0
Short-toed Rock Thrush	0	0	0	0	0	1	0	0	0	0
Sickle-winged Chat	0	0	1	1	0	0	0	0	0	0
South African Cliff Swallow	0	0	0	0	0	0	0	0	0	0
South African Shelduck	0	0	2	4	0	0	0	0	0	0

Grootpoort Winter 2021	Road disturbed	Disturbed grassland	Wetland	Open grassland 1	Open shrubland 1	Karee shrubland	Canal	Open shrubland 2	Shrubland 1	Drainage line
Southern Grey-headed Sparrow	0	0	0	0	0	0	0	0	0	0
Southern Masked Weaver	0	2	2	0	4	0	0	0	0	6
Southern Red Bishop	0	0	0	2	0	0	1	0	1	0
Speckled Pigeon	0	0	0	0	0	0	0	0	0	1
Spike-heeled Lark	0	0	0	4	0	0	0	0	0	0
Spur-winged Goose	0	0	0	1	0	0	0	0	0	0
Swallow-tailed Bee-eater	0	0	0	0	0	0	0	0	0	0
Western Cattle Egret	0	6	0	0	0	0	0	0	0	0
White-backed Mousebird	0	0	0	0	0	6	0	0	0	0
White-breasted Cormorant	0	0	0	1	0	0	0	0	0	0
White-browed Sparrow-Weaver	0	0	0	0	5	0	2	0	0	0
White-fronted Bee-eater	0	0	0	0	0	0	0	0	0	4
White-rumped Swift	0	0	0	0	0	0	0	0	0	0
White-throated Swallow	0	0	0	0	0	0	0	0	0	0
Yellow Canary	0	5	4	0	0	3	0	0	0	3
Yellow-bellied Eremomela	0	0	0	0	0	0	0	0	0	0
Zitting Cisticola	0	0	0	0	0	0	0	0	0	0

20.4 Appendix D: Abundance matrices of 2021 spring avifaunal transects for Grootpoort corridor

Grootpoort Spring 2021	Road disturbed	Disturbed grassland	Wetland	Open grassland 1	Open shrubland 1	Karee shrubland	Canal	Open shrubland 2	Shrubland 1	Drainage line
Acacia Pied Barbet	0	0	1	0	0	0	0	0	1	2
African Pipit	0	0	0	0	0	0	0	0	0	0
African Red-eyed Bulbul	0	0	0	0	0	2	0	0	7	6
Ant-eating Chat	0	0	0	4	3	0	0	3	0	0
Ashy Tit	0	0	0	0	0	0	0	0	1	0
Black-chested Prinia	0	0	2	0	2	2	0	2	6	2
Black-faced Waxbill	0	0	0	0	0	0	0	0	0	5
Black-throated Canary	1	0	9	0	0	0	0	0	1	0
Black-winged Kite	0	0	0	0	0	0	0	0	0	0
Bokmakierie	0	0	0	0	0	2	0	0	0	0
Brown-hooded Kingfisher	0	0	0	0	0	0	0	0	0	1
Brown-throated Martin	0	0	0	0	0	0	1	0	0	0
Brubru	0	0	0	0	0	0	0	0	0	0
Cape Bunting	0	0	1	0	0	1	0	0	0	0
Cape Robin-Chat	0	0	0	0	0	0	0	0	0	2
Cape Sparrow	0	0	0	0	0	0	0	2	1	0
Cape Starling	0	0	0	0	0	0	0	0	0	1
Cape Teal	0	0	0	0	0	0	0	0	0	0
Cape Wagtail	0	0	0	0	0	0	0	0	0	1
Cape Weaver	0	0	0	0	0	0	0	0	0	0
Chat Flycatcher	1	0	0	0	1	0	0	0	0	0
Chestnut-vented Warbler	0	0	0	0	0	0	0	0	1	1
Common Waxbill	0	0	0	0	0	0	0	0	0	0

Grootpoort Spring 2021	Road disturbed	Disturbed grassland	Wetland	Open grassland 1	Open shrubland 1	Karee shrubland	Canal	Open shrubland 2	Shrubland 1	Drainage line
Crested Barbet	0	0	0	0	0	0	0	0	1	2
Desert Cisticola	2	2	1	2	1	1	0	2	1	0
Dusky Sunbird	0	0	1	0	0	1	0	0	0	2
Eastern Clapper Lark	0	0	2	5	2	1	0	5	0	0
Egyptian Goose	0	0	4	0	0	0	0	0	2	5
Fairy Flycatcher	0	0	0	0	0	3	0	0	0	0
Familiar Chat	0	0	0	0	0	1	0	0	0	0
Fawn-coloured Lark	0	0	0	0	0	0	0	0	0	0
Fiscal Flycatcher	0	0	0	0	0	0	0	0	0	1
Golden-tailed Woodpecker	0	0	0	0	0	0	0	0	0	1
Greater Striped Swallow	0	0	0	0	0	0	0	0	2	2
Grey Tit	0	0	0	0	0	0	0	0	0	0
Grey-backed Cisticola	0	0	0	0	0	1	0	0	0	0
Grey-backed Sparrow-Lark	0	0	0	7	0	0	0	12	0	0
Hadeda Ibis	0	0	0	0	0	0	0	0	2	4
Hamerkop	0	0	0	0	0	0	3	0	0	0
Helmeted Guineafowl	0	0	0	0	29	0	18	0	0	0
Horus Swift	0	0	0	0	0	0	0	2	0	0
Karoo Korhaan	5	0	0	0	0	0	0	0	0	0
Karoo Scrub-Robin	1	1	0	0	0	1	0	3	2	1
Kori Bustard	0	0	0	0	0	0	0	0	0	0
Lark-like Bunting	0	3	0	0	0	3	0	9	0	3
Laughing Dove	0	1	1	0	0	1	0	2	3	4
Layard's Warbler	0	0	0	0	0	0	0	0	0	0
Lesser Honeyguide	0	0	0	0	0	0	0	0	0	1
Little Swift	0	0	0	0	0	0	4	0	3	3

Grootpoort Spring 2021	Road disturbed	Disturbed grassland	Wetland	Open grassland 1	Open shrubland 1	Karee shrubland	Canal	Open shrubland 2	Shrubland 1	Drainage line
Long-billed Crombec	0	0	0	0	0	0	0	0	0	0
Namaqua Sandgrouse	2	0	5	0	0	0	0	0	0	0
Namaqua Warbler	0	0	0	0	0	0	0	0	2	4
Neddicky	0	0	1	0	1	0	0	0	1	1
Northern Black Korhaan	0	0	0	2	0	0	0	0	0	0
Orange River White-eye	0	0	0	0	0	0	0	0	17	9
Pale Chanting Goshawk	0	0	0	0	0	0	0	0	0	0
Pied Crow	1	1	0	0	0	2	0	0	0	1
Pied Kingfisher	0	0	0	0	0	0	0	0	0	0
Pririt Batis	0	1	0	0	0	2	0	0	2	0
Red-billed Quelea	0	0	0	0	0	0	0	67	0	0
Red-eyed Dove	0	0	2	0	0	0	0	0	0	1
Red-faced Mousebird	0	0	0	0	0	0	0	0	0	0
Red-headed Finch	0	0	0	2	0	0	0	0	0	0
Reed Cormorant	0	0	1	0	0	0	0	0	0	0
Ring-necked Dove	0	0	0	0	1	0	0	0	2	1
Rock Martin	0	0	0	0	0	0	2	0	0	0
Rufous-eared Warbler	1	2	1	3	3	2	0	1	0	0
Sabota Lark	0	0	0	0	0	0	0	0	0	0
Scaly-feathered Weaver	6	0	0	0	0	0	0	0	0	0
Secretarybird	0	0	0	0	0	0	0	0	0	0
Short-toed Rock Thrush	0	0	0	0	0	0	0	0	0	0
Sickle-winged Chat	0	0	0	0	0	0	0	0	0	0
South African Cliff Swallow	2	9	5	4	0	2	37	0	0	0
South African Shelduck	0	0	0	0	1	0	0	0	0	0

Grootpoort Spring 2021	Road disturbed	Disturbed grassland	Wetland	Open grassland 1	Open shrubland 1	Karee shrubland	Canal	Open shrubland 2	Shrubland 1	Drainage line
Southern Grey-headed Sparrow	0	0	0	0	0	0	0	0	0	2
Southern Masked Weaver	0	0	5	0	0	3	0	0	1	0
Southern Red Bishop	0	0	0	1	0	0	0	0	2	4
Speckled Pigeon	0	0	0	0	0	0	0	0	0	0
Spike-heeled Lark	0	0	0	0	0	0	0	0	0	0
Spur-winged Goose	0	0	0	0	0	0	0	0	0	0
Swallow-tailed Bee-eater	0	0	1	0	0	0	0	0	0	0
Western Cattle Egret	0	0	0	0	0	0	0	0	0	2
White-backed Mousebird	0	0	0	0	0	0	0	0	0	0
White-breasted Cormorant	0	0	0	0	0	0	0	0	0	0
White-browed Sparrow-Weaver	0	0	0	0	6	0	0	0	0	0
White-fronted Bee-eater	0	0	0	0	0	0	0	0	0	0
White-rumped Swift	0	2	1	0	0	0	14	0	2	3
White-throated Swallow	0	0	0	0	0	0	0	0	1	3
Yellow Canary	3	0	4	0	0	0	0	1	0	0
Yellow-bellied Eremomela	0	1	2	0	0	0	0	0	0	0
Zitting Cisticola	0	0	0	0	0	0	0	1	0	0