BIRD IMPACT ASSESSMENT STUDY

Grid connection for the proposed Tlisitseng Solar Photovoltaic (PV) Project 2 near Lichtenburg in the North-West Province

FEBRUARY 2015

Prepared by:

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DECLARATION OF INDEPENDENCE

I, Chris van Rooyen as duly authorised representative of Chris van Rooyen Consulting, and working under the supervision of and in association with Albert Froneman (SACNASP Zoological Science Registration number 400177/09) as stipulated by the Natural Scientific Professions Act 27 of 2003, hereby confirm my independence (as well as that of Chris van Rooyen Consulting) as a specialist and declare that neither I nor Chris van Rooyen Consulting have any interest, be it business, financial, personal or other, in any proposed activity, application or appeal in respect of which Sivest was appointed as environmental assessment practitioner in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), other than fair remuneration for worked performed, specifically in connection with the Environmental Impact Assessment for the proposed grid connection of the Tlisitseng Solar 2 Photovoltaic (PV) Project 2 near Lichtenburg in the North-West Province.

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Full Name: Chris van Rooyen

Title / Position: Director

RELEVANT EXPERTISE

Chris van Rooyen

Chris has 19 years' experience in the management of wildlife interactions with electricity infrastructure. He was head of the Eskom-Endangered Wildlife Trust (EWT) Strategic Partnership from 1996 to 2007, which has received international acclaim as a model of co-operative management between industry and natural resource conservation. He is an acknowledged global expert in this field and has worked in South Africa, Namibia, Botswana, Lesotho, New Zealand, Texas, New Mexico and Florida. Chris also has extensive project management experience and has received several management awards from Eskom for his work in the Eskom-EWT Strategic Partnership. He is the author of 15 academic papers (some with co-authors), co-author of two book chapters and several research reports. He has been involved as ornithological consultant in more than 160 power line and 30 renewable energy projects. Chris is also co-author of the Best Practice for Avian Monitoring and Impact Mitigation at Wind Development Sites in Southern Africa, which is currently accepted as the industry standard. Chris also works outside the electricity industry and had done a wide range of bird impact assessment studies associated with various residential and industrial developments.

Albert Froneman (Pr.Sci.Nat)

Albert has an M. Sc. in Conservation Biology from the University of Cape Town, and started his career in the natural sciences as a Geographic Information Systems (GIS) specialist at Council for Scientific and Industrial Research (CSIR). He is a registered Professional Natural Scientist in the field of zoological science with the South African Council of Natural Scientific Professionals (SACNASP). In 1998, he joined the Endangered Wildlife Trust where he headed up the Airports Company South Africa – EWT Strategic Partnership, a position he held until he resigned in 2008 to work as a private ornithological consultant. Albert's specialist field is the management of wildlife, especially bird related hazards at airports. His expertise is recognized internationally; in 2005 he was elected as Vice Chairman of the International Bird Strike Committee. Since 2010, Albert has worked closely with Chris van Rooyen in developing a protocol for pre-construction monitoring at wind energy facilities, and they are currently jointly coordinating pre-construction monitoring programmes at several wind farm facilities. Albert also works outside the electricity industry and had done a wide range of bird impact assessment studies associated with various residential and industrial developments.

Curriculum vitae: Chris van Rooyen

Profession/Specialisation	:	Avifaunal Specialist
Highest Qualification	:	LLB
Nationality	:	South African
Years of experience	:	19 years

Key Project Experience

Bird Impact Assessment Studies and avifaunal monitoring for wind-powered generation facilities:

1. Eskom Klipheuwel Experimental Wind Power Facility, Western Cape
2. Mainstream Wind Facility Jeffreys Bay, Eastern Cape (EIA and monitoring)
3. Biotherm, Swellendam, (Excelsior), Western Cape (EIA and monitoring)
4. Biotherm, Napier, (Matjieskloof), Western Cape (pre-feasibility)
5. Windcurrent SA, Jeffreys Bay, Eastern Cape (2 sites) (EIA and monitoring)
6. Caledon Wind, Caledon, Western Cape (EIA)
7. Innowind (4 sites), Western Cape (EIA)
8. Renewable Energy Systems (RES) Oyster Bay, Eastern Cape (EIA and monitoring)
9. Oelsner Group (Kerriefontein), Western Cape (EIA)
10. Oelsner Group (Langefontein), Western Cape (EIA)
11. InCa Energy, Vredendal Wind Energy Facility Western Cape (EIA)
12. Mainstream Loeriesfontein Wind Energy Facility (EIA and monitoring)
13. Mainstream Noupoort Wind Energy Facility (EIA and monitoring)
14. Biotherm Port Nolloth Wind Energy Facility (Monitoring)
15. Biotherm Laingsburg Wind Energy Facility (EIA and monitoring)
16. Langhoogte Wind Energy Facility (EIA)
17. Vleesbaai Wind Energy Facility (EIA and monitoring)
18. St. Helena Bay Wind Energy Facility (EIA and monitoring)
19. Electrawind, St Helena Bay Wind Energy Facility (EIA and monitoring)
20. Electrawind, Vredendal Wind Energy Facility (EIA)
21. SAGIT, Langhoogte and Wolseley Wind Energy facilities
22. Renosterberg Wind Energy Project – 12 month preconstruction avifaunal monitoring project (2014)
23. De Aar – North (Mulilo) Wind Energy Project – 12 month preconstruction avifaunal monitoring project (2014)
24. De Aar – South (Mulilo) Wind Energy Project – 12 month bird monitoring (2014)
25. Namies – Aggenys Wind Energy Project – 12 month bird monitoring (2014)
26. Pofadder - Wind Energy Project – 12 month bird monitoring (2014)
27. Dwarsrug Loeriesfontein - Wind Energy Project – 12 month bird monitoring (2014)
28. Waaihoek – Utrecht Wind Energy Project – 12 month bird monitoring (2014)
29. Amathole – Butterworth Utrecht Wind Energy Project – 12-month bird monitoring & EIA specialist
30. Phezukomoya and San Kraal Wind Energy Projects 12-month bird monitoring & EIA specialist study (Innowind)
31. Beaufort West Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mainstream)
32. Leeuwdraai Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mainstream)
33. Sutherland Wind Energy Facility 12-month bird monitoring (Mainstream)
34. Maralla Wind Energy Facility 12-month bird monitoring & EIA specialist study (Biotherm)
35. Esizayo Wind Energy Facility 12-month bird monitoring & EIA specialist study (Biotherm)
36. Humansdorp Wind Energy Facility 12-month bird monitoring & EIA specialist study (Cennergi)
37. Aletta Wind Energy Facility 12-month bird monitoring & EIA specialist study (Biotherm)
38. Eureka Wind Energy Facility 12-month bird monitoring & EIA specialist study (Biotherm)
39. Makambako Wind Energy Faclity (Tanzania) 12-month bird monitoring & EIA specialist study (Windlab)
40. R355 Wind Energy Facility 12-month bird monitoring (Mainstream)
41. Groenekloof Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mulilo)
42. Tsitsikamma Wind Energy Facility 24-months post-construction monitoring (Cennergi)
43. Noupoort Wind Energy Facility 24-months post-construction monitoring (Mainstream)
44. Kokerboom Wind Energy Facility 12-month bird monitoring & EIA specialist study (Business Venture Investments)
45. Kuruman Wind Energy Facility 12-month bird monitoring & EIA specialist study (Mulilo)

Bird Impact Assessment Studies for Solar Energy Plants:

1. Concentrated Solar Power Plant, Upington, Northern Cape.
2. Globeleq De Aar and Droogfontein Solar PV Pre- and Post-construction avifaunal monitoring
3. JUWI Kronos PV project, Copperton, Northern Cape
4. Sand Draai CSP project, Groblershoop, Northern Cape
5. Biotherm Helena PV Project, Copperton, Northern Cape
6. Biotherm Letsiao CSP Project, Aggeneys, Northern Cape
7. Biotherm Enamandla PV Project, Aggeneys, Northern Cape
8. Biotherm Sendawo PV Project, Vryburg, North-West
9. Biotherm Tlisitseng PV Project, Lichtenburg, North-West
10. JUWI Hotazel Solar Park Project, Hotazel, Northern Cape
11. Namaqua Solar Project, Aggeneys, Northern Cape.

Bird Impact Assessment Studies for the following overhead line projects:

1. Chobe 33kV Distribution line
2. Athene - Umfolozi 400kV
3. Beta-Delphi 400kV
4. Cape Strengthening Scheme 765kV
5. Flurian-Louis-Trichardt 132kV
6. Ghanzi 132kV (Botswana)
7. Ikaros 400kV
8. Matimba-Witkop 400kV
9. Naboomspruit 132kV
10. Tabor-Flurian 132kV
11. Windhoek - Walvisbaai 220 kV (Namibia)
12. Witkop-Overyssel 132kV
13. Breyten 88kV
14. Adis-Phoebus 400kV
15. Dhuva-Janus 400kV
16. Perseus-Mercury 400kV
17. Gravelotte 132kV
18. Ikaros 400 kV
19. Khanye 132kV (Botswana)
20. Moropule – Thamaga 220 kV (Botswana)
21. Parys 132kV
22. Simplon –Everest 132kV
23. Tutuka-Alpha 400kV
24. Simplon-Der Brochen 132kV
25. Big Tree 132kV
26. Mercury-Ferrum-Garona 400kV
27. Zeus-Perseus 765kV
28. Matimba B Integration Project
29. Caprivi 350kV DC (Namibia)
30. Gerus-Mururani Gate 350kV DC (Namibia)
31. Mmamabula 220kV (Botswana)
32. Steenberg-Der Brochen 132kV
33. Venetia-Paradise T 132kV
34. Burgersfort 132kV
35. Majuba-Umfolozi 765kV
36. Delta 765kV Substation
37. Braamhoek 22kV
38. Steelpoort Merensky 400kV
39. Mmamabula Delta 400kV
40. Delta Epsilon 765kV
41. Gerus-Zambezi 350kV DC Interconnector: Review of proposed avian mitigation measures for the Okavango and Kwando River crossings

42. Giyani 22kV Distribution line
43. Liqhobong-Kao 132/11kV distribution power line, Lesotho
44. 132kV Leslie – Wildebeest distribution line
45. A proposed new 50 kV Spoornet feeder line between Sishen and Saldanha
46. Cairns 132kv substation extension and associated power lines
47. Pimlico 132kv substation extension and associated power lines
48. Gyani 22kV
49. Matafin 132kV
50. Nkomazi_Fig Tree 132kV
51. Pebble Rock 132kV
52. Reddersburg 132kV
53. Thaba Combine 132kV
54. Nkomati 132kV
55. Louis Trichardt – Musina 132kV
56. Endicot 44kV
57. Apollo Lepini 400kV
58. Tarlton-Spring Farms 132kV
59. Kuschke 132kV substation
60. Bendstore 66kV Substation and associated lines
61. Kuiseb 400kV (Namibia)
62. Gyani-Malamulele 132kV
63. Watershed 132kV
64. Bakone 132kV substation
65. Eerstegoud 132kV LILO lines
66. Kumba Iron Ore: SWEP - Relocation of Infrastructure
67. Kudu Gas Power Station: Associated power lines
68. Steenberg Booysendal 132kV
69. Toulon Pumps 33kV
70. Thabatshipi 132kV
71. Witkop-Silica 132kV
72. Bakubung 132kV
73. Nelsriver 132kV
74. Rethabiseng 132kV
75. Tilburg 132kV
76. GaKgapane 66kV
77. Knobel Gilead 132kV
78. Bochum Knobel 132kV
79. Madibeng 132kV
80. Witbank Railway Line and associated infrastructure
81. Spencer NDP phase 2 (5 lines)
82. Akanani 132kV
83. Hermes-Dominion Reefs 132kV
84. Cape Pensinsula Strengthening Project 400kV
85. Magalakwena 132kV
86. Benficosa 132kV
87. Dithabaneng 132kV
88. Taunus Diepkloof 132kV
89. Taunus Doornkop 132kV
90. Tweedracht 132kV
91. Jane Furse 132kV
92. Majeje Sub 132kV
93. Tabor Louis Trichardt 132kV
94. Riversong 88kV
95. Mamatsekele 132kV
96. Kabokweni 132kV
97. MDPP 400kV Botswana
98. Marble Hall NDP 132kV
99. Bokmakiere 132kV Substation and LILO lines
100. Styldrift 132kV
101. Taunus – Diepkloof 132kV

102. Bighorn NDP 132kV
103. Waterkloof 88kV
104. Camden – Theta 765kV
105. Dhuva – Minerva 400kV Diversion
106. Lesedi –Grootpan 132kV
107. Waterberg NDP
108. Bulgerivier – Dorset 132kV
109. Bulgerivier – Toulon 132kV
110. Nokeng-Fluorspar 132kV
111. Mantsole 132kV
112. Tshilamba 132kV
113. Thabamoopo - Tshebela – Nhlovuko 132kV
114. Arthurseat 132kV
115. Borutho 132kV MTS
116. Volspruit - Potgietersrus 132kV
117. Neotel Optic Fibre Cable Installation Project: Western Cape
117. Matla-Glockner 400kV
118. Delmas North 44kV
119. Houwhoek 11kV Refurbishment
120. Clau-Clau 132kV
121. Ngwedi-Silwerkrans 134kV
122. Nieuwehoop 400kV walk-through
123. Booysendal 132kV Switching Station
124. Tarlton 132kV
125. Medupi - Witkop 400kV walk-through
126. Germiston Industries Substation
127. Sekgame 132kV
128. Botswana – South Africa 400kV Transfrontier Interconnector
129. Syferkuil – Rampheri 132kV
130. Queens Substation and associated 132kV powerlines
131. Oranjemond 400kV Transmission line

Bird Impact Assessment Studies for the following residential and industrial developments:

1. Lizard Point Golf Estate
2. Lever Creek Estates
3. Leloko Lifestyle Estates
4. Vaaloewers Residential Development
5. Clearwater Estates Grass Owl Impact Study
6. Sommerset Ext. Grass Owl Study
7. Proposed Three Diamonds Trading Mining Project (Portion 9 and 15 of the Farm Blesbokfontein)
8. N17 Section: Springs To Leandra –"Borrow Pit 12 And Access Road On (Section 9, 6 And 28 Of The Farm Winterhoek 314 Ir)
9. South African Police Services Gauteng Radio Communication System: Portion 136 Of The Farm 528 Jq, Lindley.
10. Report for the proposed upgrade and extension of the Zeekoegat Wastewater Treatment Works, Gauteng.
11. Bird Impact Assessment for Portion 265 (a portion of Portion 163) of the farm Rietfontein 189-JR, Gauteng.
12. Bird Impact Assessment Study for Portions 54 and 55 of the Farm Zwartkop 525 JQ, Gauteng.
13. Bird Impact Assessment Study Portions 8 and 36 of the Farm Nooitgedacht 534 JQ, Gauteng.
14. Shumba's Rest Bird Impact Assessment Study
15. Randfontein Golf Estate Bird Impact Assessment Study
16. Zilkaatsnek Wildlife Estate
17. Regenstein Communications Tower (Namibia)
18. Avifaunal Input into Richards Bay Comparative Risk Assessment Study
19. Maquasa West Open Cast Coal Mine
20. Glen Erasmia Residential Development, Kempton Park, Gauteng
21. Bird Impact Assessment Study, Weltevreden Mine, Mpumalanga

22. Bird Impact Assessment Study, Olifantsvlei Cemetery, Johannesburg
23. Camden Ash Disposal Facility, Mpumalanga
24. Lindley Estate, Lanseria, Gauteng

Professional affiliations

I work under the supervision of and in association with Albert Froneman (MSc Conservation Biology) (SACNASP Zoological Science Registration number 400177/09) as stipulated by the Natural Scientific Professions Act 27 of 2003.

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

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

Application for integrated environmental authorisation and waste management licence in terms of the-

(1) National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2014; and

(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 921, 2013

PROJECT TITLE

Proposed Construction of the Grid connection for the proposed Tlisitseng Solar Photovoltaic (PV) Project 2, near Lichtenburg in the North West Province.

Specialist:	Chris van Rooyen Consulting		
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4.2 The specialist appointed in terms of the Regulations_

I, Chris van Rooyen declare that -- General declaration:

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:

Chris van Rooyen Consulting
Name of company (if applicable):

7 January 2016
Date:

EXECUTIVE SUMMARY

Tlisitseng Solar PV will be located approximately 8km north-west of Lichtenburg, in the Ngaka Modiri Molema District of the North West Province. Tlisitseng Solar will consist of two 75MW solar PV facilities, namely Tlisitseng Solar 1 Project (PV) 1 and Tlisitseng Solar 1 Project (PV) 2. The Tlisitseng PV 1 substation will be connected to the existing Watershed Main Transmission substation (MTS) by a proposed 132kV power line. The Watershed Main Transmission substation is located directly adjacent to the proposed PV site. This bird impact assessment report deals with the potential impacts on avifauna of the proposed Tlisitseng Solar 1 PV2 grid connection and substation.

The proposed BioTherm Tlisitseng Solar 1 PV2 132kV grid connection is located in the Grassland endemic avifaunal region with the fourth highest number of avifaunal endemics in southern Africa. With 20% of all southern African endemics or near endemics potentially occurring at the core study area and immediate surroundings, the application site and immediate surroundings as a whole should be regarded as moderately sensitive from an avifaunal perspective. Within the core study area, high sensitive areas are surface water (boreholes) and a short section of high voltage lines which is used for roosting by Cape Vultures and White-backed Vultures. Within the immediate surroundings beyond the core study area, high voltage lines, a vulture restaurant, and wetlands and dams are potential high sensitive areas, as all of these micro-habitats are potential focal points of bird activity. The wetlands and dams may be an aggravating factor in that birds commuting to and from them could mistake the solar panels for surface water and attempt to land on them, thereby exposing themselves to the risk of collision. Boreholes could potentially be declassified as high sensitivity should it be confirmed that they will be removed and therefore cease to function as potential focal points for bird activity after the construction of the solar panels.

Potential pre-mitigation impacts on priority avifauna range from medium negative to low negative. All impacts could be reduced to low negative with the implementation of appropriate mitigation. No clear preferred alternative emerged as far as the proposed substation sites are concerned, as both sites are located in the same habitat. No fatal flaws were identified in the course of investigations from an avifaunal perspective, and the proposed development could therefore be authorised, provided all proposed mitigation measures are implemented.

Contents

1. INTRODUCTION & BACKGROUND

Tlisitseng Solar PV will be located approximately 8km north-west of Lichtenburg, in the Ngaka Modiri Molema District of the North-West Province. Tlisitseng Solar will consist of two 75MW solar PV facilities, namely Tlisitseng Solar 1 Project (PV) 1 and Tlisitseng Solar 1 Project (PV) 2. The Tlisitseng PV 2 substation will be connected to the existing Watershed Main Transmission substation (MTS) by a proposed 132kV power line. The Watershed Main Transmission substation is located directly adjacent to the proposed PV site. This bird impact assessment report deals with the potential impacts on avifauna of the proposed Tlisitseng Solar 1 PV2 grid connection and substation.

See Figures 1 - 2 below for maps of the study area, indicating the location of the study area and the various grid connection alternatives.

Figure 1: Regional map indicating the location of the proposed Biotherm Tlisitseng PV site.

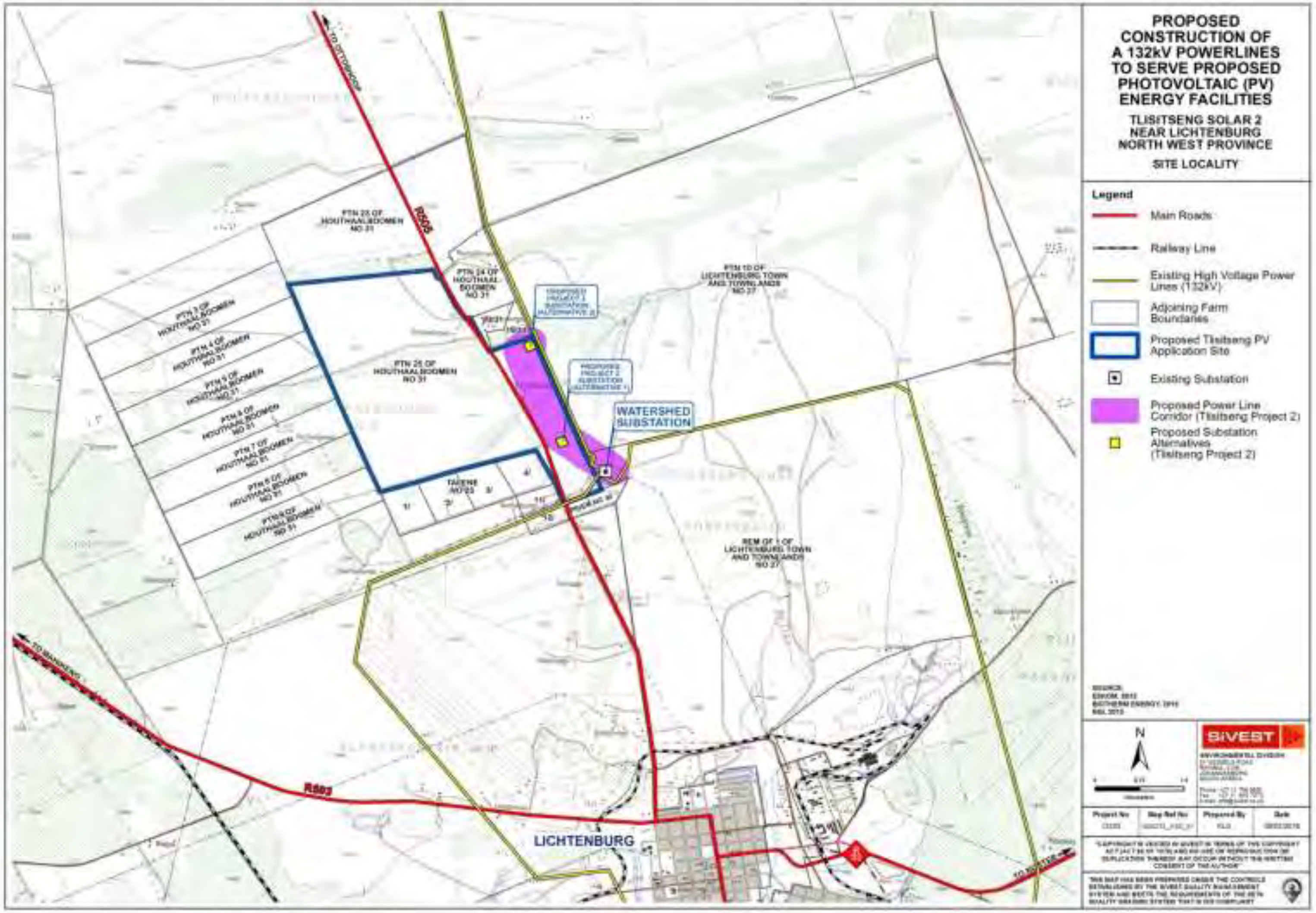

Figure 2: The various grid alternatives and the position of the Tlisitseng Solar 1 PV2 Substation

2. TERMS OF REFERENCE

The terms of reference for this bird impact assessment study are as follows:

- Describe the affected environment;
- Discuss gaps in baseline data;
- List and describe the expected impacts;
- Provide a sensitivity map of the proposed development site from an avifaunal perspective;
- Assess the identified impacts on avifauna;
- Provide recommendations for mitigation

3. SOURCES OF INFORMATION

The following information sources were consulted in order to conduct this study:

- Bird distribution data of the South African Bird Atlas 2 (SABAP 2) was obtained from the Animal Demography Unit of the University of Cape Town, as a means to ascertain which species occurs within the broader area i.e. within a block consisting of nine pentad grid cells within which the proposed solar facilities are situated. The nine pentad grid cells are the following: 2555_2600, 2555_2605, 2555_2610, 2600_2600, 2600_2605, 2600_2610, 2605_2600, 2605_2605, 2605_2610 (see Figure 4). A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5'× 5'). Each pentad is approximately 8 × 7.6 km. From 2007 to date, a total of 62 full protocol cards (i.e. 62 surveys lasting a minimum of two hours each) were completed for this area.
- The national threatened status of all priority species was determined with the use of the most recent edition of the Red Data Book of Birds of South Africa (Taylor *et al.* 2015), and the latest authoritative summary of southern African bird biology (Hockey *et al.* 2005).
- The global threatened status of all priority species was determined by consulting the latest (2015.3) IUCN Red List of Threatened Species (http://www.iucnredlist.org/).
- A classification of the vegetation types in the study area was obtained from the Atlas of Southern African Birds 1 (SABAP1) and the National Vegetation Map compiled by the South African National Biodiversity Institute (Mucina & Rutherford 2006).
- The Important Bird Areas of Southern Africa (Barnes 1998; http://www.birdlife.org.za/conservation/important-bird-areas) was consulted for information on Important Bird Areas (IBAs).
- Satellite imagery was used in order to view the broader development area on a landscape level and to help identify sensitive bird habitat.
- Information on the movement of Cape Vultures in the North-West Province was obtained from Kerri Wolter at Vulpro (Wolter *et al*. 2010).
- Information on the birds actually occurring on the site was obtained from a site visit on 9 November 2015 and a subsequent monitoring programme which was initiated at the proposed two PV sites in November 2015 and is ongoing (see **APPENDIX 1**).

Figure 3: The area covered by the SABAP2 pentads.

4. ASSUMPTIONS & LIMITATIONS

The following assumptions and limitations are applicable in this study:

- A total of 62 full protocol lists have been completed to date to date for the 9 pentads where the study area is located (i.e. lists surveys lasting a minimum of two hours each). It was decided to use 9 pentads because the habitat is very uniform, which provides the opportunity to use a larger dataset which is more representative. The SABAP2 data was therefore regarded as a reasonably conclusive snapshot of the avifauna. For purposes of completeness, the list of species that could be encountered was further supplemented with observations from an avifaunal monitoring programme which is being conducted on site as part of the pre-construction monitoring programme for the PV facility.
- Conclusions in this study are based on experience of these and similar species in different parts of South Africa. Bird behaviour can never be entirely reduced to formulas that will be valid under all circumstances. Fortunately, a robust body of research is available on birds and power line interactions, going back more than 30 year. Impacts can therefore be predicted with reasonable certainty.
- The focus of the study is on southern African Red Data species, endemics and near-endemics (referred to in the report as priority species).
- The core study area was defined as the area comprising the proposed power line corridor with a 2km buffer around it.

5. DESCRIPTION OF AFFECTED ENVIRONMENT

5.1 Biomes and vegetation types

The study area is situated in the grassland biome approximately 9km north-west of the town of Lichtenburg in the North-West Province (Harrison *et al.* 1997). The natural habitat in the core study area is highly homogenous and consists of extensive grassy plains, with scattered, stunted mostly *Vachellia* trees and a variety of shrubs. The closest Important Bird Areas (IBAs), the Baberspan and Leeupan SA026, and the Botsalano Nature Reserve SA024 are located approximately 70km away to the south-west and north-west respectively (Barnes 1998, Birdlife 2014). The study area is too far away from these IBAs to have any direct impact on them. The study area is situated partially within to the 6000ha Lichtenburg Game Breeding Centre which contains an important vulture restaurant, which is situated approximately 4.3km from Watershed MTS. The centre contains good grassland habitat and is a refuge for many grassland avifauna. Within and directly south of the Game Breeding Centre is an extensive network of dams and wetland areas, which is situated approximately 10km from the study area (see Figure 4). The dams and wetlands could potentially attract an abundance of waterbirds, but the water levels are linked to rainfall. During periods of drought the wetlands are dry (pers. obs).

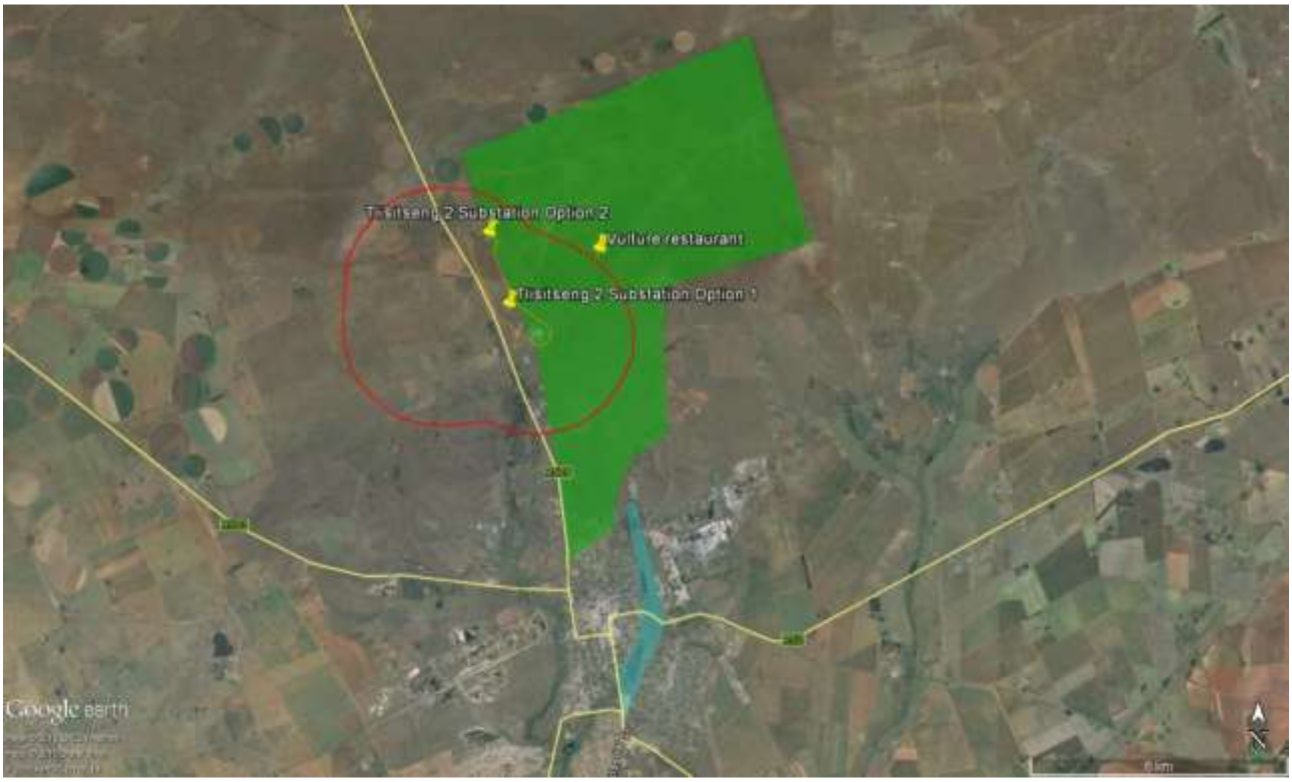

Figure 4: The location of the Lichtenburg Game Breeding Centre (green) and the wetlands (blue) relative to the study area (red outlined polygon).

5.2 Habitat classes and avifauna in the study area

Whilst much of the distribution and abundance of the bird species in the study area can be explained by the description of the natural vegetation, it is as important to examine the modifications which have changed the natural landscape, and which may have an effect on the distribution of avifauna. These are sometimes evident at a much smaller spatial scale than the biome or vegetation types.

The following bird habitat classes have been identified at the core study area.

5.2.1 Grassland

The dominant natural vegetation type in the core study area and immediate surroundings is Carltonville Dolomite Grassland. Carltonville Dolomite Grassland occurs on slightly undulating plains dissected by chert ridges. In the study area, small, mostly *Vachellia* trees, and a variety of shrubs are scattered across the landscape. Species-rich grassland forms a complex mosaic pattern dominated by many grass species. Rainfall is in summer with an overall mean annual precipitation of 593mm, with temperatures ranging from very cold with frost in winter to very hot in summer (Mucina & Rutherford 2006).

Priority species that could be found in natural grassland vegetation in the core study area are Cape Sparrow, Scaly-feathered Finch, Yellow Canary, Kalahari Scrub-robin, Red-headed Finch, Black-chested Prinia, Crimson-breasted Shrike, Cape Penduline-Tit, Bokmakierie, Eastern Clapper Lark, Lark-like Bunting, Fiscal Flycatcher, Northern Black Korhaan, White-backed Mousebird, Ant-eating Chat, South African Cliff-swallow, Pied Starling, Orange River White-eye, African Red-eyed Bulbul, Sabota Lark and Spike-heeled Lark. Occasional priority visitors to the study area could include Lanner Falcon, Martial Eagle, Tawny Eagle, Secretarybird, Kori Bustard, Blue Crane, Fairy Flycatcher, Namaqua Sandgrouse, Burchell's Sandgrouse, Southern Pale Chanting Goshawk, Grey-backed Sparrowlark, White-backed Vulture, Lappet-faced Vulture and Cape Vulture.

5.2.2 Surface water

Surface water is of specific importance to avifauna in this relatively arid study area. The core study area contains at least eleven boreholes with water troughs for livestock (see Figure 6). Boreholes with open water troughs are important sources of surface water and are used extensively by various species, including large raptors, to drink and bath. Smaller priority species such as Cape Sparrow, Red-headed Finch, Scaly-feathered Finch, Yellow Canary, Namaqua Sandgrouse, Pied Starling and Lark-like Bunting congregate in large numbers around water troughs which in turn could attract priority predators such as Southern Pale Chanting Goshawk and Lanner Falcon. The habitat around boreholes (shrubs and trees) often attract other priority species such as Bokmakierie, Kalahari Scrub-robin, Crimson-breasted Shrike, Fiscal Flycatcher, Karoo Thrush, African Red-eyed Bulbul, Orange River White-eye, Fairy Flycatcher and White-backed Mousebird. The water troughs and reservoirs are also attractive to large raptors and vultures, and could attract Martial Eagle, Tawny Eagle, White-backed Vulture, Lappet-faced

Vulture and Cape Vulture, however no large raptors have been observed at boreholes thus far in the course of the monitoring at the PV sites.

The wetland areas indicated in Figure 4 might become relevant in that the waterbirds flying over the study area on their way to the wetlands area might mistake the PV area for surface water and attempt to land on the PV panels (the so-called lake effect) (Kagan *et al.* 2014), which could expose them to collision risk with the proposed 132V grid connection. Priority species that could be at risk are South African Shelduck, Black Stork, Yellow-billed Stork, Greater Flamingo, Lesser Flamingo, Great White Pelican and Marabou Stork.

5.2.3 Agriculture

The core study area contains several agricultural centre-pivots, where a variety of crops are cultivated. Although agricultural lands completely destroy the structure of the original vegetation, some bird species do benefit from this transformation. Blue Crane, Abdim's Stork and Black-winged Pratincole are the priority species most likely to utilise agricultural clearings in the study area. Abdim's Stork and Black-winged Pratincole can occur in flocks of several hundred on irrigated fields, although the species do not seem to occur in large numbers in the area. The clearings could also be utilised by Secretarybirds, but the species is likely to occur sparsely. Thus far none of the species mentioned in this paragraph above have been recorded, which may be an indication of their scarcity in the study area.

5.2.4 High voltage lines

High voltage lines are an important potential roosting and breeding substrate for large raptors and vultures. Existing high-voltage lines are used extensively by large raptors, especially Martial Eagles, but also Tawny Eagles for breeding purposes (Jenkins *et al.* 2006) while Cape Vultures and White-backed Vultures use them extensively as roosts (Wolter *et al.* 2010 pers. obs). Some of the lines in the Lichtenburg Game Breeding Centre are used extensively by Cape, White-backed and Lappet-faced Vultures which are attracted to the vulture restaurant, for roosting (pers. obs).

See Figure 5 below for the location of boreholes and high voltage lines in the study area, and **APPENDIX 2** for a photographic record of the habitat.

Figure 5: The location of boreholes (blue placemarks) and HV lines (pink) relative to the study area (red polygon).

5.2.6 Avifauna

An estimated 284 species could potentially occur at the core study area and immediate surroundings (which includes the Lichtenburg Game Breeding Centre and wetland areas south-east of the core study area). Of these, 21 are South African Red Data species, 12 are southern African endemics and 21 are near-endemics. This means that 7.8% of the species that could potentially occur at the core study area and immediate surroundings are Red Data species, and 11.7% are southern African endemics of near-endemics. Southern Africa contains 13 avifaunal endemic regions, namely Western Arid, Woodland, Evergreen Forest, Grassland, Montane, Rocky slopes and cliffs, Fynbos, Marine and Inland Waters (MacLean 1999). Of these regions, Grassland, where the study area is located, contains the fourth highest number of endemics. Overall, the core study area and immediate surroundings potentially contains a total of 33 endemics and near-endemics, which is 20% of the 167 southern African endemics and near-endemics (Hockey *et al.* 2005).

See **APPENDIX 3** for a list of species potentially occurring in the core study area and immediate surroundings. Potential impacts on priority species are listed in Table 1.

Table 1: Priority species potentially occurring at the core study area and immediate surroundings. Red Data species are indicated in red.

EN = Endangered

VU = Vulnerable

NT = Near-threatened

LC = Least concern

End = Southern African Endemic

N-End = Southern African near endemic

Name	Scientific name	National Red Data Status	Global status	Collisions with powerlines	Displacement through disturbance and habitat transformation*
Eagle, Martial	*Polemaetus bellicosus*	EN	VU	x	x
Eagle, Tawny	*Aquila rapax*	EN	LC	x	x
Stork, Yellow-billed	*Mycteria ibis*	EN	LC	x	
Vulture, Cape	*Gyps coprotheres*	EN	VU	x	x
Vulture, Lappet-faced	*Torgos tracheliotus*	EN	VU	x	x
Vulture, White-backed	*Gyps africanus*	EN	VU	x	x
Chat, Ant-eating	*Myrmecocichla formicivora*	End			x
Cliff-swallow, South African	*Hirundo spilodera*	End			x
Flycatcher, Fairy	*Stenostira scita*	End			x
Flycatcher, Fiscal	*Sigelus silens*	End			x
Korhaan, Northern Black	*Afrotis afraoides*	End		x	x
Marsh-harrier, African	*Circus ranivorus*	End		x	
Shelduck, South African	*Tadorna cana*	End		x	
Starling, Pied	*Spreo bicolor*	End			x
Thrush, Karoo	*Turdus smithi*	End			x
White-eye, Cape	*Zosterops virens*	End			x
White-eye, Orange River	*Zosterops pallidus*	End			x
Mousebird, White-backed	*Colius colius*	End			x
Bokmakierie	*Telophorus zeylonus*	N-end			x
Bulbul, African Red-eyed	*Pycnonotus nigricans*	N-end			x
Bunting, Cape	*Emberiza capensis*	N-end			x
Bunting, Lark-like	*Emberiza impetuani*	N-end			x
Canary, Yellow	*Crithagra flaviventris*	N-end			x

Name	Scientific name	National Red Data Status	Global status	Collisions with powerlines	Displacement through disturbance and habitat transformation
Chanting Goshawk, Southern Pale	*Melierax canorus*	N-end		x	x
Clapper-Lark, Eastern	*Mirafra fasciolata*	N-end			x
Finch, Red-headed	*Amadina erythrocephala*	N-end			x
Finch, Scaly-feathered	*Sporopipes squamifrons*	N-end			x
Lark, Eastern Clapper	*Mirafra fasciolata*	N-end			x
Lark, Sabota	*Calendulauda sabota*	N-end			x
Lark, Spike-heeled	*Chersomanes albofasciata*	N-end			x
Penduline – Tit, Cape	*Anthoscopus minutus*	N-end			x
Prinia, Black-chested	*Prinia flavicans*	N-end			x
Sandgrouse, Burchell's	*Pterocles burchelli*	N-end		x	x
Sandgrouse, Namaqua	*Pterocles namaqua*	N-end		x	x
Scrub-Robin, Kalahari	*Cercotrichas paena*	N-end			x
Shrike, Crimson-breasted	*Laniarius atrococcineus*	N-end			x
Sparrow, Cape	*Passer melanurus*	N-end			x
Sparrowlark, Grey-backed	*Eremopterix verticalis*	N-end			x
Wheatear, Mountain	*Oenanthe monticola*	N-end			x
Bustard, Kori	*Ardeotis kori*	NT	NT	x	x
Courser, Double-banded	*Rhinoptilus africanus*	NT	LC	x	x
Crane, Blue	*Anthropoides paradiseus*	NT	VU	x	x
Falcon, Red-footed	*Falco vespertinus*	NT	NT		
Flamingo, Greater	*Phoenicopterus ruber*	NT	NT	x	
Flamingo, Lesser	*Phoenicopterus minor*	NT	NT	x	
Pratincole, Black-winged	*Glareola nordmanni*	NT	NT		x
Roller, European	*Coracias garrulus*	NT	NT		x
Stork, Abdim's	*Ciconia abdimii*	NT	LC	x	
Stork, Marabou	*Leptoptilos crumeniferus*	NT	LC	x	
Falcon, Lanner	*Falco biarmicus*	VU	LC	x	
Painted-snipe, Greater	*Rostratula benghalensis*	VU	LC		
Pelican, Great White	*Pelecanus onocrotalus*	VU	LC	x	
Secretarybird	*Sagittarius serpentarius*	VU	VU	x	x
Stork, Black	*Ciconia nigra*	VU	LC	x	

6. DESCRIPTION OF EXPECTED IMPACTS

Because of their size and prominence, electrical infrastructures constitute an important interface between wildlife and man. Negative interactions between wildlife and electricity structures take many forms, but two common problems in southern Africa are electrocution of birds (and other animals) and birds colliding with power lines. (Ledger and Annegarn 1981; Ledger 1983; Ledger 1984; Hobbs and Ledger 1986a; Hobbs and Ledger 1986b; Ledger, Hobbs and Smith, 1992; Verdoorn 1996; Kruger and Van Rooyen 1998; Van Rooyen 1998; Kruger 1999; Van Rooyen 1999; Van Rooyen 2000; Anderson 2001; Shaw 2013). Habitat destruction and disturbance associated with the construction of power lines and other electricity infrastructure (e.g. substations) also constitute an impact on avifauna.

6.1 Electrocutions

Electrocution refers to the scenario where a bird is perched or attempts to perch on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (van Rooyen 2004). The electrocution risk is largely determined by the pole/tower design. The tower design that has been proposed for this project is the steel monopole (see **APPENDIX 4**).

Clearance between phases on the same side of the 132kV pole structure is approximately 2.2m for this type of design, and the clearance on strain structures is 1.8m. This clearance should be sufficient to reduce the risk of phase – phase electrocutions of birds on the towers to negligible. The length of the stand-off insulators is approximately 1.6m. If very large species attempts to perch on the stand-off insulators, they are potentially able to touch both the conductor and the earthed pole simultaneously potentially resulting in a phase – earth electrocution. This is particularly likely when more than one bird attempts to sit on the same pole.

It is likely that Cape Vultures, White-backed Vultures and Lappet-faced Vultures could forage in the study area where the power lines are proposed, given the close proximity of the vulture restaurant at the Lichtenburg Game Breeding Centre where up to 80 vultures have been observed in the course of the pre-construction monitoring. In addition, there are plenty of livestock in the surrounding area, and should a carcass be available to the birds, they might attempt to roost on the poles. The pole design holds no inherent electrocution risk for other large solitary species such as eagles that could potentially occur in the study area, as they almost never perch together in large numbers next to each other.

Electrocutions at the proposed Tlisitseng 1 substation yard is possible, but should not affect the more sensitive Red List bird species as these species are unlikely to use the infrastructure within the substation yards for perching or roosting.

6.2 Collisions

Collisions are probably the biggest single threat posed by transmission lines to birds in southern Africa (van Rooyen 2004; Shaw 2013). Most heavily impacted upon are bustards, storks, cranes and various species of waterbirds. These species are mostly heavy-bodied birds with limited manoeuvrability, which makes it difficult for them to take the necessary evasive action to avoid colliding with power lines (van Rooyen 2004; Anderson 2001; Shaw 2013).

In a recent PhD study, Shaw (2013) provides a concise summary of the phenomenon of avian collisions with power lines:

"The collision risk posed by power lines is complex and problems are often localised. While any bird flying near a power line is at risk of collision, this risk varies greatly between different groups of birds, and depends on the interplay of a wide range of factors (APLIC 1994). Bevanger (1994) described these factors in four main groups – biological, topographical, meteorological and technical. Birds at highest risk are those that are both susceptible to collisions and frequently exposed to power lines, with waterbirds, gamebirds, rails, cranes and bustards usually the most numerous reported victims (Bevanger 1998, Rubolini et al. 2005, Jenkins et al. 2010).

The proliferation of man-made structures in the landscape is relatively recent, and birds are not evolved to avoid them. Body size and morphology are key predictive factors of collision risk, with large-bodied birds with high wing loadings (the ratio of body weight to wing area) most at risk (Bevanger 1998, Janss 2000). These birds must fly fast to remain airborne, and do not have sufficient manoeuvrability to avoid unexpected obstacles. Vision is another key biological factor, with many collision-prone birds principally using lateral vision to navigate in flight, when it is the lower-resolution, and often restricted, forward vision that is useful to detect obstacles (Martin & Shaw 2010, Martin 2011, Martin et al. 2012). Behaviour is important, with birds flying in flocks, at low levels and in crepuscular or nocturnal conditions at higher risk of collision (Bevanger 1994). Experience affects risk, with migratory and nomadic species that spend much of their time in unfamiliar locations also expected to collide more often (Anderson 1978, Anderson 2002). Juvenile birds have often been reported as being more collision-prone than adults (e.g. Brown et al. 1987, Henderson et al. 1996).

Topography and weather conditions affect how birds use the landscape. Power lines in sensitive bird areas (e.g. those that separate feeding and roosting areas, or cross flyways) can be very dangerous (APLIC 1994, Bevanger 1994). Lines crossing the prevailing wind conditions can pose a problem for large birds that use the wind to aid take-off and landing (Bevanger 1994). Inclement weather can disorient birds and reduce their flight altitude, and strong winds can result in birds colliding with power lines that they can see but do not have enough flight control to avoid (Brown et al. 1987, APLIC 1994).

The technical aspects of power line design and siting also play a big part in collision risk. Grouping similar power lines on a common servitude, or locating them along other features such as tree lines, are both approaches thought to reduce risk (Bevanger 1994). In general, low lines with short span lengths (i.e. the distance between two adjacent pylons) and flat conductor configurations are thought to be the least dangerous (Bevanger 1994, Jenkins et al. 2010). On many higher voltage lines, there is a thin earth (or ground) wire above the conductors, protecting the system from lightning strikes. Earth wires are widely accepted to cause the majority of collisions on power lines with this configuration because they are difficult to see, and birds flaring to avoid hitting the conductors often put themselves directly in the path of these wires (Brown et al. 1987, Faanes 1987, Alonso et al. 1994a, Bevanger 1994)."

As mentioned by Shaw (2013) in the extract above, several factors are thought to influence avian collisions, including the manoeuvrability of the bird, topography, weather conditions and power line configuration. An important additional factor that previously has received little attention is the visual capacity of birds; i.e. whether they are able to see obstacles such as power lines, and whether they are looking ahead to see obstacles with enough time to avoid a collision. In addition to helping explain the susceptibility of some species to collision, this factor is key to planning effective mitigation measures. Recent research provides the first evidence that birds can render themselves blind in the direction of travel during flight through voluntary head movements (Martin & Shaw 2010). Visual fields were determined in three bird species representative of families known to be subject to high levels of mortality associated with power lines i.e. Kori Bustards, Blue Cranes *Anthropoides paradiseus* and White Storks *Ciconia ciconia.* In all species the frontal visual fields showed narrow and vertically long binocular fields typical of birds that take food items directly in the bill under visual guidance. However, these species differed markedly in the vertical extent of their binocular fields and in the extent of the blind areas which project above and below the binocular fields in the forward facing hemisphere. The importance of these blind areas is that when in flight, head movements in the vertical plane (pitching the head to look downwards) will render the bird blind in the direction of travel. Such movements may frequently occur when birds are scanning below them (for foraging or roost sites, or for conspecifics). In bustards and cranes pitch movements of only 25° and 35° respectively are sufficient to render the birds blind in the direction of travel; in storks head movements of 55° are necessary. That flying birds can render themselves blind in the direction of travel has not been previously recognised and has important implications for the effective mitigation of collisions with human artefacts including wind turbines and power lines. These findings have applicability to species outside of these families especially raptors (*Accipitridae*) which are known to have small binocular fields and large blind areas similar to those of bustards and cranes, and are also known to be vulnerable to power line collisions.

Thus visual field topographies which have evolved primarily to meet visual challenges associated with foraging may render certain bird species particularly vulnerable to collisions with human artefacts, such as power lines and wind turbines that extend into the otherwise open airspace above their preferred habitats. For these species placing devices upon power lines to render them more visible may have limited success since no matter what the device the birds may not see them. It may be that in certain situations it may be necessary to distract birds away from the obstacles, or encourage them to land nearby (for example by the use of decoy models of conspecifics, or the provision of sites attractive for roosting) since increased marking of the obstacle cannot be guaranteed to render it visible if the visual field configuration prevents it being detected. Perhaps most importantly, the results indicate that collision mitigation may need to vary substantially for different collision prone species, taking account of species specific behaviours, habitat and foraging preferences, since an effective all-purpose marking device is probably not realistic if some birds do not see the obstacle at all (Martin & Shaw 2010).

Despite speculation that line marking might be ineffective for some species due to differences in visual fields and behaviour, or have only a small reduction in mortality in certain situations for certain species, particularly bustards (Martin & Shaw 2010; Barrientos *et al.* 2012; Shaw 2013), it is generally accepted that marking a line with PVC spiral type Bird Flight Diverters (BFDs) can reduce the collision mortality rates (Hoogstad 2015 pers.comm ; Sporer et al. 2013; Barrientos *et al.* 2012, Alonso & Alonso 1999; Koops & De Jong 1982). Regardless of statistical significance, a slight mortality reduction may be very biologically relevant in areas, species or populations of high conservation concern (e.g. Ludwig's Bustard) (Barrientos *et al.* 2012). Beaulaurier (1981) summarised the results of 17 studies that involved the marking of earth wires and found an average reduction in mortality of 45%. A recent study reviewed the results of 15 wire marking experiments in which transmission or distribution wires were marked to examine the effectiveness of flight diverters in reducing bird mortality. The presence of flight diverters was associated with a decrease in bird collisions. At unmarked lines, there were 0.21 deaths/1000 birds (n = 339,830) that flew among lines or over lines. At marked lines, the mortality rate was 78% lower (n = 1,060,746) (Barrientos *et al.* 2011). Koops and De Jong (1982) found that the spacing of the BFDs were critical in reducing the mortality rates - mortality rates are reduced up to 86% with a spacing of 5 metres, whereas using the same devices at 10 metre intervals only reduces the mortality by 57%. Line markers should be as large as possible, and highly contrasting with the background. Colour is probably less important, as during the day the background will be brighter than the obstacle with the reverse true at lower light levels (e.g. at twilight, or during overcast conditions). Black and white interspersed patterns are likely to maximise the probability of detection (Martin *et al.* 2010).

A potential impact of the proposed Tlisitseng Solar 1 132kV grid connection is collisions with the earth wire of the proposed line. Quantifying this impact in terms of the likely number of birds that will be impacted, is very difficult because such a huge number of variables play a role in determining the risk, for example weather, rainfall, wind, age, flocking behaviour, power line height, light conditions, topography, population density and so forth. However, from incidental record keeping by the Endangered Wildlife Trust, it is possible to give a measure of what species are likely to be impacted upon (see Figure 6 below - Jenkins *et al.* 2010). This only gives a measure of the general susceptibility of the species to power line collisions, and not an absolute measurement for any specific line.

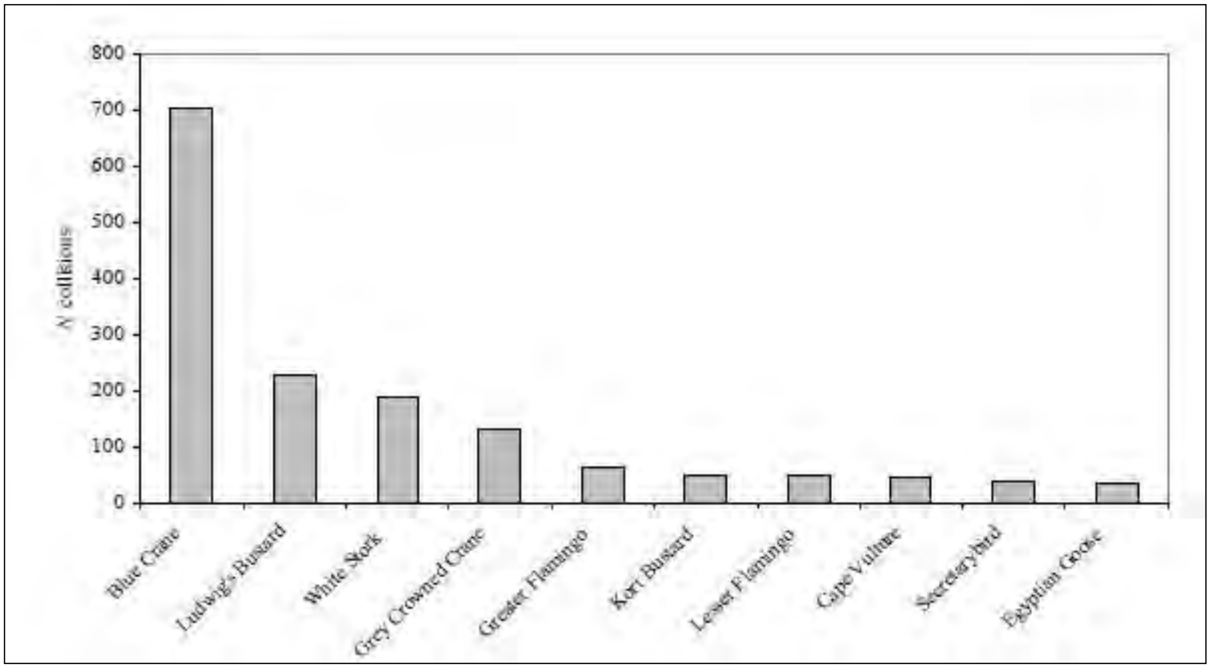

Figure 6: The top ten collision prone bird species in South Africa, in terms of reported incidents contained in the Eskom/EWT Strategic Partnership central incident register 1996 - 2008 (Jenkins *et al.* 2010)

Priority species other than waterbirds that could potentially be at risk of the collisions with the earth wire of the proposed 132kV grid connection include Cape Vulture, White-backed Vulture, Lappet-faced Vulture, Tawny Eagle, Kori Bustard, Martial Eagle, Marabou Stork, Northern Black Korhaan, Namaqua Sandgrouse, Burchell's Sandgrouse, Blue Crane, Abdim's Stork, Double-banded Courser and Secretarybird. The proposed alignment is not situated in any obvious flight path or close to any major focal point of bird activity. There is one borehole very close to the corridor but it is unlikely to be a major attraction for larger, collision-prone species as it is situated directly next to the R505 which is a busy tar road. The only real risk of vulture collisions would be if a carcass becomes available within a few hundred metres from the power line and the birds descend rapidly. In such an instance the birds are focused on the carcass and in the process may be less attuned to obstacles like power lines. However, such a scenario would be exceptional, as the birds habitually feed at the vulture restaurant. In general therefore it is expected that collisions are likely to be a fairly rare event and of a random spatial and temporal nature.

If the "lake effect" draws in priority waterbirds, South African Shelduck, Maccoa Duck, Greater Flamingo, Lesser Flamingo, Great White Pelican, Black Stork and Yellow-billed Stork could potentially be at risk, as well as sandgrouse. The extent to which this may be possible is impossible to gauge at this stage, as very little data is available on the phenomenon world-wide (Kagan *et al.* 2012), which means any finding in this respect is inevitably speculative at this stage. The presence of the wetlands south of the study area means that periodic influxes of waterbirds are possible in the greater study area, which may heighten the risk of collisions. This necessitates the application of the pre-cautionary principle on the assumption that there is a possible collision risk associated with the "lake effect".

6.3 Displacement due to habitat transformation and disturbance associated with the construction of the 132kV grid connection and Tlisitseng substation

During the construction phase and maintenance of power lines and substations, some habitat destruction and transformation inevitably takes place. This happens with the construction of access roads, the clearing of servitudes and the levelling of substation yards. As a rule, servitudes have to be cleared of excess vegetation at regular intervals in order to allow access to the line for maintenance, to prevent vegetation from intruding into the legally prescribed clearance gap between the ground and the conductors and to minimize the risk of fire under the line, which can result in electrical flashovers. These activities could have an impact on birds breeding, foraging and roosting in or in close proximity of the servitude through transformation of habitat, which could result in temporary or permanent displacement.

Apart from direct habitat destruction, the above mentioned construction and maintenance activities also impact on birds through disturbance; this could lead to breeding failure if the disturbance happens during a critical part of the breeding cycle. Construction activities in close proximity could be a source of disturbance and could lead to temporary breeding failure or even permanent abandonment of nests.

In the present instance, the construction of the 132kV power line is likely to have a limited transformation impact on the habitat, due to the nature of the vegetation. It is envisaged that very little vegetation clearing will have to be performed. The footprint of the power line is limited and it will not have a major displacement impact on priority species. As far as disturbance is concerned, this should be a temporary impact and very site specific. The vultures roosting on the HV lines in the Lichtenburg Game Breeding Centre should not be at risk of displacement as the construction activities would take place at least 1.5km away from the closest roosting vultures (pers. obs).

It is also not envisaged that significant numbers of priority species will be permanently displaced from the study area by the habitat transformation and disturbance that will take place at any of the two proposed the sites for the Tlisitseng substation. The two substation alternatives are not located near to any sensitive focal points of bird activity, nor is the habitat particularly sensitive (disturbed grassland). The priority species that will be directly affected by the loss of habitat are the birds breeding and foraging in the area that will be taken up by the substation. These are likely to be made up of smaller, non-Red List passerine species.

In summary, the combined disturbance and habitat transformation impact of the Tlisitseng Solar 1 substation and 132kV grid connection should not materially threaten the local or regional populations of any priority species, due to the relatively small size of the development footprint and the temporary nature of the disturbance associated with the construction of the infrastructure. It should however be noted that the impacts of the electricity infrastructure should not be viewed in isolation, but in conjunction with the proposed PV development. The combined, cumulative impact of the PV development and the associated electricity infrastructure is more significant, and any future assessment should take cognisance of that.

7. IMPACT TABLES

The EIA Methodology assists in evaluating the overall effect of a proposed activity on the environment. The determination of the effect of an environmental impact on an environmental parameter is determined through a systematic analysis of the various components of the impact. This is undertaken using information that is available to the environmental practitioner through the process of the environmental impact assessment. The impact evaluation of predicted impacts was undertaken through an assessment of the significance of the impacts.

7.1 Determination of Significance of Impacts

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.

7.2 Impact Rating System

Impact assessment must take account of the nature, scale and duration of effects on the environment whether such effects are positive (beneficial) or negative (detrimental). Each issue / impact is also assessed according to the project stages:

- construction
- operation
- decommissioning

Where necessary, the proposal for mitigation or optimisation of an impact has been detailed. A brief discussion of the impact and the rationale behind the assessment of its significance has also been included.

Rating System Used To Classify Impacts

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the mitigation of the impact. Impacts have been consolidated into one rating. In assessing the significance of each issue the following criteria (including an allocated point system) is used:

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 expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.		
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).
REVERSIBILITY		
This describes the degree to which an impact on an environmental parameter 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.
DURATION		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity		
1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects 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 and its effects 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 – 50 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 transient (Indefinite).
CUMULATIVE EFFECT		
This describes the cumulative effect of the impacts on the environmental parameter. A cumulative effect/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. While a single activity may itself result in a minor impact, it may, when combined with other impacts (minor or significant) in the same geographical area, and occurring at the same time, result in a cumulative impact that is collectively significant.		
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

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 (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.

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. This describes the significance of the impact on the environmental parameter. 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.

7.3 Impact Assessments

7.3.1 Construction Phase

CONSTRUCTION: 132KV POWER LINE	
Environmental Parameter	*Avifauna*
Issue/Impact/Environmental Effect/Nature	*Displacement of priority species due to disturbance and habitat transformation associated with construction of the 132kV power line.*
Extent	*Site = 1 The displacement impact should only affect priority species at a site level*
Probability	*Probable = 3 The impact will likely occur.*
Reversibility	*Partly reversible = 2 Once the construction activity ceases, the source of displacement will be removed and the priority species should be able to utilise the habitat again.*
Irreplaceable loss of resources	*Marginal loss of resources = 2 It should only affect small, non-threatened species.*
Duration	*Short term = 2 the impact and its effects will last for a relatively short construction period and a limited recovery time after construction, thereafter it will be largely negated.*
Cumulative effect	*High = 4 The cumulative displacement effect of the power line in combination with substation and PV arrays will be high within the study area.*
Intensity/magnitude	*Medium = 2 At a local level the functioning of the bird population will be moderately affected.*
Significance Rating	*14 x 2 = 28 Negative low impact*

	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1	1
Probability	3	2
Reversibility	2	2
Irreplaceable loss	2	2
Duration	2	2
Cumulative effect	4	4
Intensity/magnitude	2	2
Significance rating	-28 (low negative)	-26 (low negative)
Mitigation measures	• *Construction activity should be restricted to the immediate footprint of the infrastructure.* • *Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species.* • *Measures to control noise and dust should be applied according to current best practice in the industry.* • *Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.*	

CONSTRUCTION: TLISITSENG SOLAR 1 SUBSTATION ALT 1	
Environmental Parameter	*Avifauna*
Issue/Impact/Environmental Effect/Nature	*Displacement of priority species due to disturbance and habitat transformation associated with construction of the substation.*
Extent	*Site = 1 The displacement impact will be restricted to the site.*
Probability	*Possible = 3 The impact will possibly occur.*
Reversibility	*Irreversible = 4 The impact will not be reversible*
Irreplaceable loss of resources	*Marginal loss of resources = 2 The impact on priority species will result in a marginal loss of resources at a site level*
Duration	*Long term = 3 The impact is likely to continue right through the operational life-time of the facility.*
Cumulative effect	*High = 4 The cumulative displacement effect of the substation in combination with power line and PV arrays will be high within the study area.*

Intensity/magnitude	*Low = 1 At a site level the functioning of the bird population will be slightly impacted.*	
Significance Rating	*17 x 1 = 17* *Negative low impact*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	4	3
Reversibility	3	3
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	4	4
Intensity/magnitude	1	1
Significance rating	-17 (low negative)	-16 (low negative)
Mitigation measures	• *Construction activity should be restricted to the immediate footprint of the infrastructure.* • *Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species.* • *Measures to control noise and dust should be applied according to current best practice in the industry.* • *Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.*	
CONSTRUCTION: TLISITSENG SOLAR 1 SUBSTATION ALT 2		
Environmental Parameter	*Avifauna*	
Issue/Impact/Environmental Effect/Nature	*Displacement of priority species due to disturbance and habitat transformation associated with construction of the substation.*	
Extent	*Site = 1 The displacement impact will be restricted to the site.*	
Probability	*Possible = 3 The impact will possibly occur.*	
Reversibility	*Irreversible = 4 The impact will not be reversible*	
Irreplaceable loss of resources	*Marginal loss of resources = 2The impact on priority species will result in a marginal loss of resources at a site level*	
Duration	*Long term = 3 The impact is likely to continue right through the operational life-time of the facility.*	

Cumulative effect	*High = 4 The cumulative displacement effect of the substation in combination with the power line and PV arrays will be high within the study area.*	
Intensity/magnitude	*Low = 1 At a site level the functioning of the bird population will be slightly impacted.*	
Significance Rating	*17 x 1 = 17* *Negative low impact*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	4	3
Reversibility	3	3
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	4	4
Intensity/magnitude	1	1
Significance rating	-17 (low negative)	-16 (low negative)
Mitigation measures	• *Construction activity should be restricted to the immediate footprint of the infrastructure.* • *Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species.* • *Measures to control noise and dust should be applied according to current best practice in the industry.* • *Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.*	

7.3.2 *Operational Phase*

OPERATION: COLLISIONS WITH THE 132KV POWER LINE	
Environmental Parameter	*Avifauna*
Issue/Impact/Environmental Effect/Nature	*Collisions of priority species with the proposed 132kV line.*
Extent	*Regional = 3 The collision mortality may affect local populations of some highly mobile priority species e.g. Greater Flamingo.*
Probability	*Probable = 3 The impact will likely occur.*

Reversibility	*Partly reversible = 2 mitigation will reduce the impact but not eliminate it.*	
Irreplaceable loss of resources	*Significant loss of resources = 3.*	
Duration	*Long term = 3 The impact is likely to continue for the lifetime of the facility.*	
Cumulative effect	*Medium = 3 The cumulative effect of the collision mortality on the power line in combination with the substation and PV arrays will be medium within the study area.*	
Intensity/magnitude	*Medium = 2 At a local level the functioning of the bird population will be moderately affected.*	
Significance Rating	*17 x 2 = 34* *Negative medium impact*	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	2	2
Probability	3	2
Reversibility	2	2
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	3	3
Intensity/magnitude	2	2
Significance rating	-34 (medium negative)	-28 (low negative)
Mitigation measures	• *The 132kV grid connection should be inspected at least once a quarter for a minimum of three years by the avifaunal specialist to establish if there is any significant collision mortality. Thereafter the frequency of inspections will be informed by the results of the first three years.* • *The detailed protocol to be followed for the inspections will be compiled by the avifaunal specialist prior to the first inspection.* • *The line should be marked with Bird Flight Diverters (BFDs) for its entire length on the earth wire of the line, 5m apart, alternating black and white. See* ***APPENDIX 4*** *for the type of BFD which is recommended.*	

OPERATION: ELECTROCUTION ON THE 132KV POWER LINE AND SUBSTATION	
Environmental Parameter	*Avifauna*

Issue/Impact/Environmental Effect/Nature	*Electrocutions of priority species on the proposed 132kV line and in the substation.*	
Extent	*Regional = 3 The electrocution mortality may affect local populations of some highly mobile priority species e.g. Cape Vulture.*	
Probability	*Possible = 2 The impact may occur.*	
Reversibility	*Completely reversible = 1 the impact can be reversed with mitigation.*	
Irreplaceable loss of resources	*Significant loss of resources = 3.*	
Duration	*Long term = 3 The impact is likely to continue for the lifetime of the facility.*	
Cumulative effect	*Medium = 3 The cumulative effect of the electrocution mortality on the power line in combination with the displacement impact of PV arrays and the collision and electrocution mortality on the existing power lines will be medium within the study area.*	
Intensity/magnitude	*Medium = 2 At a local level the functioning of the bird population will be moderately affected.*	
Significance Rating	*15 x 2 = 30* *Negative medium impact*	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	3	2
Probability	2	1
Reversibility	1	1
Irreplaceable loss	3	2
Duration	3	3
Cumulative effect	3	3
Intensity/magnitude	2	2
Significance rating	-30 (medium negative)	-24 (low negative)
Mitigation measures	• *An Eskom approved bird friendly pole design must be used (**APPENDIX 5**) incorporating a bird perch, to provide safe perching substrate for birds well above the dangerous hardware.* • *Substation hardware is often too complex for blanket, pro-active mitigation. It is rather recommended that if on-going impacts are recorded once operational, site specific mitigation be applied reactively. This is an acceptable approach since Red List bird species are unlikely to frequent the substation and be electrocuted.*	

7.3.3 De-commissioning Phase

DE-COMMISSIONING: 132KV POWER LINE	
Environmental Parameter	*Avifauna*
Issue/Impact/Environmental Effect/Nature	*Displacement of priority species due to disturbance and habitat transformation associated with de-commissioning of the 132kV power line.*
Extent	*Site = 1 The displacement impact should only affect priority species at a site level*
Probability	*Probable = 3 The impact will likely occur.*
Reversibility	*Partly reversible = 2 Once the de-commissioning activity ceases, the source of displacement will be removed and the priority species should be able to utilise the habitat again.*
Irreplaceable loss of resources	*Marginal loss of resources = 2 It should only affect small, non-threatened species.*
Duration	*Short term = 2 the impact and its effects will last for the period of a relatively short de-commissioning period and a limited recovery time after de-commissioning, thereafter it will be largely negated.*
Cumulative effect	*High = 4 The cumulative displacement effect of the power line in combination with the substation and PV arrays will be high within the study area.*
Intensity/magnitude	*Medium = 2 At a local level the functioning of the bird population will be moderately affected.*
Significance Rating	*14 x 2 = 28 Negative low impact*

	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1	1
Probability	3	2
Reversibility	2	2
Irreplaceable loss	2	2
Duration	2	2
Cumulative effect	4	4
Intensity/magnitude	2	2
Significance rating	-28 (low negative)	-26 (low negative)

Mitigation measures	• *De-commissioning activity should be restricted to the immediate footprint of the infrastructure.* • *Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species.* • *Measures to control noise and dust should be applied according to current best practice in the industry.* • *Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.*

DECOMMISIONING: TLISITSENG SOLAR 1 SUBSTATION		
Environmental Parameter	*Avifauna*	
Issue/Impact/Environmental Effect/Nature	*Displacement of priority species due to disturbance and habitat transformation associated with de-commissioning of the substation.*	
Extent	*Site = 1 The displacement impact will be restricted to the site.*	
Probability	*Probable = 3 The impact will possibly occur.*	
Reversibility	*Reversible = 1 Completely reversible*	
Irreplaceable loss of resources	*Marginal loss of resources = 2The impact on priority species will result in a marginal loss of resources at a site level*	
Duration	*Short term = 2 the impact and its effects will last for the period of a relatively short de-commissioning period and a limited recovery time after de-commissioning, thereafter it will be largely negated.*	
Cumulative effect	*High = 4 The cumulative displacement effect of the substation in combination with the power line and PV arrays will be high within the study area.*	
Intensity/magnitude	*Low = 1 At a site level the functioning of the bird population will be slightly impacted.*	
Significance Rating	*12 x 1 = 12* *Negative low impact*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	2

Reversibility	1	1
Irreplaceable loss	2	2
Duration	2	2
Cumulative effect	4	4
Intensity/magnitude	1	1
Significance rating	-13 (low negative)	-12 (low negative)
Mitigation measures	• *De-commissioning activity should be restricted to the immediate footprint of the infrastructure.* • *Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species.* • *Measures to control noise and dust should be applied according to current best practice in the industry.* • *Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.*	

7.4 Impact Summary

The impacts were summarised and a comparison made between pre and post mitigation phases as shown in Table 2 below. The rating of environmental issues associated with different parameters prior to and post mitigation of a proposed activity was averaged. A comparison was then made to determine the effectiveness of the proposed mitigation measures. The comparison identified critical issues related to the environmental parameters. Both substation alternatives have identical ratings (see table 3).

Table 2: Comparison of summarised impacts on environmental parameters.

Environmental parameter	Issues	Rating prior to mitigation	Rating post mitigation
Avifauna	Displacement by power line construction	-28 (low negative)	-26 (low negative
	Displacement by the substation construction	-17 (low negative)	-16 (low negative)
	Collisions with powerline	-34 (medium negative)	-28 (low negative)
	Displacement by power line de-commissioning	-28 (low negative)	-26 (low negative)
	Displacement by the substation de-commissioning	-13 (low negative)	-12 (low negative)
	Average	**23.6 (low negative)**	**21.6 (low negative)**

The 2010 EIA regulations also specify that alternatives must be compared in terms of impact assessment.

Table 3 below sets out the comparative assessment of the various alternatives.

Table 3: Comparison of alternatives

PREFERRED	The alternative will result in a low impact / reduce the impact	
FAVOURABLE	The impact will be relatively insignificant	
NOT PREFERRED	The alternative will result in a high impact / increase the impact	
NO PREFERENCE	The alternative will result in equal impacts	
POWER LINES		
Substation Alternative 1	**NO PREFERENCE**	The extent of the impacts of the two substation alternatives is identical for all practical reasons. The alternative will result in equal impacts.
Substation Alternative 2	**NO PREFERENCE**	The extent of the impacts of the two substation alternatives is identical for all practical reasons. The alternative will result in equal impacts.

8. CUMULATIVE IMPACTS

The area has seen some interest from developers of various renewable energy projects, which could be associated with the wind and solar energy resource potential found in the region, proximity to the existing sub-station and its evacuation capacity, as well as other factors. Such developments, whether already approved or only proposed, need to be considered as they have the potential to create numerous cumulative impacts, whether positive or negative, if implemented.

Table 3 lists the projects within a 20km radius around the Watershed Substation that will need to be considered when examining the cumulative impacts; their location relative to the project under review is illustrated in Error! Reference source not found.**7**.

Table 3: Proposed renewable energy projects within a 20km radius from the Watershed Substation

Table 6: Renewable energy projects within a 25km radius around Watershed Substation

roposed Development	DEA Reference Number	Current Status of EIA	Proponent	Proposed Capacity	Farm Details	Bird impact assessment study	Relevant proposed mitigation
Tlisitseng 1	14/12/16/3/3/2/889	EIA ongoing	BioTherm Energy	75MW	Portion 25 of the Farm Houthaalboomen No 31	Yes	1. Construction activity should be restricted to the immediate footprint of the infrastructure. 2. Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species. 3. Measures to control noise and dust should be applied according to current best practice in the industry. 4. Maximum used should be made of existing access roads and the construction of new roads should be kept to a minimum. 5. The vegetation between the solar arrays should be maintained in as close a state as possible to the original vegetation. 6. The recommendations for the vegetation management as detailed in the botanical specialist report must be strictly implemented. 7. Monitoring should be implemented to search the ground between arrays of solar panels on a two-weekly basis for at least one year to determine the magnitude of collision fatalities. Searches should be done on foot. Searches should be conducted randomly or at systematically selected arrays of solar panels to the extent that equals 33% or more of the project area. Detection trials should be integrated into the searches.

							8. Depending on the results of the carcass searches, a range of mitigation measures will have to be considered if mortality levels turn out to be significant, including minor modifications of panel and mirror design to reduce the illusory characteristics of solar panels. What is considered to be significant will have to be established on a species-specific basis by the avifaunal specialist. 9. The exact protocol to be followed for the operational phase monitoring should be compiled by the avifaunal specialist in consultation with the plant operator and Environmental Control Officer before the commencement of operations. The exact scope and nature of the operational phase monitoring will be informed on an ongoing basis by the result of the monitoring and the EMP will be updated accordingly. 10. Depending on the results of the carcass searches, a range of mitigation measures will have to be considered if mortality levels turn out to be significant, including minor modifications of panel and mirror design to reduce the illusory characteristics of solar panels. What is considered to be significant will have to be established on a species-specific basis by the avifaunal specialist.

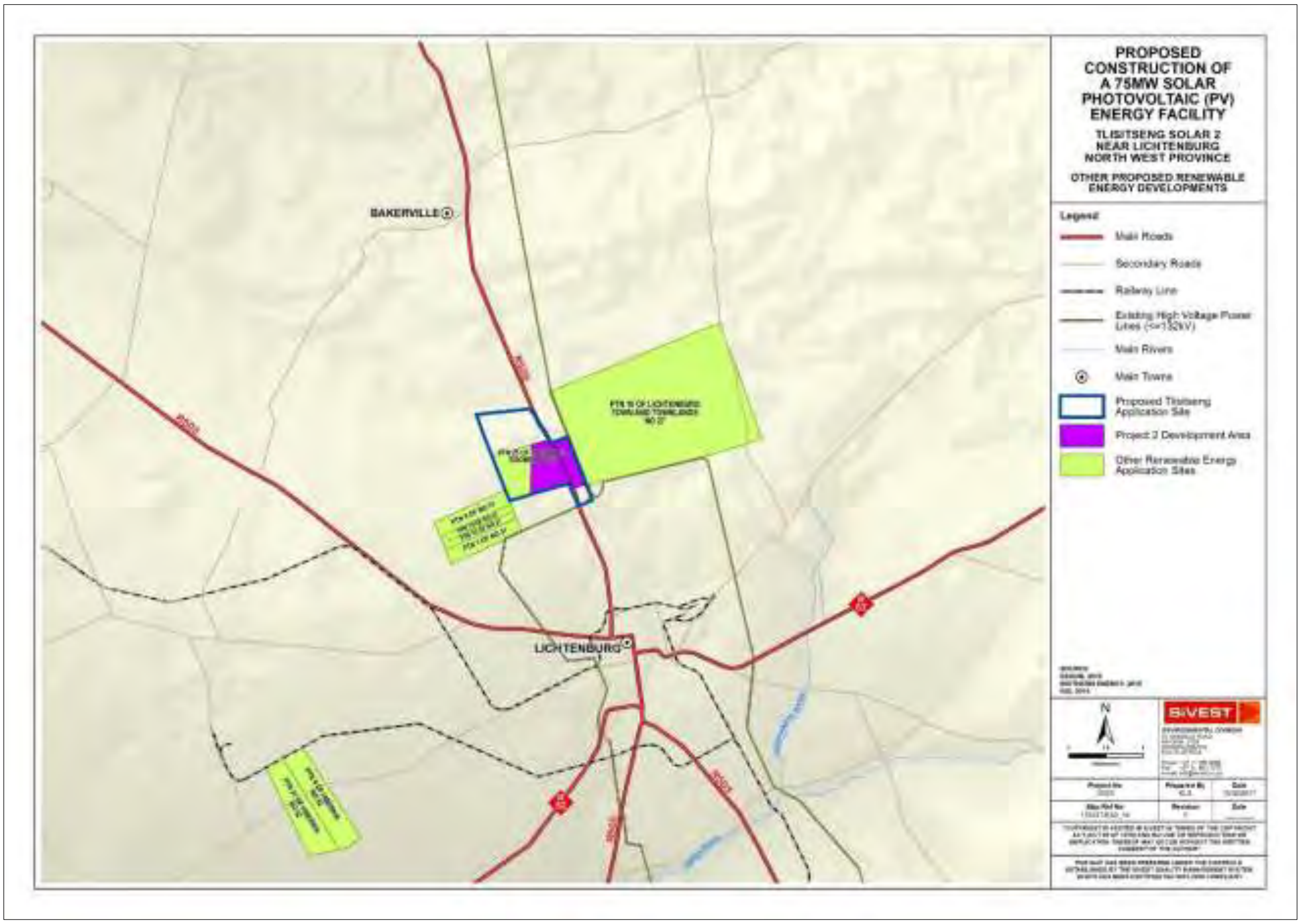

Figure 7: Renewable energy developments proposed within a 20km radius from the Watershed Substation.

The total surface area in a 20km radius around the Watershed Substation amounts to approximately 126 120ha. The combined area taken up by the proposed renewable energy developments in this 20km radius, including the Tlisitseng PV 1 project, amounts to approximately 5 071ha. This is approximately 4% of the total amount of habitat available. The existing high voltage lines within a 20km radius run into hundreds of kilometres, and will increase slightly by about 3.2km if the proposed 132kV grid connection is added, which is insignificant. However, if all the proposed renewable energy projects are actually constructed, it will significantly increase the total length of high voltage lines within the 20km radius. There are definitely problems with vulture mortality within the Lichtenburg Game Breeding Centre - at least five White-backed Vultures were killed by power lines in the reserve since January 2016. The potential cumulative impact of displacement and especially direct mortality of priority species linked to the proposed 132kV grid connection, in combination with the existing and planned power line network in this area, is therefore rated as **medium** within a 20km radius, on the assumption that all the projects which are currently proposed within this radius are actually constructed (see Impact Table below).

CUMULATIVE IMPACTS: PV PLANT AND ASSOCIATED INFRASTRUCTURE	
Environmental Parameter	*Avifauna*
Issue/Impact/Environmental Effect/Nature	*The cumulative impact of:* • *Displacement of priority species due to disturbance associated with construction of the grid connection.* • *Electrocution of priority species on the 132kV grid connection* • *Collisions with the earth-wire of the 132kV grid connection.*
Extent	*Region = 3 The cumulative impact could affect the entire region if vultures are electrocuted*
Probability	*3 = The impact will likely occur (Between a 50% to 75% chance of occurrence).*
Reversibility	*Completely reversible = 1 The impact will be completely reversible on de-commissioning of the plant provided the powerline is removed and the habitat allowed to recover over time.*
Irreplaceable loss of resources	*Marginal loss of resources = 2 The impact on priority species will result in a minor loss of resources at a regional level, but it will not be irreplaceable.*
Duration	*Long term = 3 The impact is likely to continue right through the operational life-time of the facility.*
Cumulative effect	*Medium cumulative impact = 3 The impact would result in minor cumulative effects at a regional level*
Intensity/magnitude	*Medium = 2 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).*
Significance Rating	*15 x 2 = 30* *Medium impact*

	Pre-mitigation impact rating	Post mitigation impact rating
Extent	3	1
Probability	3	2
Reversibility	1	1
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	2	2
Intensity/magnitude	2	2
Significance rating	- 30 (low negative)	-24 (low negative)

Mitigation measures	• *Activity should be restricted to the immediate footprint of the infrastructure.* • *Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species.* • *Measures to control noise and dust should be applied according to current best practice in the industry.* • *Maximum used should be made of existing access roads and the construction of new roads should be kept to a minimum.* • *Monitoring should be implemented to search the ground between arrays of solar panels on a two-weekly basis for at least one year to determine the magnitude of collision fatalities.* • *Depending on the results of the carcass searches, a range of mitigation measures will have to be considered if mortality levels turn out to be significant, including minor modifications of panel and mirror design to reduce the illusory characteristics of solar panels. What is considered to be significant will have to be established on a species-specific basis by the avifaunal specialist.*

9. SENSITIVITY MAP

The core study area is located in the endemic region with the fourth highest number of endemics in southern Africa. With 20% of all southern African endemics or near endemics potentially occurring in the study area, the study area should be regarded as moderately sensitive from an avifaunal perspective. Within the study area and immediately beyond it, high voltage lines, a vulture restaurant, and wetlands and dams are potential high sensitive areas, as all of these micro-habitats are potential focal points of bird activity. Figure 8 below indicates areas of high sensitivity. It is important to note that the sensitivity of the study area could be influenced by the PV development itself, in that the construction of the solar panels could result in the relocation of boreholes from the study area. The sensitivity map in Figure 8 does not take into account the potential removal of the boreholes.

10. CONCLUSIONS

The proposed BioTherm Tlisitseng Solar 1 PV2 132kV grid connection is located in the Grassland endemic avifaunal region with the fourth highest number of avifaunal endemics in southern Africa. With 20% of all southern African endemics or near endemics potentially occurring at the core study area and immediate surroundings, the application site and immediate surroundings as a whole should be regarded as moderately sensitive from an avifaunal perspective. Within the core study area, high sensitive areas are surface water (boreholes) and a short section of high voltage lines which is used for roosting by Cape Vultures and White-backed Vultures. Within the immediate surroundings beyond the core study area, high voltage lines, a vulture restaurant, and wetlands and dams are potential high sensitive areas, as all of these micro-habitats are potential focal points of bird activity. The wetlands and dams may be an aggravating factor in that birds commuting to and from them could mistake the solar panels for surface water and attempt to land on them, thereby exposing themselves to the risk of collision. Boreholes could potentially be declassified as high sensitivity should it be confirmed that they will be removed and therefore cease to function as potential focal points for bird activity after the construction of the solar panels.

Potential pre-mitigation impacts on priority avifauna range from medium negative to low negative. All impacts could be reduced to low negative with the implementation of appropriate mitigation. No clear preferred alternative emerged as far as the proposed substation sites are concerned, as both sites are located in the same habitat. No fatal flaws were identified in the course of investigations from an avifaunal perspective, and the proposed development could therefore be authorised, provided all proposed mitigation measures are implemented.

Figure 8: Sensitivity map of the study area. Red areas indicate high sensitivity.

11. RECOMMENDATIONS

See impact tables above under Section 7.

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APPENDIX 1 PRE-CONSTRUCTION MONITORING

BIRD MONITORING PROGRESS REPORT 1

TLISITSENG SOLAR ENERGY FACILITY

December 2015

Chris van Rooyen &
Albert Froneman *Pr.Sci.Nat*

Avifaunal Specialist Consultants

1. Objectives

The objective of the pre-construction monitoring at the proposed Tlisitseng Solar Facilities is to gather baseline data over a period of six months on the following aspects pertaining to avifauna:

- The abundance and diversity of birds at the solar farm sites to measure the potential displacement effect of the wind farm.
- Flight patterns of priority species at the solar farm sites to measure the potential impact on flight activity of the solar farm.

The objective of this short progress report is to provide feedback on the first monitoring period, with a few basic descriptive analyses of the data**. In depth statistical analyses will be performed on the full dataset after the monitoring has been completed.**

2. Methods

The monitoring protocol for the site is designed according to the draft version (November 2015) of *Best Practice Guidelines for assessing and monitoring the impact of solar energy facilities on birds in southern Africa (Jenkins et.al).*

The first monitoring survey was conducted at the proposed turbine sites by one field monitor during November 2015.

Monitoring is conducted in the following manner:

- Two walk transects of 1km each were identified at the turbine site and counted 8 times per sampling season. All birds are recorded during walk transects.
- The following variables are recorded:
    - Species;
    - Number of birds;

  - Date;
  - Start time and end time;
  - Distance from transect (0-50 m, 50-100 m, >100 m);
  - Wind direction;
  - Wind strength (calm; moderate; strong);
  - Weather (sunny; cloudy; partly cloudy; rain; mist);
  - Temperature (cold; mild; warm; hot);
  - Behaviour (flushed; flying-display; perched; perched-calling; perched-hunting; flying-foraging; flying-commute; foraging on the ground); and
  - Co-ordinates (priority species only).

- One vantage point (VP) was identified from which the majority of the proposed PV areas can be observed (the “VP area”), to record the flight altitude and patterns of priority species. The following variables were recorded for each flight:
  - Species;
  - Number of birds;
  - Date;
  - Start time and end time;
  - Wind direction;
  - Wind strength (estimated Beaufort scale 1-7);
  - Weather (sunny; cloudy; partly cloudy; rain; mist);
  - Temperature (cold; mild; warm; hot);
  - Flight altitude (high i.e. >200m; medium i.e. 20m – 200m; low i.e. <20m);
  - Flight mode (soar; flap; glide ; kite; hover); and
  - Flight time (in 15 second-intervals).

The objective of the transect monitoring is to gather baseline data on the use of the site by birds in order to measure potential displacement by the wind farm activities. The objective of vantage point counts is to measure the potential collision risk with the PV arrays, and to see how flight behaviour is influenced by the PV arrays. South African Red Data species and Southern African endemics and near-endemics were classified as priority species. The list will be reviewed and revised on an ongoing basis.

No potential focal point of bird activity was identified at the proposed site itself. The closest potential focal point of bird activity is the vulture restaurant in the former Lichtenburg Game Breeding Centre which is located adjacent to the proposed development approximately 2.2km from the eastern boundary. According to Mr. Jan Steinman, who has recently taken over the now derelict Game Breeding Centre, there are up to 180 vultures feeding at the restaurant when food is available (pers.comm 03 December 2015).

Figure 1 below indicates the area where monitoring is taking place.

Figure 1: Area where monitoring is taking place, with position of VP (yellow placemark), focal point (red placemark), walk transects (yellow lines) and land parcel boundaries (white polygon).

3. Results

3.1 Transects

The dominant natural vegetation type in the study area and immediate surroundings is Carltonville Dolomite Grassland. Carltonville Dolomite Grassland occurs on slightly undulating plains dissected by chert ridges. In the study area, small, mostly Vachellia trees, and a variety of shrubs are scattered across the landscape. Species-rich grassland forms a complex mosaic pattern dominated by many grass species. Rainfall is in summer with an overall mean annual precipitation of 593mm, with temperatures ranging from very cold with frost in winter to very hot in summer (Mucina & Rutherford 2006). The core study area also contains several pivots where a variety of crops are grown.

To date, a total of 32 species have been recorded at the development site. The total number of birds recorded during transect counts at the turbine site to date is 203. Of the transect recorded species at the development site, 9 species (28% of recorded species) are priority species (according to the current classification).

Figure 2 below presents the priority species transect count data for the development site, presented as an Index of Kilometric Abundance (IKA = birds/km).

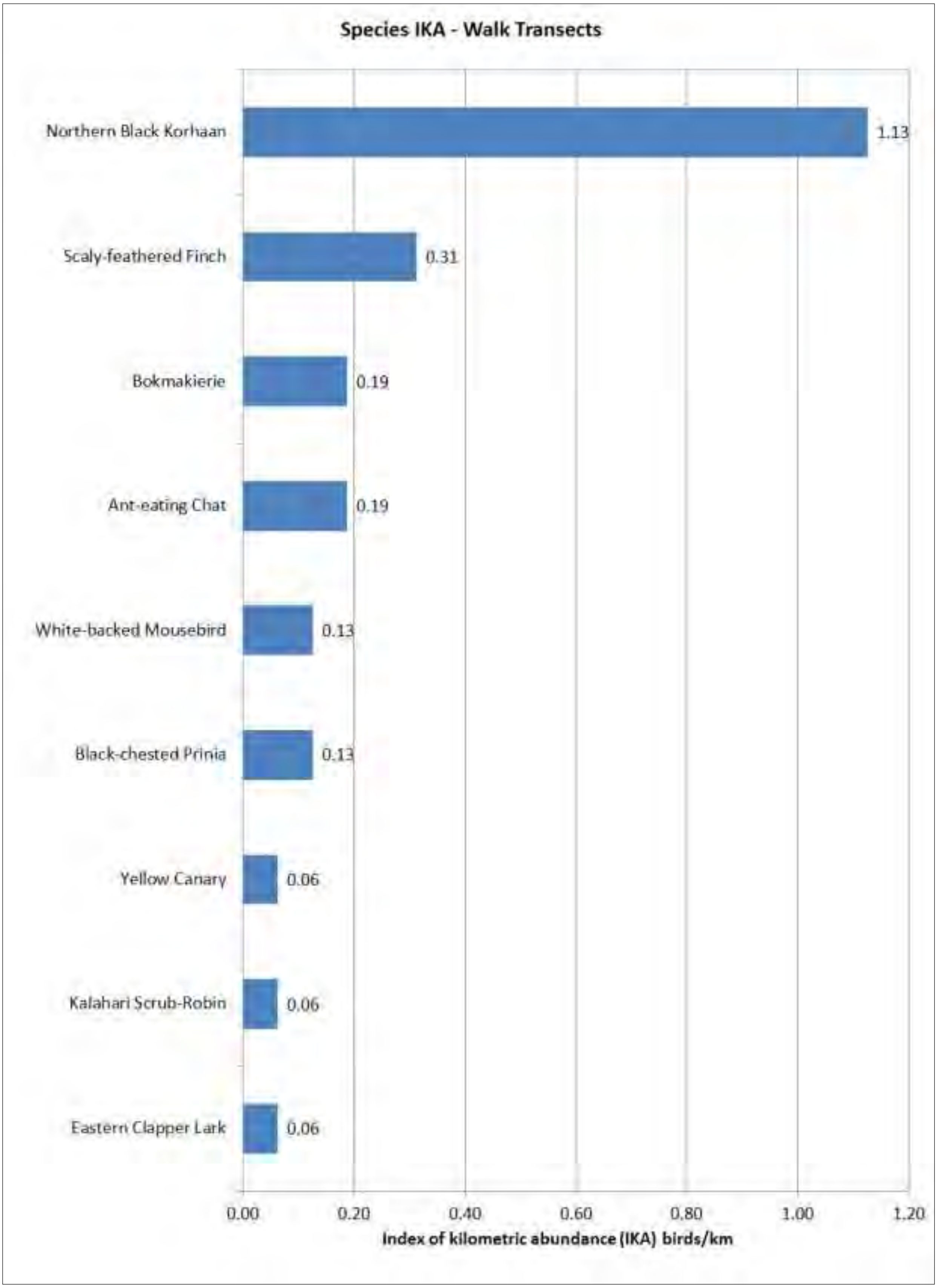


Figure 2: IKA for walk transects priority species at the development site

3.2 Vantage points

To date, observations to record flight patterns of priority species have been conducted for 12 hours (12 hours per VP) at 1 vantage point at the development site in three bands (high i.e. >200m; medium i.e. 20m – 200m; low i.e. <20m). Approximate flight height is visually judged by an observer with the aid of binoculars. However, no priority species flights were recorded during this round of monitoring. This may have been due to unusually dry and windy conditions which persisted during the VP watches.

4 Potential red flags

No “Red Flag” issues were identified during this round of monitoring.

Final analysis and recommendations will be done when the pre-construction monitoring is completed and statistical analyses are performed.

It is imperative that any changes to the proposed lay-out are communicated through to us immediately.

A consolidated list of all recorded species is attached as Appendix A.

APPENDIX A: Consolidated list of species recorded at the Tlisitseng Solar Energy facility during the first season of monitoring (includes incidental sightings)

Priority species	Scientific name	Status (Southern Africa)	Walk
Anteating Chat	*Myrmecocichla formicivora*	Endemic	*
Black-chested Prinia	*Prinia flavicans*	Near-endemic	*
Bokmakierie	*Telophorus zeylonus*	Near-endemic	*
Eastern Clapper Lark	*Mirafra [apiata] fasciolata*	Near-endemic	*
Kalahari Scrub-Robin	*Cercotrichas paena*	Near-endemic	*
Northern Black Korhaan	*Afrotis afraoides*	Endemic	*
Scaly-feathered Finch	*Sporopipes squamifrons*	Near-endemic	*
White-backed Mousebird	*Colius colius*	Endemic	*
Yellow Canary	*Crithagra flaviventris*	Near-endemic	*
		Priority species subtotal:	9
Non-priority species	**Scientific name**	**Status**	**Walk**
African Palm-Swift	*Cypsiurus parvus*	-	*
Barn Owl	*Tyto alba*	-	*
Barn Swallow	*Hirundo rustica*	-	*
Blue Waxbill	*Uraeginthus angolensis*	-	*
Cape Glossy Starling	*Lamprotornis nitens*	-	*
Cattle Egret	*Bubulcus ibis*	-	*
Common Fiscal	*Lanius collaris*	-	*
Common Scimitarbill	*Rhinopomastus cyanomelas*	-	*
Crowned Lapwing	*Vanellus coronatus*	-	*
Dark-capped Bulbul	*Pycnonotus tricolor*	-	*
Desert Cisticola	*Cisticola aridulus*	-	*
Greater Striped swallow	*Hirundo cucullata*	-	*
Laughing Dove	*Streptopelia senegalensis*	-	*
Little Swift	*Apus affinis*	-	*
Long-tailed Widowbird	*Euplectes progne*	-	*
Pied Crow	*Corvus albus*	-	*
Red-billed Quelea	*Quelea quelea*	-	*
Southern Masked-Weaver	*Ploceus velatus*	-	*
Southern Red Bishop	*Euplectes orix*	-	*
Speckled Pigeon	*Columba guinea*	-	*
Wattled Starling	*Creatophora cinerea*	-	*
White-browed Sparrow-Weaver	*Plocepasser mahali*	-	*
White-rumped Swift	*Apus caffer*	-	*
		Non-Priority species subtotal:	23
		Grand Total:	32

APPENDIX 2 BIRD HABITATS

Figure 1: Typical grassland habitat in the study area (Carltonville Dolomite Grassland)

Figure 2: Irrigated lands in the study area

Figure 3: The vulture restaurant in the Lichtenburg Game Breeding Centre with the Watershed MTS in the background.

Figure 4: Existing high voltage lines in the study area.

APPENDIX 3: SPECIES THAT COULD POTENTIALLY OCCUR AT THE CORE STUDY AREA AND IMMEDIATE SURROUNDINGS (priority species highlighted in yellow)

Species	Scientific name
Babbler, Southern Pied	*Turdoides bicolor*
Barbet, Acacia Pied	*Tricholaema leucomelas*
Barbet, Black-collared	*Lybius torquatus*
Barbet, Crested	*Trachyphonus vaillantii*
Batis, Pririt	*Batis pririt*
Bee-eater, European	*Merops apiaster*
Bee-eater, Little	*Merops pusillus*
Bee-eater, Swallow-tailed	*Merops hirundineus*
Bishop, Southern Red	*Euplectes orix*
Bishop, Yellow-crowned	*Euplectes afer*
Bokmakierie	*Telophorus zeylonus*
Brubru	*Nilaus afer*
Bulbul, African Red-eyed	*Pycnonotus nigricans*
Bunting, Cinnamon-breasted	*Emberiza tahapisi*
Bunting, Golden-breasted	*Emberiza flaviventris*
Bunting, Lark-like	*Emberiza impetuani*
Bustard, Kori	*Ardeotis kori*
Buzzard, Steppe	*Buteo vulpinus*
Canary, Black-throated	*Crithagra atrogularis*
Canary, Yellow	*Crithagra flaviventris*
Chat, Anteating	*Myrmecocichla formicivora*
Chat, Familiar	*Cercomela familiaris*
Cisticola, Desert	*Cisticola aridulus*
Cisticola, Levaillant's	*Cisticola tinniens*
Cisticola, Rattling	*Cisticola chiniana*
Cisticola, Zitting	*Cisticola juncidis*
Cliff-swallow, South African	*Hirundo spilodera*
Coot, Red-knobbed	*Fulica cristata*
Cormorant, Reed	*Phalacrocorax africanus*
Cormorant, White-breasted	*Phalacrocorax carbo*
Coucal, Burchell's	*Centropus burchellii*
Courser, Burchell's	*Cursorius rufus*
Courser, Double-banded	*Rhinoptilus africanus*
Crake, Black	*Amaurornis flavirostris*
Crombec, Long-billed	*Sylvietta rufescens*
Crow, Pied	*Corvus albus*
Cuckoo, Diderick	*Chrysococcyx caprius*
Cuckoo, Jacobin	*Clamator jacobinus*
Cuckoo, Klaas's	*Chrysococcyx klaas*
Darter, African	*Anhinga rufa*
Dove, Laughing	*Streptopelia senegalensis*
Dove, Namaqua	*Oena capensis*

Dove, Red-eyed	*Streptopelia semitorquata*
Dove, Rock	*Columba livia*
Drongo, Fork-tailed	*Dicrurus adsimilis*
Duck, African Black	*Anas sparsa*
Duck, Comb	*Sarkidiornis melanotos*
Duck, Maccoa	*Oxyura maccoa*
Duck, Mallard	*Anas platyrhynchos*
Duck, White-faced	*Dendrocygna viduata*
Duck, Yellow-billed	*Anas undulata*
Eagle, Martial	*Polemaetus bellicosus*
Eagle-owl, Spotted	*Bubo africanus*
Egret, Cattle	*Bubulcus ibis*
Egret, Great	*Egretta alba*
Egret, Little	*Egretta garzetta*
Egret, Yellow-billed	*Egretta intermedia*
Eremomela, Yellow-bellied	*Eremomela icteropygialis*
Falcon, Amur	*Falco amurensis*
Finch, Red-headed	*Amadina erythrocephala*
Finch, Scaly-feathered	*Sporopipes squamifrons*
Firefinch, Red-billed	*Lagonosticta senegala*
Fiscal, Common (Southern)	*Lanius collaris*
Fish-eagle, African	*Haliaeetus vocifer*
Flycatcher, Chat	*Bradornis infuscatus*
Flycatcher, Fairy	*Stenostira scita*
Flycatcher, Fiscal	*Sigelus silens*
Flycatcher, Marico	*Bradornis mariquensis*
Flycatcher, Spotted	*Muscicapa striata*
Francolin, Orange River	*Scleroptila levaillantoides*
Goose, Egyptian	*Alopochen aegyptiacus*
Goose, Spur-winged	*Plectropterus gambensis*
Goshawk, Gabar	*Melierax gabar*
Goshawk, Southern Pale Chanting	*Melierax canorus*
Grebe, Great Crested	*Podiceps cristatus*
Grebe, Little	*Tachybaptus ruficollis*
Guineafowl, Helmeted	*Numida meleagris*
Hamerkop	*Scopus umbretta*
Harrier-Hawk, African	*Polyboroides typus*
Heron, Black-headed	*Ardea melanocephala*
Heron, Green-backed	*Butorides striata*
Heron, Grey	*Ardea cinerea*
Heron, Purple	*Ardea purpurea*
Honeyguide, Greater	*Indicator indicator*
Honeyguide, Lesser	*Indicator minor*
Hoopoe, African	*Upupa africana*
Hornbill, African Grey	*Tockus nasutus*
Hornbill, Southern Yellow-billed	*Tockus leucomelas*

Ibis, African Sacred	*Threskiornis aethiopicus*
Ibis, Glossy	*Plegadis falcinellus*
Ibis, Hadeda	*Bostrychia hagedash*
Indigobird, Village	*Vidua chalybeata*
Kestrel, Greater	*Falco rupicoloides*
Kestrel, Lesser	*Falco naumanni*
Kestrel, Rock	*Falco rupicolus*
Kingfisher, Brown-hooded	*Halcyon albiventris*
Kingfisher, Giant	*Megaceryle maximus*
Kingfisher, Malachite	*Alcedo cristata*
Kingfisher, Pied	*Ceryle rudis*
Kite, Black-shouldered	*Elanus caeruleus*
Kite, Yellow-billed	*Milvus aegyptius*
Korhaan, Northern Black	*Afrotis afraoides*
Korhaan, Red-crested	*Lophotis ruficrista*
Lapwing, Blacksmith	*Vanellus armatus*
Lapwing, Crowned	*Vanellus coronatus*
Lark, Eastern Clapper	*Mirafra fasciolata*
Lark, Fawn-coloured	*Calendulauda africanoides*
Lark, Red-capped	*Calandrella cinerea*
Lark, Rufous-naped	*Mirafra africana*
Lark, Sabota	*Calendulauda sabota*
Lark, Spike-heeled	*Chersomanes albofasciata*
Longclaw, Cape	*Macronyx capensis*
Mannikin, Bronze	*Spermestes cucullatus*
Martin, Brown-throated	*Riparia paludicola*
Martin, Rock	*Hirundo fuligula*
Moorhen, Common	*Gallinula chloropus*
Mousebird, Red-faced	*Urocolius indicus*
Mousebird, White-backed	*Colius colius*
Myna, Common	*Acridotheres tristis*
Neddicky	*Cisticola fulvicapilla*
Night-Heron, Black-crowned	*Nycticorax nycticorax*
Ostrich, Common	*Struthio camelus*
Owl, Barn	*Tyto alba*
Owl, Marsh	*Asio capensis*
Owlet, Pearl-spotted	*Glaucidium perlatum*
Palm-swift, African	*Cypsiurus parvus*
Paradise-flycatcher, African	*Terpsiphone viridis*
Paradise-whydah, Long-tailed	*Vidua paradisaea*
Penduline-tit, Cape	*Anthoscopus minutus*
Pigeon, Speckled	*Columba guinea*
Pipit, African	*Anthus cinnamomeus*
Pipit, Buffy	*Anthus vaalensis*
Pipit, Plain-backed	*Anthus leucophrys*
Plover, Kittlitz's	*Charadrius pecuarius*

Plover, Three-banded	*Charadrius tricollaris*
Pochard, Southern	*Netta erythrophthalma*
Prinia, Black-chested	*Prinia flavicans*
Pytilia, Green-winged	*Pytilia melba*
Quail, Common	*Coturnix coturnix*
Quailfinch, African	*Ortygospiza atricollis*
Quelea, Red-billed	*Quelea quelea*
Reed-warbler, Great	*Acrocephalus arundinaceus*
Robin-chat, Cape	*Cossypha caffra*
Roller, European	*Coracias garrulus*
Roller, Lilac-breasted	*Coracias caudatus*
Roller, Purple	*Coracias naevius*
Ruff	*Philomachus pugnax*
Sandgrouse, Burchell's	*Pterocles burchelli*
Sandgrouse, Namaqua	*Pterocles namaqua*
Sandpiper, Common	*Actitis hypoleucos*
Sandpiper, Curlew	*Calidris ferruginea*
Sandpiper, Marsh	*Tringa stagnatilis*
Sandpiper, Wood	*Tringa glareola*
Scimitarbill, Common	*Rhinopomastus cyanomelas*
Scrub-robin, Kalahari	*Cercotrichas paena*
Secretarybird	*Sagittarius serpentarius*
Shelduck, South African	*Tadorna cana*
Shrike, Crimson-breasted	*Laniarius atrococcineus*
Shrike, Lesser Grey	*Lanius minor*
Shrike, Red-backed	*Lanius collurio*
Snake-eagle, Black-chested	*Circaetus pectoralis*
Snake-eagle, Brown	*Circaetus cinereus*
Snipe, African	*Gallinago nigripennis*
Sparrow, Cape	*Passer melanurus*
Sparrow, Great	*Passer motitensis*
Sparrow, House	*Passer domesticus*
Sparrow, Southern Grey-headed	*Passer diffusus*
Sparrowlark, Chestnut-backed	*Eremopterix leucotis*
Sparrowlark, Grey-backed	*Eremopterix verticalis*
Sparrow-weaver, White-browed	*Plocepasser mahali*
Spoonbill, African	*Platalea alba*
Spurfowl, Swainson's	*Pternistis swainsonii*
Starling, Burchell's	*Lamprotornis australis*
Starling, Cape Glossy	*Lamprotornis nitens*
Starling, Wattled	*Creatophora cinerea*
Stilt, Black-winged	*Himantopus himantopus*
Stint, Little	*Calidris minuta*
Stonechat, African	*Saxicola torquatus*
Stork, Abdim's	*Ciconia abdimii*
Stork, Black	*Ciconia nigra*

Sunbird, Marico	*Cinnyris mariquensis*
Sunbird, White-bellied	*Cinnyris talatala*
Swallow, Barn	*Hirundo rustica*
Swallow, Greater Striped	*Hirundo cucullata*
Swallow, Red-breasted	*Hirundo semirufa*
Swallow, White-throated	*Hirundo albigularis*
Swamphen, African Purple	*Porphyrio madagascariensis*
Swamp-warbler, Lesser	*Acrocephalus gracilirostris*
Swift, African Black	*Apus barbatus*
Swift, Bradfield's	*Apus bradfieldi*
Swift, Little	*Apus affinis*
Swift, White-rumped	*Apus caffer*
Tchagra, Brown-crowned	*Tchagra australis*
Teal, Cape	*Anas capensis*
Teal, Red-billed	*Anas erythrorhyncha*
Thick-knee, Spotted	*Burhinus capensis*
Thrush, Groundscraper	*Psophocichla litsipsirupa*
Thrush, Karoo	*Turdus smithi*
Thrush, Olive	*Turdus olivaceus*
Tit, Ashy	*Parus cinerascens*
Tit-babbler, Chestnut-vented	*Parisoma subcaeruleum*
Turtle-dove, Cape	*Streptopelia capicola*
Wagtail, Cape	*Motacilla capensis*
Warbler, Willow	*Phylloscopus trochilus*
Waxbill, Black-faced	*Estrilda erythronotos*
Waxbill, Blue	*Uraeginthus angolensis*
Waxbill, Common	*Estrilda astrild*
Waxbill, Violet-eared	*Granatina granatina*
Weaver, Sociable	*Philetairus socius*
Wheatear, Capped	*Oenanthe pileata*
White-eye, Cape	*Zosterops virens*
White-eye, Orange River	*Zosterops pallidus*
Whydah, Pin-tailed	*Vidua macroura*
Whydah, Shaft-tailed	*Vidua regia*
Widowbird, Long-tailed	*Euplectes progne*
Wood-hoopoe, Green	*Phoeniculus purpureus*
Woodpecker, Cardinal	*Dendropicos fuscescens*
Woodpecker, Golden-tailed	*Campethera abingoni*
Wren-warbler, Barred	*Calamonastes fasciolatus*

APPENDIX 4 BIRD FLIGHT DIVERTERS

DISTRIBUTION
TECHNICAL BULLETIN

3 April 2009

Enquiries: B P Hill

Tel: (011) 871 2397

TECHNICAL BULLETIN: 09 TB – 01
PART: 4 - MV

APPROVED BIRD FLIGHT DIVERTERS TO BE USED ON ESKOMS LINES (MITIGATING DEVICES)

This Technical Bulletin replaces all other Technical Bulletins that were published previously.

The following two flight diverters (mitigating devices) have been successfully installed and successfully tested on an active line in the Colesberg area.

1) EBM Flapper

Buyers guide number DDT 3053

The EBM bird flapper tested for the following:

- Pull down test (spirally moving along the conductor) for squirrel and Hare conductor
- Testing for radio interference at 27kv on fox conductor
- Testing for corona at 27kv on fox conductor
- Salt fog test for 1000 hours.

The flapper was installed live line on a line in the NW region in conjunction with EWT and proved very successful as a mitigating device.

From field experience and the testing of the flapper it was decided at the Envirotech work group meeting that this EBM flapper can be used on conductors ranging from 6mm to 24mm on ACSR, AAAC conductors and shield wires.

The EBM Flapper can be attached with a link stick and a standard attachment or by hand from a bucket live line or under dead conditions.

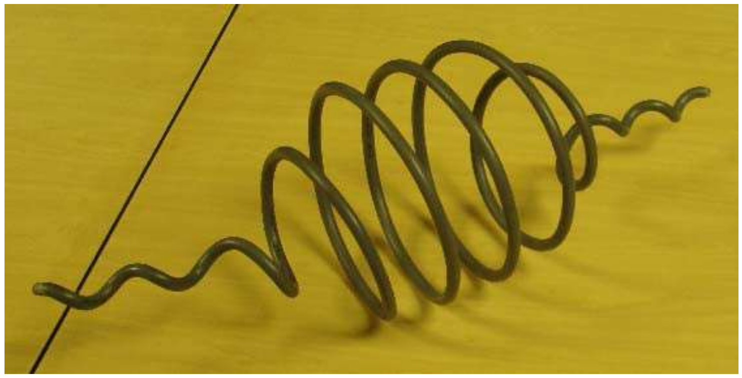
Contact Roger Martin: EBM Tel 011 288 0000

Eskom Distribution

DISTRIBUTION TECHNOLOGY (FAX 011-871-2352)
PRIVATE BAG X1074
GERMISTON 1400

2

2) Tyco Flight Diverter.



<u>Buyers guide number DDT 3107</u>

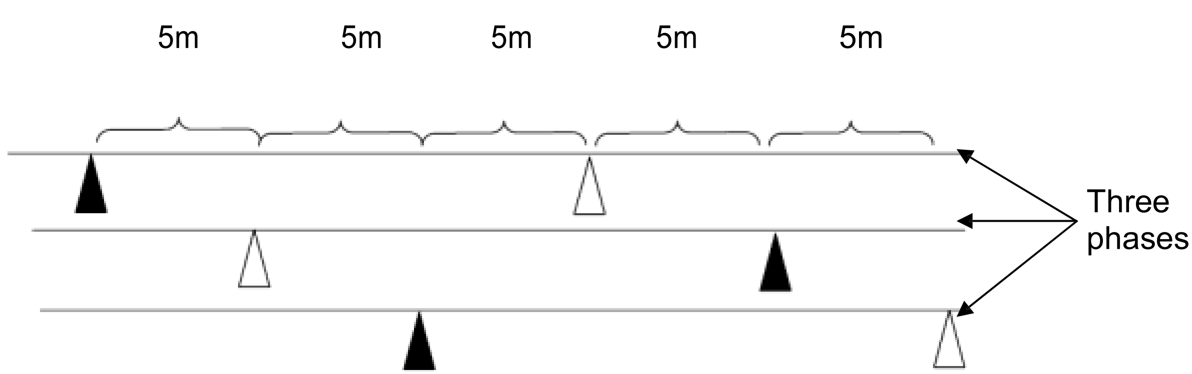
The TYCo flight diverter has been used successfully in many places around the world and has been installed on a line in the NW region in conjunction with EWT and proved very successful as a mitigating device. The device is supplied in colours white and grey.

Contact person: Mr Silas Moloko: TIS Tel 011 635 8000

3) Installing Flight Diverters

- Spacing of the bird diverters are to be 5m apart alternating on each phase, for single phase lines the colours would alternate 5m apart on the two lines.
- The flight diverters are to be installed with alternating colours,

Figure 1



Signed

COMPILED BY:

DATE: **April 2009**
B P Hill
Chief Engineer
IARC

Signed

APPROVED BY:

DATE: **April 2009**
Vinod Singh
Power Plant Technologies Manager
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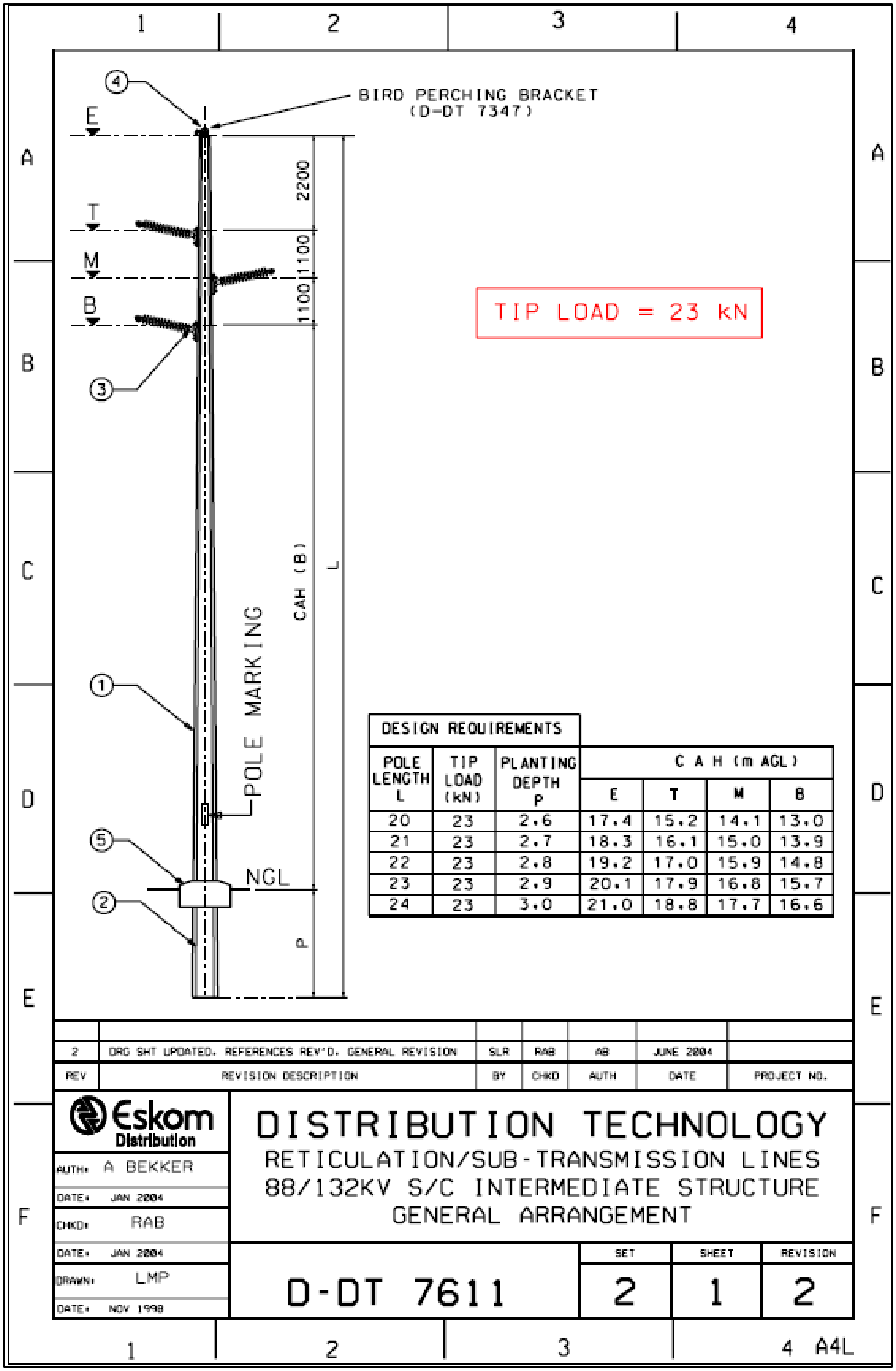
GERMISTON 1400

APPENDIX 5 BIRD FLIGHT DIVERTERS



DESIGN REQUIREMENTS

POLE LENGTH L	TIP LOAD (kN)	PLANTING DEPTH P	C A H (m AGL)			
			E	T	M	B
20	23	2.6	17.4	15.2	14.1	13.0
21	23	2.7	18.3	16.1	15.0	13.9
22	23	2.8	19.2	17.0	15.9	14.8
23	23	2.9	20.1	17.9	16.8	15.7
24	23	3.0	21.0	18.8	17.7	16.6