PROPOSED PLAN 8 GRAHAMSTOWN WIND ENERGY PROJECT
GRAHAMSTOWN AREA, MAKANA MUNICIPALITY
EASTERN CAPE PROVINCE OF SOUTH AFRICA

ADDENDUM TO SECOND FINAL AMENDED EIA REPORT

NEAS REFERENCE: DEA/EIA/0000679/2011
DEA REFERENCE NUMBER: 12/12/20/2523

Prepared for:	Prepared by:
Plan 8 (Pty) Ltd. Infinite Energy	**EOH Coastal & Environmental Services**
100 New Church St Cape Town, 8001	P.O. Box 934 Grahamstown, 6140 *(also in Port Elizabeth, Cape Town, Gauteng & East London)*
South Africa	South Africa

Aoril 2015

TABLE OF CONTENTS

BACKGROUND AND INTRODUCTION

The final Environmental Impact Assessment Report (EIAR) and Environmental Management Programme (EMPr) for the proposed Plan 8 Grahamstown Wind Energy Project were submitted to the Department of Environmental Affairs (DEA) for consideration of environmental authorisation in November 2013. The Department rejected the EIAR on 8th April 2014 (Appendix 1), mainly on the basis that "*a 12-month bird and bat monitoring report is still required by the Department*", although there were also a number of other relatively minor issues to be addressed.

(a) "*A 12 month bird and bat monitoring study should be completed and submitted to the Department,*

(b) *The Department of Communications and SENTEC must be listed as registered Interested and Affected parties. Comments from the Department of Communications and SENTEC must be included in the amended EIAR,*

(c) *The cumulative impact assessment is to be included as part of the amended EIAR, should there be other similar facilities in the region,*

(d) *A shapefile of the preferred development layout/ footprint must be submitted to the Department".*

Item (a): Pre-construction bird and bat monitoring programmes were initiated in early 2014 and were completed in early 2015. All four reports from each of the monitoring programmes are included in this Addendum EIAR as Appendices 2 and 3.

The conclusions and recommendations from the monitoring programmes have been summarised in the Draft Amended EIA Report (CES February 2015), and adjustments to the turbine layout have been proposed to address the issues raised by the avifauna and chiroptera specialists.

Item (b): This above refers to potential interference of the proposed development on telecommunications. EOH CES has, contacted the Department of Communications by e-mail on the 21st July 2014 regarding the development. A response was received from the Department of Telecommunications and Postal Services on the 25th July 2014 indicating that EOH CES should instead correspond with Telkom and Sentech.

Based on their own studies Sentech has indicated that they expect only limited degradation of Sentech transmitted terrestrial UHF/VHF television and /or FM radio services in the planned deployment area and that, based on this, they grant the applicant approval to proceed with the construction of its energy project at the site subject to conditions contained in the letter.

TELKOM also gave conditional approval for the project to proceed, based on its internal study of the turbine layout.

Documents relating to the interactions with these organisations are included in Appendices 4, 5, 6 and 7. SENTECH's July 2014 report *Grahamstown Wind Turbine Generator Interference* is included in the specialist report volume.

Item (c): A comprehensive assessment of the potential cumulative impacts of the facility has been included in Chapter 7 of the Draft Amended EIA Report (CES February 2015), and is not repeated here

Item (d): The shapefiles have been prepared for the project layout described and assessed in the Draft Amended EIA Report (CES February 2015), and will be submitted to the Department with the Report.

APPENDIX 1: DEA REJECTION OF EAIR

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

Private Bag X 447· PRETORIA · 0001· Fedsure Building · 315 Pretorius Street · PRETORIA
Tel (+ 27 12) 310 3911 · Fax (+ 2712) 322 2682

DEA Reference: 12/12/20/2523
Enquiries: Mr Muhammad Essop
Telephone: (012) 395 1734 **Fax:** (012) 320 7539 **E-mail:** MEssop@environment.gov.za

Mr Bill Rowlston
Coastal & Environmental Services (Pty) Ltd
PO Box 934
GRAHAMSTOWN
6140

Telephone Number: (046) 622 2364
Fax Number: (046) 622 6564

PER FACSIMILE / MAIL

Dear Mr Rowlston

REJECTION OF THE AMENDED ENVIRONMENTAL IMPACT ASSESSMENT REPORT FOR THE PROPOSED PLAN 8 GRAHAMSTOWN WIND ENERGY FACILITY, GRAHAMSTOWN, EASTERN CAPE PROVINCE

The amended Environmental Impact Assessment Report (EIAr) dated November 2013 for the abovementioned application, submitted in terms of the requirement of Regulation 34(1) of the Environmental Impact Assessment (EIA) Regulations, 2010 refers.

Following a review of the application form received in October 2011, the EIAr dated August 2012 and the amended EIAr dated November 2013, the Department of Environmental Affairs ("the Department") rejects the amended EIAr in accordance with Regulation 34(2)(b) of the EIA Regulations, 2010. The Department requests that the EIAr be amended to include the following as a matter of urgency:

a) A twelve month bird and bat monitoring study. The Bird and Bat monitoring must be conducted in accordance to the minimum requirements of the best practice guidelines prepared by Bird Life South Africa and the South African Bat Assessment Advisory Panel.
b) The Department of Communications and SENTEC must be listed as registered Interested and Affected Parties. Comments from the Department of Communications and SENTEC must be provided in the amended EIAr.
c) A Cumulative[1] Impact Assessment is required to be part of the amended EIAr, should there be other similar facilities in the region.
d) A shapefile of the preferred development layout/footprint must be submitted to the Department. The shapefile must be created using the Hartebeesthoek 94 Datum and the data should be in Decimal Degree Format using the WGS 84 Spheroid. The shapefile must include at a minimum, the following extensions i.e. .shp; .shx; .dbf; .prj; and, .xml (Metadata file). If specific symbology was assigned to the file, then the .avl and/or the .lyr file must also be included. Data must be mapped at a scale of 1:10 000 (please specify if an alternative scale was used. The metadata must include a description of the base data used for digitising. The shapefile must be submitted in a zip file using the EIA application reference number as the title. The shape file must be submitted to:

[1] ***"cumulative impact"***, in relation to an activity, means the impact of an activity that in itself may not be significant, but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area

Postal Address:
Department of Environmental Affairs
Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Fedsure Forum Building (corner of Pretorius and Lillian Ngoyi Streets)
4th Floor South Tower
315 Pretorius Street
Pretoria
0002

For Attention: Mr Muhammad Essop
Integrated Environmental Authorisations
Strategic Infrastructure Developments
Telephone Number: (012) 395 1734
Fax Number: (012) 320 7539
Email Address: MEssop@environment.gov.za

The reasons for the decision are provided below:

a) Regulation 31(2)(r) of the EIA Regulations, 2010 states that the EIAr must include *any specific information that may be required by the competent authority*. In this regard, the Department requires a 12 month Bird and Bat Monitoring report.
b) Should the Department make a decision on the abovementioned application without the required information, it may be deemed as a premature decision resulting in a high risk of appeal against the decision or possible litigation.
c) In another similar matter, a decision was made on an appeal by the Minister of Water and Environmental Affairs where the Minister clearly indicated that the Department requires the 12 month Bird and Bat Monitoring report as part of the EIA process.
d) The EAP was made aware of the requirements of the Department regarding the Bird and Bat monitoring requirement report. The Department subsequently sent out a letter to all EAP's via its database notifying them prior to the 3rd REIPPP bidding round of this requirement and again at the beginning of this year advising of the 12 month Bird and Bat monitoring report requirement.
e) Please be aware that the Department communicates with the EAP managing the application and not directly with the applicant. As such, all communication will be sent to the EAP and the Department requests that the EAP submits correspondence and information to the Department.

Copies of the amended EIAr must be circulated to all key stakeholders, Organs of State and registered I&AP's for a duration of 40 days for comment. The issues raised by I&AP's must be addressed in a table format indicating the issue/concern raised and the EAP's response thereto and must include copies of the I&AP's correspondence as well as a copy of the Department's rejection letter.

The EAP must provide proof that all registered I&AP's have been notified of the availability of the amended SR.

On receipt of the abovementioned information, the Department will reconsider the report in accordance with Regulation 34(1) of the EIA Regulations, 2010.

2

You are hereby reminded of Section 24F of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended, that no activity may commence prior to an Environmental Authorisation being granted by the Department.

Should you have any queries or wish to discuss the points raised above, please do not hesitate to contact the writer.

Yours faithfully

Mr Ishaam Abader
Deputy Director-General: Legal, Authorisations, Compliance and Enforcement
Department of Environmental Affairs
Date: 8/04/14

cc:	Mr J Cope	Plan8 (Pty) Ltd	Tel: (021) 801 7272	Fax (021) 422 2621

3

APPENDIX 2: BIRD MONITORING PROGRESS REPORTS

Appendix 2a: First Progress Report 19th May 2014

Grahamstown Plan8 Wind Energy Facility

Pre-construction bird monitoring programme

Progress report 1 – submitted to Plan8 Infinite Energy (Pty) Ltd.

19 May 2014

Jon Smallie

WildSkies Ecological Services

Background

Plan8 Infinite Energy (Pty) Ltd (hereafter referred to as Plan8) wish to develop a wind energy facility (WEF) between Grahamstown and Peddie in the Eastern Cape. The facility will consist of up to 27 turbines, associated roads, cables and an electrical substation. The site is split either side of the N2 road, and consists of open grassland on the higher ground and thicket in the valleys.

WildSkies Ecological Services (Pty) Ltd (Jon Smallie) was contracted by Plan8 to conduct pre-construction bird monitoring on the site. This monitoring programme is conducted post the Environmental Impact Assessment, which was conducted in 2012.

This report details the progress and preliminary findings made to date. The intention of this report is to describe the programme and highlight any significant preliminary findings. It is not the intention to provide formal analysis of data at this stage. This formal analysis will be reported on in the final report when all four seasons of monitoring have been completed.

This monitoring programme setup and first site visit (autumn) was completed during April 2014.

1. Programme design and methods

This monitoring programme is conducted in conformance with the "BirdLife South Africa/Endangered Wildlife Trust - Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy developments in Southern Africa" by Jenkins, van Rooyen, Smallie, Anderson & Smit, 2012.

The overall objectives of the pre-construction bird monitoring programme are as follows:

- To establish a bird baseline for the site before construction;
- To characterise bird movement on the site;
- To gain a better understanding of these first two factors

Since the wind energy industry is relatively new in South Africa, and our understanding of the industries' interactions with avifauna is therefore low, these are fairly broad goals to start off with. At a national level, monitoring of birds at WEF's in South Africa aims to develop an understanding of the interactions between birds and WEF's, and to develop means of mitigating impacts where necessary. This will ensure that the wind energy industry remains sustainable into the future.

1.1. Definition of the 'inclusive impact zone' (monitoring study area)

Due to their mobility and the fact that one of the main possible impacts of the wind energy facility, i.e. bird collision with turbine blades, occurs whilst birds are mobile, the zone within which bird activity is relevant to the WEF is potentially far larger than the WEF itself. An important step in designing a monitoring programme is therefore defining this zone. Ideally this zone would encompass the likely range of all bird species likely to be affected by the WEF. However in the case of large birds of prey for example this could be tens of kilometres, and it is not considered feasible to monitor all of this. For the purpose of this study this area was defined as the area within an approximate two kilometre buffer around the proposed turbine positions (see Figure 1).

1.2. Development of a target species list

Determining the target species for this study, i.e. the most important species to be considered, is a three step process. Firstly, existing data on which species occur or could occur in the area at significant abundances, and the importance of the study area for those species is consulted. Secondly, the recent document “A briefing document on best practice for pre-construction assessment of the impacts of onshore wind farms on birds” (Jordan & Smallie, 2010) was consulted to determine which groups of species could possibly be impacted on by wind farms. This document summarises which taxonomic groups of species have been found to be vulnerable to collision with wind turbines in the USA, UK, EU, Australia and Canada. The taxonomic groups that have been found to be vulnerable in two or more of these regions are as follows: Pelicaniformes (pelicans, gannets, cormorants); Ciconiiformes (storks, herons, ibises, spoonbills); Anseriformes (swans, ducks, geese); Falconiformes (birds of prey); Charadriiformes (gulls, terns, waders); Strigiformes (owls); Caprimulgiformes (nightjars); Gruiformes (cranes, bustards, rails); Galliformes (pheasants, grouse, francolins); and Passeriformes (songbirds). In addition to Jordan & Smallie’s summary, the recent document entitled “Avian Wind Farm Sensitivity Map for South Africa: Criteria and procedures used” (Retief, Diamond, Anderson, Smit, Jenkins & Brooks, 2011) classified all bird species in terms of their risk of interaction with wind energy. The methods used by this project (Retief *et al*, 2011) are far more thorough and comprehensive than is possible during the course of a monitoring programme such as this. The third and final step is to consider the species conservation status or other reasons for protecting the species. This involved primarily consulting the Red List bird species (Taylor, 2014) and the IUCN 2013 Red List.

2.3 Frequency of site visits

It was decided at the outset of this programme that 4 site visits should be conducted at this site in the 12 month period. This allows for good coverage of the four seasons to cover any other significant variation or factor that is determined to be relevant.

2.4 Data collection on site

During this programme data will be collected through five primary data collection techniques, described in detail below. The layout of these activities is shown in Figure 1.

2.4.1 Sample counts of small terrestrial species

Although not traditionally the focus of wind farm–bird studies and literature, small terrestrial birds are an important component of this programme. Due to the rarity of many of our threatened bird species, it is anticipated that statistically significant trends in abundance and density may be difficult to observe for these species. More common, similar species could provide early evidence for trends and point towards the need for more detailed future study. Given the large spatial scale of most WEF’s, these smaller species may also be particularly vulnerable to displacement and habitat level effects. Sampling these species is aimed at establishing indices of abundance for small terrestrial birds in the study area. These counts should be done when conditions are optimal. In this case this means the times when birds are most active and vocal, i.e. early mornings. Six walked transects (WT) of approximately 1 kilometre length each were established on the site.

2.4.2 Counts of large terrestrial species and raptors

This is a very similar data collection technique to that above, the aim being to establish indices of abundance for large terrestrial species and raptors. These species are relatively easily detected from a vehicle, hence vehicle based (VT) transects are conducted in order to determine the number of birds of relevant species in the study area. Detection of these large species is less dependent on their activity levels and calls, so these counts can be done later in the day. Four VT's were established on suitable roads in the area, with a total length of approximately 28 kilometres. These transects are each counted once on each site visit. For more detail on exact methods of conducting Vehicle Based transects see Jenkins *et al* (2012).

2.4.3 Focal site surveys

The immediately obvious bird resource areas on this site are the 3 small gorges which have potential breeding habitat for cliff nesting bird species in addition to roosting and perching substrate, and general refugia. These three gorges have been established as Focal Sites 1 to 3. The fourth Focal site is the measuring mast stay wires, where we will survey for collision casualties.

2.4.4 Incidental observations

This monitoring programme comprises a significant amount of field time on site by the observers, much of it spent driving between the above activities. As such it is important to record any other relevant information whilst on site. All other incidental sightings of priority species (and particularly those suggestive of breeding or important feeding or roosting sites or flight paths) within the broader study area will be carefully plotted and documented. Where patterns in these observations are identified this may lead to additional focal site surveys in future.

2.4.5 Direct observation of bird movements

The aim of direct observation is to record bird flight activity on site. An understanding of this flight behaviour will help explain any future interactions between birds and the facility. Spatial patterns in bird flight movement may also be detected, which will allow for input into turbine placement. Direct observation is conducted through counts at two vantage points (VP) in the study area. These VP's provide coverage of a reasonable and representative proportion of the entire study area (total coverage being unnecessary and impractical given resource constraints). VP's were identified using GIS (Geographic Information Systems), and then fine-tuned during the project setup, based on access and other information. Since these VP's aim at capturing both usage and behavioural data, they were positioned mostly on high ground to maximise visibility. The survey radius for VP counts is 2 kilometres. VP counts are conducted by two observers, seated at the VP and taking care not to make their presence so obvious as to effect bird behaviour. Birds are recorded 360° around observers. Data should be collected during representative conditions, so the sessions are spread throughout the day, with each VP being counted over 'early to mid-morning', 'mid to late morning', 'early to mid-afternoon', and 'mid-afternoon to evening'. Each session is 3 hours long, resulting in a total of 12 hours of observation being conducted at each vantage point on each site visit. Three hours is believed to be towards the upper limit of observer concentration span, whilst also maximising duration of data capture relative to travel time required in order to gain access to the VP's. A maximum of two VP sessions are conducted per day, to avoid observer fatigue compromising data quality. For more detail on exact criteria recorded for each flying bird observed, see Jenkins *et al* (2012).

One of the most important attributes of any bird flight event is its height above ground, since this will determine its risk of collision with turbine blades. Since it is possible that the turbine model (and hence the exact height of the rotor swept zone) could still change on this project, actual flight height is estimated rather than assigning flight height to broad bands (such as proposed by Jenkins *et al* 2012). This 'raw' data will allow flexibility in assigning to classes later on depending on final turbine specifications.

2.5 Control site

A suitable control site has been identified approximately 5 kilometres south-east of the main site. This site was chosen as it is one of the few areas at comparable altitude and with similar open plateau grassland to the main site. One vantage point and three walked transects have been established on the control site.

For a full explanation of the data capture methods above, see Jenkins *et al* (2012). The layout of the above activities are shown in Figure 1.

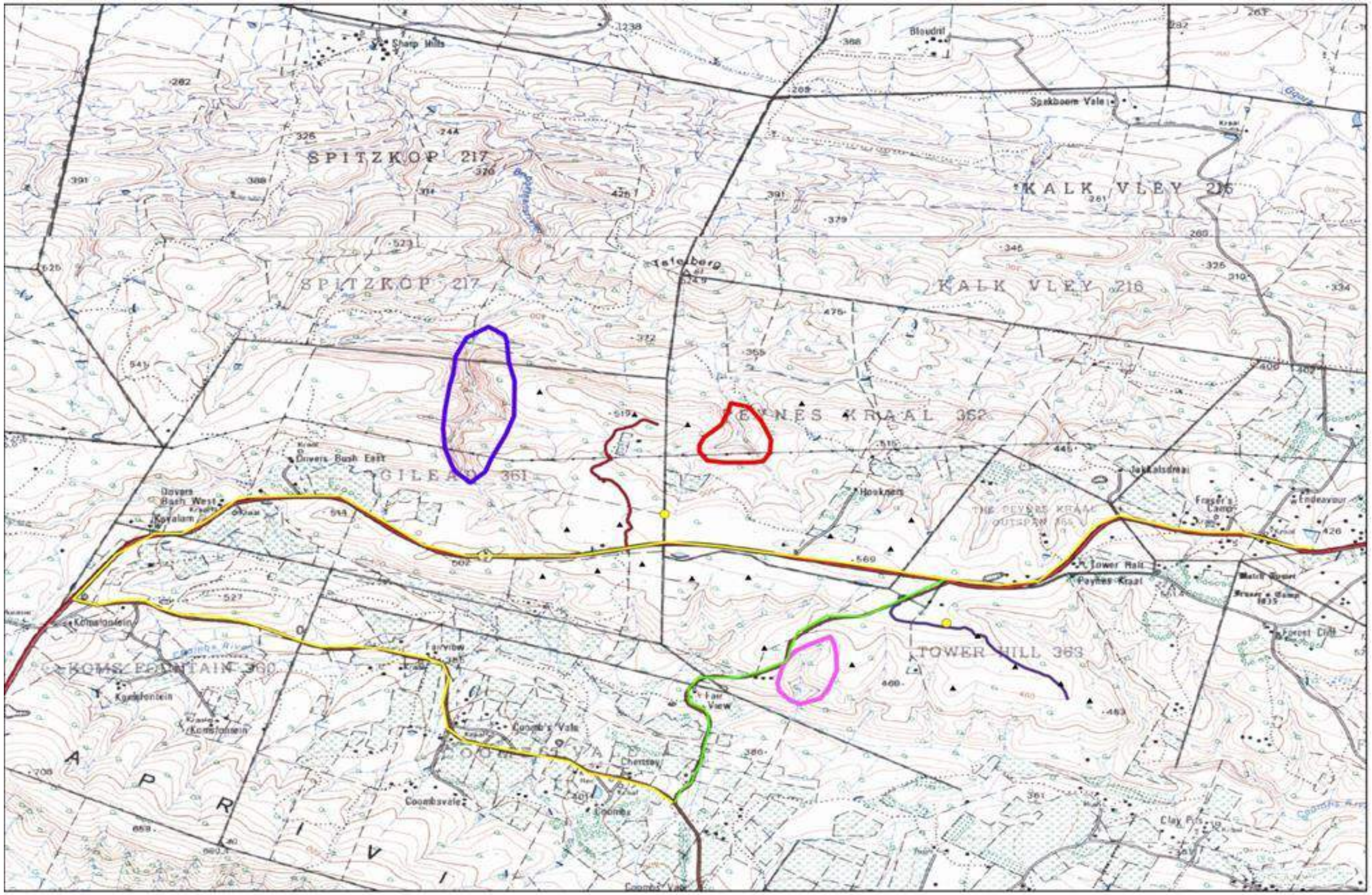


Figure 1. The layout of the pre-construction bird monitoring activities on the Grahamstown Plan8 Wind Energy Facility site. Yellow points indicate vantage point positions, coloured lines indicate vehicle transects, and polygons indicate focal points.

2. Findings to date

3.1 Target species

Up to approximately 229 bird species could occur on site, based on what has been recorded in the broader area by the first and second bird atlas projects (Harrison *et al*, 1997; www.sabap2.adu.org.za). Thirteen of these species are Red Listed (Taylor, 2014). Of these bird species, the following have been selected as the 'target species' for this study, i.e. those species for which there is special concern related to the proposed WEF: African Crowned Eagle *Stephanoaetus coronatus;* African Fish-Eagle *Haliaeetus vocifer;* African Harrier-Hawk *Polyboroides typus;* African Marsh-Harrier *Circus ranivorus;* Black Harrier *Circus maurus;* Black Stork *Ciconia nigra;* Black-shouldered Kite *Elanus caeruleus;* Black-winged Lapwing *Vanellus melanopterus;* Booted Eagle *Aquila pennatus;* Common Buzzard *Buteo vulpinus;* Denham's Bustard *Neotis denhami;* Jackal Buzzard *Buteo rufofuscus;* Lanner Falcon *Falco biarmicus;* Martial Eagle *Polemaetus bellicosus;* Peregrine Falcon *Falco peregrinus*; Rock Kestrel *Falco rupicolus*; Secretarybird *Sagittarius serpentarius;* Verreaux's Eagle *Aquila verreauxii;* White Stork *Ciconia ciconia;* White-bellied Korhaan *Eupodotis senegalensis;* Black Kite *Milvus migrans;* and. These are the species which we expect to occur on the site and be particularly susceptible to impacts associated with the proposed facility. This programme will investigate the importance of the site for these species and any others identified as important during the course of the programme. To date, the most important of these appears to be the Rock Kestrel, Peregrine Falcon and Jackal Buzzard. These species will be discussed in more detail as this programme collects more data.

Table 1. Preliminary target bird species for the Grahamstown Plan8 Wind Energy Facility site.

Common name	Species name	Taylor 2014	IUCN 2013	Preferred micro habitat	Theoretical interactions with facility
African Crowned Eagle	*Stephanoaetus coronatus*	VU	NT	Indigenous forest, gorges	Collision, disturbance if breeding nearby
African Fish-Eagle	*Haliaeetus vocifer*			Open water sources	Collision, disturbance if breeding nearby
African Harrier-Hawk	*Polyboroides typus*.			Generalist	Collision
African Marsh-Harrier	*Circus ranivorus*	EN	LC	Grassland, wetland	Collision, disturbance, habitat destruction
Black Harrier	*Circus maurus*	EN	VU	Grassland, wetland, Fynbos	Collision, disturbance, habitat destruction
Black (Yellow-billed) Kite	*Milvus migrans*			Generalist	Collision
Black Stork	*Ciconia nigra*	VU	LC	Riverine, cliffs	Collision
Black-shouldered Kite	*Elanus caeruleus*			Generalist	Collision
Black-winged Lapwing	*Vanellus melanopterus*			Short grassland	Collision
Booted Eagle	*Aquila pennatus*			Generalist	Collision, disturbance, habitat destruction
Common (Steppe) Buzzard	*Buteo buteo*			Generalist	Collision
Denham's Bustard	*Neotis denhamii*	VU	NT	Grassland	Collision, disturbance, habitat destruction
Jackal Buzzard	*Buteo rufofuscus*			Generalist	Collision, disturbance, habitat destruction
Lanner Falcon	*Falco biarmicus*	VU	LC	Generalist, open vegetation, cliffs	Collision
Martial Eagle	*Polemaetus bellicosus*	EN	VU	Woodland	Collision, disturbance, habitat destruction, electrocution on power lines
Rock Kestrel	*Falco rupicolus*			Generalist	Collision
Peregrine Falcon	*Falco peregrinus*			Open habitat, cliffs	Collision, disturbance if breeding
Secretarybird	*Sagittarius serpentarius*	VU	VU	Grassland, open woodland	Collision, disturbance, habitat destruction
Verreaux's Eagle	*Aquila verreauxi*	VU	LC	Mountainous rocky areas	Collision, disturbance, habitat destruction, electrocution on power lines
White-bellied Korhaan	*Eupodotis senegalensis*	VU	LC	Grassland	Collision
White Stork	*Ciconia ciconia*	BONN		Arable, grassland, wetland, dams	Collision

EN = Endangered; VU = Vulnerable; NT = Near-threatened; LC = Least concern.

3.2 Sample counts of small terrestrial species

During the first site visit a total of 50 bird species were recorded on the walked transects. None of these species are Red Listed. The only target species recorded was Rock Kestrel. The most commonly recorded species were: Cape Glossy Starling; Speckled Mousebird; Cape Turtle Dove; and Cape Sparrow.

3.3 Counts of large terrestrial species and raptors

A total of four target bird species were recorded using this method: Jackal Buzzard; Long-crested Eagle; Peregrine Falcon; and Rock Kestrel. The most frequently recorded species was Jackal Buzzard.

3.4 Incidental observations

Five target bird species were recorded during the course of the summer site visit: the Jackal Buzzard; African Harrier-Hawk; Black-shouldered Kite; Peregrine Falcon; and Rock Kestrel. Once again the most frequently recorded of these species was Jackal Buzzard.

3.5 Focal sites

Three focal site areas were surveyed during the first site visit, the fourth being inaccessible due to poor weather. At Focal Site 1 a large stick nest was recorded on the cliff (see Figure 2). This is likely to belong to a raptor or possibly a Black Stork, but no birds were in attendance at the time. This situation will be monitored on future site visits. At Focal Site 2 a stick nest was again recorded with no birds present (see Figure 3). The nest did not appear to be recently used. Two Rock Kestrels were observed in this area, but the nest is too large to be theirs. No stay wire collision casualties were recorded at the measuring mast.

Figure 2. Large nest at Focal Site 1.

Figure 3. Large nest at Focal Site 2.

3.6 Direct observation of bird movements

In total 5 target bird species were recorded flying on site. Most frequently recorded was Rock Kestrel, closely followed by Jackal Buzzard. Peregrine Falcon and Black Harrier were recorded flying multiple times, and Booted Eagle was recorded once. It is too early to detect any spatial patterns in this flight activity.

3.7 Site sensitivity and project constraints

At this early stage the only sensitive features detected are the focal site areas shown in Figure 1, where the potential exists for sensitive cliff nesting species to breed, and old nests have been found. The first site visit was a little early in the season for many of these species to be actively breeding. These areas will be visited again in the winter site visit during prime breeding season.

3. Conclusion

This programme has started well and the first site visit went relatively smoothly, with the exception of some weather interruptions. Several target bird species have been recorded flying on site to date, and with time we will be able to estimate how much collision risk these species will face once turbines are constructed. Three key small gorges on the periphery of the site have been found and initial investigations made. These areas will be visited and surveyed again on each site visit in order to determine whether any sensitive bird species are using these areas for breeding or other purposes.

These should be considered preliminary findings and will be refined, added to or overruled based on additional data still to be collected on site. The next site visit will be in approximately July 2014. Thereafter a spring site visit will be conducted in the period 1 September to 30 October, and a summer visit between 1 November and 30 January 2015.

4. References

Jenkins, A.R., van Rooyen, C., Smallie, J., Anderson, M.D. & Smit, H. 2012. Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy developments in Southern Africa". Unpublished Endangered Wildlife Trust and BirdLife South Africa document.

Jordan, M., & Smallie, J. 2010. A briefing document on best practice for pre-construction assessment of the impacts of onshore wind farms on birds. Endangered Wildlife Trust , Unpublished report

Retief, E, Anderson, M., Diamond, M., Smit, H., Jenkins, A. & Brooks, M. 2011. Avian Wind Farm Sensitivity Map for South Africa: Criteria and Procedures used.

Taylor, M. (ed). 2014. The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. BirdLife South Africa, Johannesburg. In press.

www.iucnredlist.org. Accessed November 2013

Appendix 2b: Second Progress Report 14th August 2014

Grahamstown Plan8 Wind Energy Facility

Pre-construction bird monitoring programme

Progress report 2 – submitted to Plan8 Infinite Energy (Pty) Ltd.

14 August 2014

Jon Smallie
WildSkies Ecological Service
s

1. Background

Plan8 Infinite Energy (Pty) Ltd (hereafter referred to as Plan8) wish to develop a wind energy facility (WEF) between Grahamstown and Peddie in the Eastern Cape. The facility will consist of up to 27 turbines, associated roads, cables and an electrical substation. The site is split either side of the N2 road, and consists of open grassland on the higher ground and thicket in the valleys.

WildSkies Ecological Services (Pty) Ltd (Jon Smallie) was contracted by Plan8 to conduct pre-construction bird monitoring on the site. This monitoring programme is conducted post the Environmental Impact Assessment, which was conducted in 2012.

This report details the progress and preliminary findings made to date. The intention of this report is to describe the programme and highlight any significant preliminary findings. It is not the intention to provide formal analysis of data at this stage. This formal analysis will be reported on in the final report when all four seasons of monitoring have been completed.

This monitoring programme setup and first site visit (autumn) was completed during April 2014, and the second site visit (winter) was completed in early August 2014.

2. Programme design and methods

This monitoring programme is conducted in conformance with the "BirdLife South Africa/Endangered Wildlife Trust - Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy developments in Southern Africa" by Jenkins, van Rooyen, Smallie, Anderson & Smit, 2012.

The overall objectives of the pre-construction bird monitoring programme are as follows:

- To establish a bird baseline for the site before construction;
- To characterise bird movement on the site;
- To gain a better understanding of these first two factors

Since the wind energy industry is relatively new in South Africa, and our understanding of the industries' interactions with avifauna is therefore low, these are fairly broad goals to start off with. At a national level, monitoring of birds at WEF's in South Africa aims to develop an understanding of the interactions between birds and WEF's, and to develop means of mitigating impacts where necessary. This will ensure that the wind energy industry remains sustainable into the future.

2.1. Definition of the 'inclusive impact zone' (monitoring study area)

Due to their mobility and the fact that one of the main possible impacts of the wind energy facility, i.e. bird collision with turbine blades, occurs whilst birds are mobile, the zone within which bird activity is relevant to the WEF is potentially far larger than the WEF itself. An important step in designing a monitoring programme is therefore defining this zone. Ideally this zone would encompass the likely range of all bird species likely to be affected by the WEF. However in the case of large birds of prey for example this could be tens of kilometres, and it is not considered feasible to monitor all of this. For the purpose of this study this area was defined as the area within an approximate two kilometre buffer around the proposed turbine positions (see Figure 1).

2.2. Development of a target species list

Determining the target species for this study, i.e. the most important species to be considered, is a three step process. Firstly, existing data on which species occur or could occur in the area at significant abundances, and the importance of the study area for those species is consulted. Secondly, the recent document "A briefing document on best practice for pre-construction assessment of the impacts of onshore wind farms on birds" (Jordan & Smallie, 2010) was consulted to determine which groups of species could possibly be impacted on by wind farms. This document summarises which taxonomic groups of species have been found to be vulnerable to collision with wind turbines in the USA, UK, EU, Australia and Canada. The taxonomic groups that have been found to be vulnerable in two or more of these regions are as follows: Pelicaniformes (pelicans, gannets, cormorants); Ciconiiformes (storks, herons, ibises, spoonbills); Anseriformes (swans, ducks, geese); Falconiformes (birds of prey); Charadriiformes (gulls, terns, waders); Strigiformes (owls); Caprimulgiformes (nightjars); Gruiformes (cranes, bustards, rails); Galliformes (pheasants, grouse, francolins); and Passeriformes (songbirds). In addition to Jordan & Smallie's summary, the recent document entitled "Avian Wind Farm Sensitivity Map for South Africa: Criteria and procedures used" (Retief, Diamond, Anderson, Smit, Jenkins & Brooks, 2011) classified all bird species in terms of their risk of interaction with wind energy. The methods used by this project (Retief *et al*, 2011) are far more thorough and comprehensive than is possible during the course of a monitoring programme such as this. The third and final step is to consider the species conservation status or other reasons for protecting the species. This involved primarily consulting the Red List bird species (Taylor, 2014) and the IUCN 2013 Red List.

2.3 Frequency of site visits

It was decided at the outset of this programme that 4 site visits should be conducted at this site in the 12 month period. This allows for good coverage of the four seasons to cover any other significant variation or factor that is determined to be relevant.

2.4 Data collection on site

During this programme data will be collected through five primary data collection techniques, described in detail below. The layout of these activities is shown in Figure 1.

2.4.1 Sample counts of small terrestrial species

Although not traditionally the focus of wind farm–bird studies and literature, small terrestrial birds are an important component of this programme. Due to the rarity of many of our threatened bird species, it is anticipated that statistically significant trends in abundance and density may be difficult to observe for these species. More common, similar species could provide early evidence for trends and point towards the need for more detailed future study. Given the large spatial scale of most WEF's, these smaller species may also be particularly vulnerable to displacement and habitat level effects. Sampling these species is aimed at establishing indices of abundance for small terrestrial birds in the study area. These counts should be done when conditions are optimal. In this case this means the times when birds are most active and vocal, i.e. early mornings. Six walked transects (WT) of approximately 1 kilometre length each were established on the site.

2.4.2 Counts of large terrestrial species and raptors

This is a very similar data collection technique to that above, the aim being to establish indices of abundance for large terrestrial species and raptors. These species are relatively easily detected from a vehicle, hence vehicle based (VT) transects are conducted in order to determine the number of birds of relevant species in the study area. Detection of these large species is less dependent on their activity levels and calls, so these counts can be done later in the day. Four VT's were established on suitable roads in the area, with a total length of approximately 28 kilometres. These transects are each counted once on each site visit. For more detail on exact methods of conducting Vehicle Based transects see Jenkins *et al* (2012).

2.4.3 Focal site surveys

The immediately obvious bird resource areas on this site are the 3 small gorges which have potential breeding habitat for cliff nesting bird species in addition to roosting and perching substrate, and general refugia. These three gorges have been established as Focal Sites 1 to 3. The fourth Focal site is the measuring mast stay wires, where we will survey for collision casualties.

2.4.4 Incidental observations

This monitoring programme comprises a significant amount of field time on site by the observers, much of it spent driving between the above activities. As such it is important to record any other relevant information whilst on site. All other incidental sightings of priority species (and particularly those suggestive of breeding or important feeding or roosting sites or flight paths) within the broader study area will be carefully plotted and documented. Where patterns in these observations are identified this may lead to additional focal site surveys in future.

2.4.5 Direct observation of bird movements

The aim of direct observation is to record bird flight activity on site. An understanding of this flight behaviour will help explain any future interactions between birds and the facility. Spatial patterns in bird flight movement may also be detected, which will allow for input into turbine placement. Direct observation is conducted through counts at two vantage points (VP) in the study area. These VP's provide coverage of a reasonable and representative proportion of the entire study area (total coverage being unnecessary and impractical given resource constraints). VP's were identified using GIS (Geographic Information Systems), and then fine-tuned during the project setup, based on access and other information. Since these VP's aim at capturing both usage and behavioural data, they were positioned mostly on high ground to maximise visibility. The survey radius for VP counts is 2 kilometres. VP counts are conducted by two observers, seated at the VP and taking care not to make their presence so obvious as to effect bird behaviour. Birds are recorded 360° around observers. Data should be collected during representative conditions, so the sessions are spread throughout the day, with each VP being counted over 'early to mid-morning', 'mid to late morning', 'early to mid-afternoon', and 'mid- afternoon to evening'. Each session is 3 hours long, resulting in a total of 12 hours of observation being conducted at each vantage point on each site visit. Three hours is believed to be towards the upper limit of observer concentration span, whilst also maximising duration of data capture relative to travel time required in order to gain access to the VP's. A maximum of two VP sessions are conducted per day, to avoid observer fatigue compromising data quality. For more detail on exact criteria recorded for each flying bird observed, see Jenkins *et al* (2012).

One of the most important attributes of any bird flight event is its height above ground, since this will determine its risk of collision with turbine blades. Since it is possible that the turbine model (and hence the exact height of the rotor swept zone) could still change on this project, actual flight height is estimated rather than assigning flight height to broad bands (such as proposed by Jenkins *et al* 2012). This 'raw' data will allow flexibility in assigning to classes later on depending on final turbine specifications.

2.5 Control site

A suitable control site has been identified approximately 5 kilometres south-east of the main site. This site was chosen as it is one of the few areas at comparable altitude and with similar open plateau grassland to the main site. One vantage point and three walked transects have been established on the control site. For a full explanation of the data capture methods above, see Jenkins *et al* (2012). The layout of the above activities is shown in Figure 1

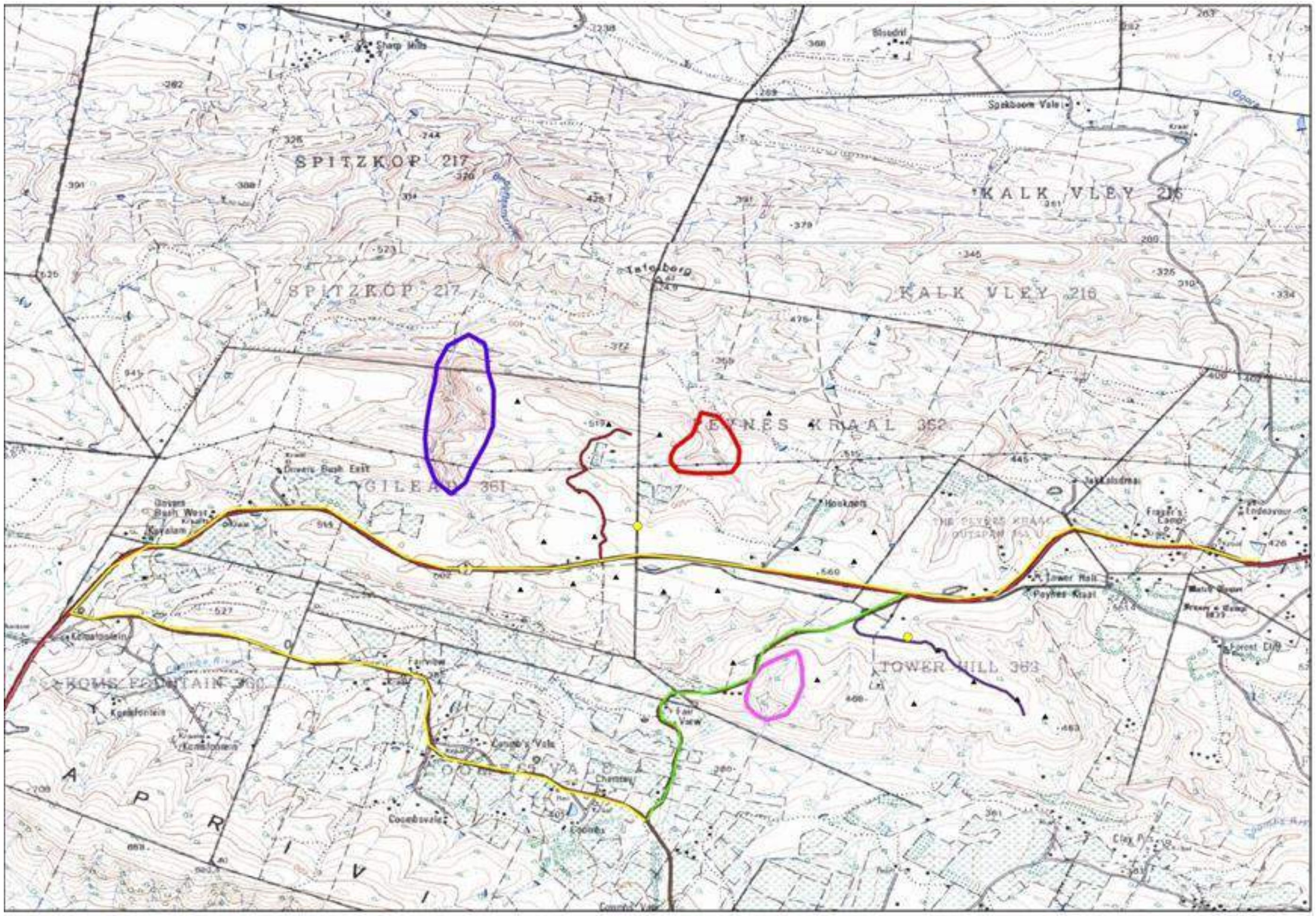


Figure 1. The layout of the pre-construction bird monitoring activities on the Grahamstown Plan8 Wind Energy Facility site. Yellow points indicate vantage point positions, coloured lines indicate vehicle transects, and polygons indicate focal points.

3. Findings to date

3.1 Target species

Up to approximately 229 bird species could occur on site, based on what has been recorded in the broader area by the first and second bird atlas projects (Harrison *et al*, 1997; www.sabap2.adu.org.za). Thirteen of these species are Red Listed (Taylor, 2014). Of these bird species, the following have been selected as the

'target species' for this study, i.e. those species for which there is special concern related to the proposed WEF: African Crowned Eagle *Stephanoaetus coronatus;* African Fish-Eagle *Haliaeetus vocifer;* African Harrier- Hawk *Polyboroides typus;* African Marsh-Harrier *Circus ranivorus;* Black Harrier *Circus maurus;* Black Stork *Ciconia nigra;* Black-shouldered Kite *Elanus caeruleus;* Black-winged Lapwing *Vanellus melanopterus;* Booted Eagle *Aquila pennatus;* Common Buzzard *Buteo vulpinus;* Denham's Bustard *Neotis denhami;* Jackal Buzzard *Buteo rufofuscus;* Lanner Falcon *Falco biarmicus;* Martial Eagle *Polemaetus bellicosus;* Peregrine Falcon *Falco peregrinus*; Rock Kestrel *Falco rupicolus*; Secretarybird *Sagittarius serpentarius;* Verreaux's Eagle *Aquila verreauxii;* White Stork *Ciconia ciconia;* White-bellied Korhaan *Eupodotis senegalensis;* Black Kite *Milvus migrans;* and. These are the species which we expect to occur on the site and be particularly susceptible to impacts associated with the proposed facility. This programme will investigate the importance of the site for these species and any others identified as important during the course of the programme. Based on the first two site visits, the most important of these species appear to be the Rock Kestrel and Jackal Buzzard. These

species will be discussed in more detail as this programme collects more data.

Table 1. Preliminary target bird species for the Grahamstown Plan8 Wind Energy Facility site.

Common name	Species name	Taylor 2014	IUCN 2013	Preferred micro habitat	Theoretical interactions with facility
African Crowned Eagle	*Stephanoaetus coronatus*	VU	NT	Indigenous forest, gorges	Collision, disturbance if breeding nearby
African Fish-Eagle	*Haliaeetus vocifer*			Open water sources	Collision, disturbance if breeding nearby
African Harrier-Hawk	*Polyboroides typus*.			Generalist	Collision
African Marsh-Harrier	*Circus ranivorus*	EN	LC	Grassland, wetland	Collision, disturbance, habitat destruction
Black Harrier	*Circus maurus*	EN	VU	Grassland, wetland, Fynbos	Collision, disturbance, habitat destruction
Black (Yellow-billed) Kite	*Milvus migrans*			Generalist	Collision
Black Stork	*Ciconia nigra*	VU	LC	Riverine, cliffs	Collision
Black-shouldered Kite	*Elanus caeruleus*			Generalist	Collision
Black-winged Lapwing	*Vanellus melanopterus*			Short grassland	Collision
Booted Eagle	*Aquila pennatus*			Generalist	Collision, disturbance, habitat destruction
Common (Steppe) Buzzard	*Buteo buteo*			Generalist	Collision
Denham's Bustard	*Neotis denhamii*	VU	NT	Grassland	Collision, disturbance, habitat destruction
Jackal Buzzard	*Buteo rufofuscus*			Generalist	Collision, disturbance, habitat destruction
Lanner Falcon	*Falco biarmicus*	VU	LC	Generalist, open vegetation, cliffs	Collision
Martial Eagle	*Polemaetus bellicosus*	EN	VU	Woodland	Collision, disturbance, habitat destruction, electrocution on power lines
Rock Kestrel	*Falco rupicolus*			Generalist	Collision
Peregrine Falcon	*Falco peregrinus*			Open habitat, cliffs	Collision, disturbance if breeding
Secretarybird	*Sagittarius serpentarius*	VU	VU	Grassland, open woodland	Collision, disturbance, habitat destruction
Verreaux's Eagle	*Aquila verreauxi*	VU	LC	Mountainous rocky areas	Collision, disturbance, habitat destruction, electrocution on power lines
White-bellied Korhaan	*Eupodotis senegalensis*	VU	LC	Grassland	Collision
White Stork	*Ciconia ciconia*	BONN		Arable, grassland, wetland, dams	Collision

EN = Endangered; VU = Vulnerable; NT = Near-threatened; LC = Least concern.

3.2 Sample counts of small terrestrial species

During the first site visit a total of 50 bird species were recorded on the walked transects. None of these species are Red Listed. The only target species recorded was Rock Kestrel. The most commonly recorded species were: Cape Glossy Starling; Speckled Mousebird; Cape Turtle Dove; and Cape Sparrow. During the second site visit (winter) 58 bird species were recorded. The most frequently recorded species were Dark- capped Bulbul, Cape Glossy Starling and Rufous-naped Lark. Only one Red Listed species was recorded, the White-bellied Korhaan, with one single bird being seen.

3.3 Counts of large terrestrial species and raptors

During autumn, a total of four target bird species were recorded using this method: Jackal Buzzard; Long- crested Eagle; Peregrine Falcon; and Rock Kestrel. The most frequently recorded species was Jackal Buzzard. During winter only two target bird species were recorded by this method, the Jackal Buzzard and Rock Kestrel. This consisted of two records of single Rock Kestrels and one record of a pair of Jackal Buzzards.

3.4 Incidental observations

Five target bird species were recorded during the course of the summer site visit: the Jackal Buzzard; African Harrier-Hawk; Black-shouldered Kite; Peregrine Falcon; and Rock Kestrel. Once again the most frequently recorded of these species was Jackal Buzzard. During winter only one target bird species was recorded as incidental observations. Jackal Buzzard was recorded 5 times, in each case a single bird.

3.5 Focal sites

Three focal site areas were surveyed during the first site visit, the fourth being inaccessible due to poor weather. At Focal Site 1 a large stick nest was recorded on the cliff (see Figure 1). This is likely to belong to a raptor or possibly a Black Stork, but no birds were in attendance at the time. This situation will be monitored on future site visits. At Focal Site 2 a stick nest was again recorded with no birds present (see Figure 1). The nest did not appear to be recently used. Two Rock Kestrels were observed in this area, but the nest is too large to be theirs. No stay wire collision casualties were recorded at the measuring mast.

3.6 Direct observation of bird movements

During the winter site visit, Focal sites 2 and 3 (see Figure 1) revealed no significant sightings. At Focal Site 1 a Rock Kestrel and a Booted Eagle were seen flying in the gorge. The landowner at Focal Site 1 also reported a Verreaux's Eagle nest site in the gorge but difficult access prevented our team from confirming this. Given that no Verreaux's Eagles have been seen on site during this programme at all, it seems possible that this nest is no longer active. This will be investigated further in the coming season.

During autumn, in total 5 target bird species were recorded flying on site. Most frequently recorded was Rock Kestrel, closely followed by Jackal Buzzard. Peregrine Falcon and Black Harrier were recorded flying multiple times, and Booted Eagle was recorded once. It is too early to detect any spatial patterns in this flight activity.

During winter, three target bird species were recorded flying on site: the Rock Kestrel; Jackal Buzzard; and African Fish-Eagle. The Rock Kestrel and Jackal Buzzard were by far the most frequent fliers, with the African Fish Eagle being recorded only on one day.

3.7 Site sensitivity and project constraints

At this early stage the only sensitive features detected are the focal site areas shown in Figure 1, where the potential exists for sensitive cliff nesting species to breed, and old nests have been found. The first site visit was a little early in the season for many of these species to be actively breeding. The second site visit has included a survey of these areas again. Focal Sites 2 and 3 have revealed no suspected breeding of sensitive species. At Focal Site 1, although the team did not find any breeding target species, the landowner did report a pair of Verreaux's Eagle. Unfortunately this was too far down the gorge to be easily accessed on this site visit. This breeding site therefore remains un-confirmed and will be revisited on the next site visit. It must be emphasised thatno Verreaux's Eagles have been recorded on the site yet by any data collection means, which suggests that this nest may no longer be active, as we would have expected to see the birds on site. If such a breeding site exists, the likely mitigation approach would be to identify a suitable size buffer around the nest, within which no turbines should be built. At this stage it appears that only one proposed turbine position could be at risk (approximately 1 kilometre from the nest), although it must be repeated that this breeding site still requires confirmation.

4 Conclusion

This programme has started well and the first two site visits went relatively smoothly, with the exception of some weather interruptions. Several target bird species have been recorded flying on site to date, and with time we will be able to estimate how much collision risk these species will face once turbines are constructed. Three key small gorges on the periphery of the site have been found and initial investigations made.

These should be considered preliminary findings and will be refined, added to or overruled based on additional data still to be collected on site. The next site visit will be in approximately September 2014.

5 References

Jenkins, A.R., van Rooyen, C., Smallie, J., Anderson, M.D. & Smit, H. 2012. Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy developments in Southern Africa". Unpublished Endangered Wildlife Trust and BirdLife South Africa document.

Jordan, M., & Smallie, J. 2010. A briefing document on best practice for pre-construction assessment of the impacts of onshore wind farms on birds. Endangered Wildlife Trust , Unpublished report

Retief, E, Anderson, M., Diamond, M., Smit, H., Jenkins, A. & Brooks, M. 2011. Avian Wind Farm Sensitivity Map for South Africa: Criteria and Procedures used.

Taylor, M. (ed). 2014. The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. BirdLife South Africa, Johannesburg. In press. www.iucnredlist.org. Accessed November 2013

Appendix 2c: Third Progress Report 14th November 2014

Grahamstown Plan8 Wind Energy Facility

Pre-construction bird monitoring programme

Progress report 3 – submitted to Plan8 Infinite Energy (Pty) Ltd.

14 November 2014

WildSkies ecological services

Jon Smallie
WildSkies Ecological Services

1. Background

Plan8 Infinite Energy (Pty) Ltd (hereafter referred to as Plan8) wish to develop a wind energy facility (WEF) between Grahamstown and Peddie in the Eastern Cape. The facility will consist of up to 27 turbines, associated roads, cables and an electrical substation. The site is split either side of the N2 road, and consists of open grassland on the higher ground and thicket in the valleys.

WildSkies Ecological Services (Pty) Ltd (Jon Smallie) was contracted by Plan8 to conduct pre-construction bird monitoring on the site. This monitoring programme is conducted post the Environmental Impact Assessment, which was conducted in 2012.

This report details the progress and preliminary findings made to date. The intention of this report is to describe the programme and highlight any significant preliminary findings. It is not the intention to provide formal analysis of data at this stage. This formal analysis will be reported on in the final report when all four seasons of monitoring have been completed.

This monitoring programme setup and first site visit (autumn) was completed during April 2014, the second site visit (winter) was completed in early August 2014, and the third (spring) in early November 2014.

2. Programme design and methods

This monitoring programme is conducted in conformance with the "BirdLife South Africa/Endangered Wildlife Trust - Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy developments in Southern Africa" by Jenkins, van Rooyen, Smallie, Anderson & Smit, 2012.

The overall objectives of the pre-construction bird monitoring programme are as follows:

> To establish a bird baseline for the site before construction;
> To characterise bird movement on the site;
> To gain a better understanding of these first two factors

Since the wind energy industry is relatively new in South Africa, and our understanding of the industries' interactions with avifauna is therefore low, these are fairly broad goals to start off with. At a national level, monitoring of birds at WEF's in South Africa aims to develop an understanding of the interactions between birds and WEF's, and to develop means of mitigating impacts where necessary. This will ensure that the wind energy industry remains sustainable into the future.

2.1. Definition of the 'indusive impact zone' (monitoring study area)

Due to their mobility and the fact that one of the main possible impacts of the wind energy facility, i.e. bird collision with turbine blades, occurs whilst birds are mobile, the zone within which bird activity is relevant to the WEF is potentially far larger than the WEF itself. An important step in designing a monitoring programme is therefore defining this zone. Ideally this zone would encompass the likely range of all bird species likely to be affected by the WEF. However in the case of large birds of prey for example this could be tens of kilometres, and it is not considered feasible to monitor all of this. For the purpose of this study this area was defined as the area within an approximate two kilometre buffer around the proposed turbine positions (see Figure 1).

2.2. Development of a target species list

Determining the target species for this study, i.e. the most important species to be considered, is a three step process. Firstly, existing data on which species occur or could occur in the area at significant abundances, and the importance of the study area for those species is consulted. Secondly, the recent document "A briefing document on best practice for pre-construction assessment of the impacts of onshore wind farms on birds" (Jordan & Smallie, 2010) was consulted to determine which groups of species could possibly be impacted on by wind farms. This document summarises which taxonomic groups of species have been found to be vulnerable to collision with wind turbines in the USA, UK, EU, Australia and Canada. The taxonomic groups that have been found to be vulnerable in two or more of these regions are as follows: Pelicaniformes (pelicans, gannets, cormorants); Ciconiiformes (storks, herons, ibises, spoonbills); Anseriformes (swans, ducks, geese); Falconiformes (birds of prey); Charadriiformes (gulls, terns, waders); Strigiformes (owls); Caprimulgiformes (nightjars); Gruiformes (cranes, bustards, rails); Galliformes (pheasants, grouse, francolins); and Passeriformes (songbirds). In addition to Jordan & Smallie's summary, the recent document entitled "Avian Wind Farm Sensitivity Map for South Africa: Criteria and procedures used" (Retief, Diamond, Anderson, Smit, Jenkins & Brooks, 2011) classified all bird species in terms of their risk of interaction with wind energy. The methods used by this project (Retief *et al*, 2011) are far more thorough and comprehensive than is possible during the course of a monitoring programme such as this. The third and final step is to consider the species conservation status or other reasons for protecting the species. This involved primarily consulting the Red List bird species (Taylor, 2014) and the IUCN 2013 Red List.

2.3 Frequency of site visits

It was decided at the outset of this programme that 4 site visits should be conducted at this site in the 12 month period. This allows for good coverage of the four seasons to cover any other significant variation or factor that is determined to be relevant.

2.4 Data collection on site

During this programme data will be collected through five primary data collection techniques, described in detail below. The layout of these activities is shown in Figure 1.

2.4.1 Sample counts of small terrestrial species

Although not traditionally the focus of wind farm–bird studies and literature, small terrestrial birds are an important component of this programme. Due to the rarity of many of our threatened bird species, it is anticipated that statistically significant trends in abundance and density may be difficult to observe for these species. More common, similar species could provide early evidence for trends and point towards the need for more detailed future study. Given the large spatial scale of most WEF's, these smaller species may also be particularly vulnerable to displacement and habitat level effects. Sampling these species is aimed at establishing indices of abundance for small terrestrial birds in the study area. These counts should be done when conditions are optimal. In this case this means the times when birds are most active and vocal, i.e. early mornings. Six walked transects (WT) of approximately 1 kilometre length each were established on the site.

2.4.2 Counts of large terrestrial species and raptors

This is a very similar data collection technique to that above, the aim being to establish indices of abundance for large terrestrial species and raptors. These species are relatively easily detected from a vehicle, hence vehicle based (VT) transects are conducted in order to determine the number of birds of relevant species in the study area. Detection of these large species is less dependent on their activity levels and calls, so these counts can be done later in the day. Four VT's were established on suitable roads in the area, with a total length of approximately 28 kilometres. These transects are each counted once on each site visit. For more detail on exact methods of conducting Vehicle Based transects see Jenkins *et al* (2012).

2.4.3 Focal site surveys

The immediately obvious bird resource areas on this site are the 3 small gorges which have potential breeding habitat for cliff nesting bird species in addition to roosting and perching substrate, and general refugia. These three gorges have been established as Focal Sites 1 to 3. The fourth Focal site is the measuring mast stay wires, where we will survey for collision casualties.

2.4.4 Incidental observations

This monitoring programme comprises a significant amount of field time on site by the observers, much of it spent driving between the above activities. As such it is important to record any other relevant information whilst on site. All other incidental sightings of priority species (and particularly those suggestive of breeding or important feeding or roosting sites or flight paths) within the broader study area will be carefully plotted and documented. Where patterns in these observations are identified this may lead to additional focal site surveys in future.

2.4.5 Direct observation of bird movements

The aim of direct observation is to record bird flight activity on site. An understanding of this flight behaviour will help explain any future interactions between birds and the facility. Spatial patterns in bird flight movement may also be detected, which will allow for input into turbine placement. Direct observation is conducted through counts at two vantage points (VP) in the study area. These VP's provide coverage of a reasonable and representative proportion of the entire study area (total coverage being unnecessary and impractical given resource constraints). VP's were identified using GIS (Geographic Information Systems), and then fine-tuned during the project setup, based on access and other information. Since these VP's aim at capturing both usage and behavioural data, they were positioned mostly on high ground to maximise visibility. The survey radius for VP counts is 2 kilometres. VP counts are conducted by two observers, seated at the VP and taking care not to make their presence so obvious as to effect bird behaviour. Birds are recorded 360° around observers. Data should be collected during representative conditions, so the sessions are spread throughout the day, with each VP being counted over 'early to mid-morning', 'mid to late morning', 'early to mid-afternoon', and 'mid-afternoon to evening'. Each session is 3 hours long, resulting in a total of 12 hours of observation being conducted at each vantage point on each site visit. Three hours is believed to be towards the upper limit of observer concentration span, whilst also maximising duration of data capture relative to travel time required in order to gain access to the VP's. A maximum of two VP sessions are conducted per day, to avoid observer fatigue compromising data quality. For more detail on exact criteria recorded for each flying bird observed, see Jenkins *et al* (2012).

One of the most important attributes of any bird flight event is its height above ground, since this will determine its risk of collision with turbine blades. Since it is possible that the turbine model (and hence the exact height of the rotor swept zone) could still change on this project, actual flight height is estimated rather than assigning flight height to broad bands (such as proposed by Jenkins *et al* 2012). This 'raw' data will allow flexibility in assigning to classes later on depending on final turbine specifications.

2.5 Control site

A suitable control site has been identified approximately 5 kilometres south-east of the main site. This site was chosen as it is one of the few areas at comparable altitude and with similar open plateau grassland to the main site. One vantage point and three walked transects have been established on the control site.

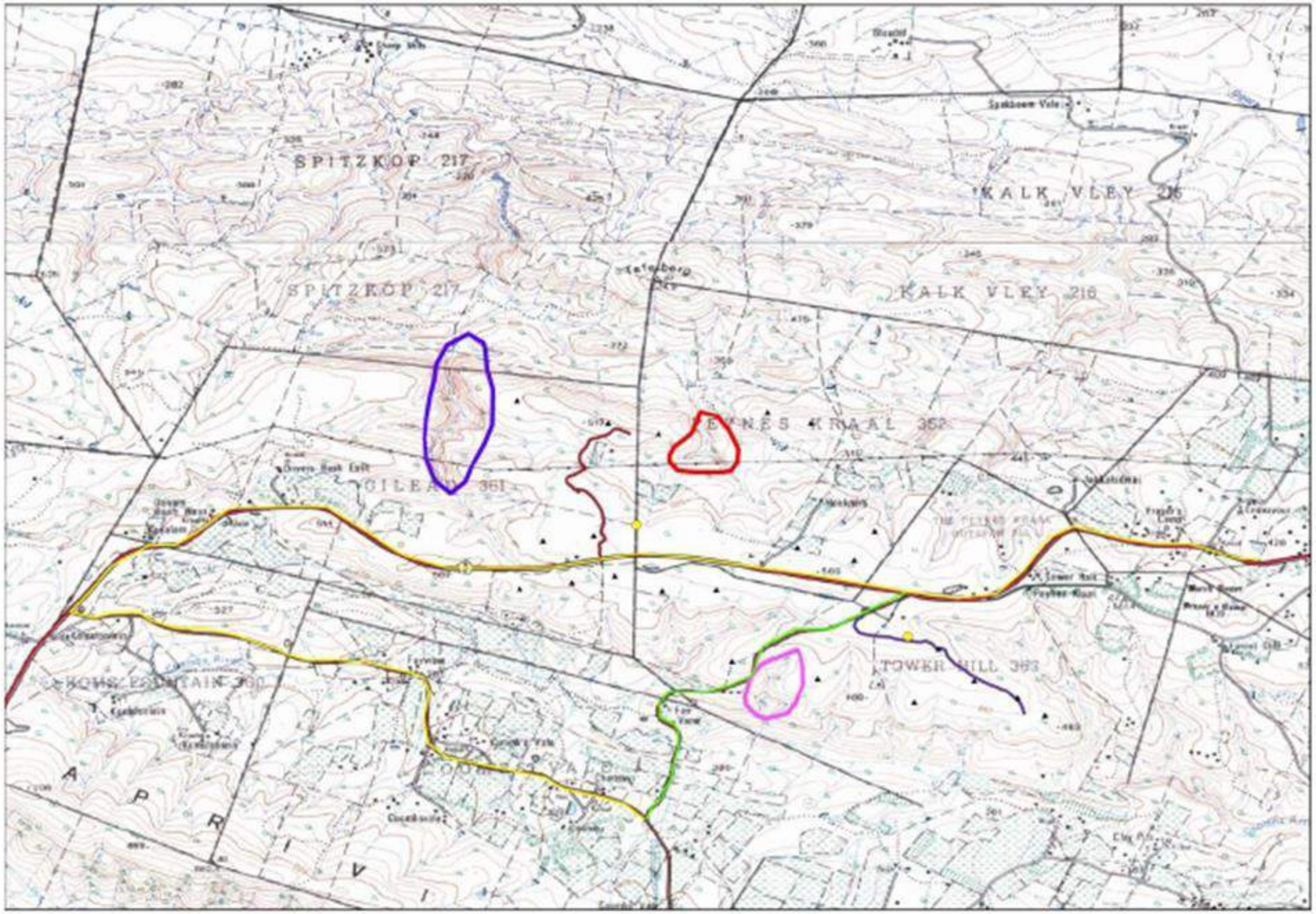


Figure 1. The layout of the pre-construction bird monitoring activities on the Grahamstown Plan8 Wind Energy Facility site. Yellow points indicate vantage point positions, coloured lines indicate vehicle transects, and polygons indicate focal points.

3. Findings to date

3.1 Target species

Up to approximately 229 bird species could occur on site, based on what has been recorded in the broader area by the first and second bird atlas projects (Harrison *et al*, 1997; www.sabap2.adu.org.za). Thirteen of these species are Red Listed (Taylor, 2014). Of these bird species, the following have been selected as the 'target species' for this study, i.e. those species for which there is special concern related to the proposed WEF: African Crowned Eagle *Stephanoaetus coronatus;* African Fish-Eagle *Haliaeetus vocifer;* African Harrier-Hawk *Polyboroides typus;* African Marsh-Harrier *Circus ranivorus;* Black Harrier *Circus maurus;* Black Stork *Ciconia nigra;* Black-shouldered Kite *Elanus caeruleus;* Black-winged Lapwing *Vanellus melanopterus;* Booted Eagle *Aquila pennatus;* Common Buzzard *Buteo vulpinus;* Denham's Bustard *Neotis denhami;* Jackal Buzzard *Buteo rufofuscus;* Lanner Falcon *Falco biarmicus;* Martial Eagle *Polemaetus bellicosus;* Peregrine Falcon *Falco peregrinus*; Rock Kestrel *Falco rupicolus*; Secretarybird *Sagittarius serpentarius;* Verreaux's Eagle *Aquila verreauxii;* White Stork *Ciconia ciconia;* White-bellied Korhaan *Eupodotis senegalensis;* Black Kite *Milvus migrans;* and. These are the species which we expect to occur on the site and be particularly susceptible to impacts associated with the proposed facility. This programme will investigate the importance of the site for these species and any others identified as important during the course of the programme. Based on the first three site visits, the most important of these species appear to be the African Crowned Eagle, Rock Kestrel and Jackal Buzzard. These species will be discussed in more detail as this programme collects more data.

Table 1. Preliminary target bird species for the Grahamstown Plan8 Wind Energy Facility site.

Common name	Species name	Taylor 2014	IUCN 2013	Preferred micro habitat	Theoretical interactions with facility
African Crowned Eagle	*Stephanoaetus coronatus*	VU	NT	Indigenous forest, gorges	Collision, disturbance if breeding nearby
African Fish-Eagle	*Haliaeetus vocifer*			Open water sources	Collision, disturbance if breeding nearby
African Harrier-Hawk	*Polyboroides typus.*			Generalist	Collision
African Marsh-Harrier	*Circus ranivorus*	EN	LC	Grassland, wetland	Collision, disturbance, habitat destruction
Black Harrier	*Circus maurus*	EN	VU	Grassland, wetland, Fynbos	Collision, disturbance, habitat destruction
Black (Yellow-billed) Kite	*Milvus migrans*			Generalist	Collision
Black Stork	*Ciconia nigra*	VU	LC	Riverine, cliffs	Collision
Black-shouldered Kite	*Elanus caeruleus*			Generalist	Collision
Black-winged Lapwing	*Vanellus melanopterus*			Short grassland	Collision
Booted Eagle	*Aquila pennatus*			Generalist	Collision, disturbance, habitat destruction
Common (Steppe) Buzzard	*Buteo buteo*			Generalist	Collision
Denham's Bustard	*Neotis denhamii*	VU	NT	Grassland	Collision, disturbance, habitat destruction
Jackal Buzzard	*Buteo rufofuscus*			Generalist	Collision, disturbance, habitat destruction
Lanner Falcon	*Falco biarmicus*	VU	LC	Generalist, open vegetation, cliffs	Collision
Martial Eagle	*Polemaetus bellicosus*	EN	VU	Woodland	Collision, disturbance, habitat destruction, electrocution on power lines
Rock Kestrel	*Falco rupicolus*			Generalist	Collision
Peregrine Falcon	*Falco peregrinus*			Open habitat, cliffs	Collision, disturbance if breeding
Secretarybird	*Sagittarius serpentarius*	VU	VU	Grassland, open woodland	Collision, disturbance, habitat destruction
Verreaux's Eagle	*Aquila verreauxi*	VU	LC	Mountainous rocky areas	Collision, disturbance, habitat destruction, electrocution on power lines
White-bellied Korhaan	*Eupodotis senegalensis*	VU	LC	Grassland	Collision
White Stork	*Ciconia ciconia*	BONN		Arable, grassland, wetland, dams	Collision

EN = Endangered; VU = Vulnerable; NT = Near-threatened; LC = Least concern.

3.2 Sample counts of small terrestrial species

During the autumn site visit a total of 50 bird species were recorded on the walked transects. None of these species are Red Listed. The only target species recorded was Rock Kestrel. The most commonly recorded species were: Cape Glossy Starling; Speckled Mousebird; Cape Turtle Dove; and Cape Sparrow. During the second site visit (winter) 58 bird species were recorded. The most frequently recorded species were Dark-capped Bulbul, Cape Glossy Starling and Rufous-naped Lark. Only one Red Listed species was recorded, i.e. the White-bellied Korhaan (one single bird being seen). The spring site visit recorded 67 different species, and generally higher abundance of most species than in the previous seasons.

3.3 Counts of large terrestrial species and raptors

During autumn, a total of four target bird species were recorded using this method: Jackal Buzzard; Long-crested Eagle; Peregrine Falcon; and Rock Kestrel. The most frequently recorded species was Jackal Buzzard. During winter only two target bird species were recorded by this method, the Jackal Buzzard and Rock Kestrel. This consisted of two records of single Rock Kestrels and one record of a pair of Jackal Buzzards. The spring survey recorded 5 species: Martial Eagle; Long-crested Eagle; Jackal Buzzard; Booted Eagle and Rock Kestrel.

3.4 Incidental observations

Five target bird species were recorded during the course of the summer site visit: the Jackal Buzzard; African Harrier-Hawk; Black-shouldered Kite; Peregrine Falcon; and Rock Kestrel. Once again the most frequently recorded of these species was Jackal Buzzard. During winter only one target bird species was recorded as incidental observations. Jackal Buzzard was recorded 5 times, in each case a single bird. During spring 11 species were recorded, including two summer migrants: Yellow-billed (Black) Kite; and Steppe (Common) Buzzard. Importantly the White-bellied Korhaan, and Martial Eagle were also recorded on site. The species recorded most frequently was Jackal Buzzard.

3.5 Focal sites

Three focal site areas were surveyed during the first site visit, the fourth being inaccessible due to poor weather. At Focal Site 1 a large stick nest was recorded on the cliff (see Figure 1). This is likely to belong to a raptor or possibly a Black Stork, but no birds were in attendance at the time. This situation will be monitored on future site visits. At Focal Site 2 a stick nest was again recorded with no birds present (see Figure 1). The nest did not appear to be recently used. Two Rock Kestrels were observed in this area, but the nest is too large to be theirs. No stay wire collision casualties were recorded at the measuring mast.

During the winter site visit, Focal sites 2 and 3 (see Figure 1) revealed no significant sightings. At Focal Site 1 a Rock Kestrel and a Booted Eagle were seen flying in the gorge. The landowner at Focal Site 1 also reported a

Verreaux's Eagle nest site in the gorge but difficult access prevented our team from confirming this. Given that no Verreaux's Eagles have been seen on site during this programme at all, it seems possible that this nest is no longer active.

During the spring survey, an active White-necked Raven nest (with two chicks) was recorded at Focal Site 2. Focal Site 1 was revisited to confirm the presence of breeding eagles. An active African Crowned Eagle nest was found by the team, with adults incubating two eggs. The nest is shown in Figure 2. The implications of this nest for the project are discussed in Section 3.7.

Figure 2. African Crowned Eagle nest found in the gorge west of the site.

3.6 Direct observation of bird movements

During autumn, in total 5 target bird species were recorded flying on site. Most frequently recorded was Rock Kestrel, closely followed by Jackal Buzzard. Peregrine Falcon and Black Harrier were recorded flying multiple times, and Booted Eagle was recorded once. It is too early to detect any spatial patterns in this flight activity. During winter, three target bird species were recorded flying on site: the Rock Kestrel; Jackal Buzzard; and African Fish-Eagle. The Rock Kestrel and Jackal Buzzard were by far the most frequent fliers, with the African Fish Eagle being recorded only on one day. The spring survey recorded 8 species flying, the most frequent of which was Booted Eagle, followed by Jackal Buzzard. African Crowned Eagle was recorded flying on site three times.

3.7 Site sensitivity and project constraints

At this early stage the sensitive features detected on and near site are primarily the focal site areas shown in Figure 1, where the potential exists for sensitive cliff or tree nesting species to breed.

The most significant feature at this stage is the African Crowned Eagle nest to the west of the proposed facility (see Figure 3). In our opinion the appropriate mitigation measure for risk posed to these birds by the facility is to identify a buffer area around the nest, within which turbines, roads and overhead lines should not be constructed. Large eagles such as this are often protected against wind farm impacts through the use of buffers. The radius of these buffers is mainly determined by the measured or estimated core foraging ranges of the affected birds (Martinéz *et al.* 2010). Where such information does not yet exist (such as for this project) a theoretical buffer area may be imposed to provide protection for the birds. A survey of literature available pertaining to eagle buffer sizes for various forms of development resulted in a range of recommended buffers

6

from as little as 400 metres to 10 kilometres (see Ruddock & Whitfield 2007; Marja-Liisa Kaisanlahti-Jokimäki, *et al.* 2008; Colorado Division of Wildlife 2008; USFWS Utah Field Office's Guidelines for Raptor Protection From Human and Land Use Disturbances Guidelines; Bright, Langston, & Anthony – RSBP; Rydell, Engström, Hedenström, Larsen, Pettersson & Green, 2012). Some of this literature also points towards the importance of 'line of sight' in determining buffer size. The assumption is that if adult birds are able to see the proposed development (and presumably construction activities) from the nest this may disturb them or alter their behaviour. Informal discussion with other avifaunal specialists practising in SA reveals a range of buffers of between 800 and 2 000 metres. More recently the US Fish & Wildlife Service 2013 has recommended a buffer radius equal to half the inter nest distance for the species in the area.

In this case we believe a buffer of approximately 1.2 km to be appropriate, since: we have relatively few records of these birds flying on the site itself, implying that they may have a relatively small home range confined mostly within the gorge (which would make sense given their known behaviour, prey and foraging habits); and the topographic nature of the gorge means a nest is likely to out of line of sight of turbines anyway. Figure 3 illustrates the implications of such a buffer for the proposed turbine layout. One turbine will need to be shifted eastwards to avoid this area.

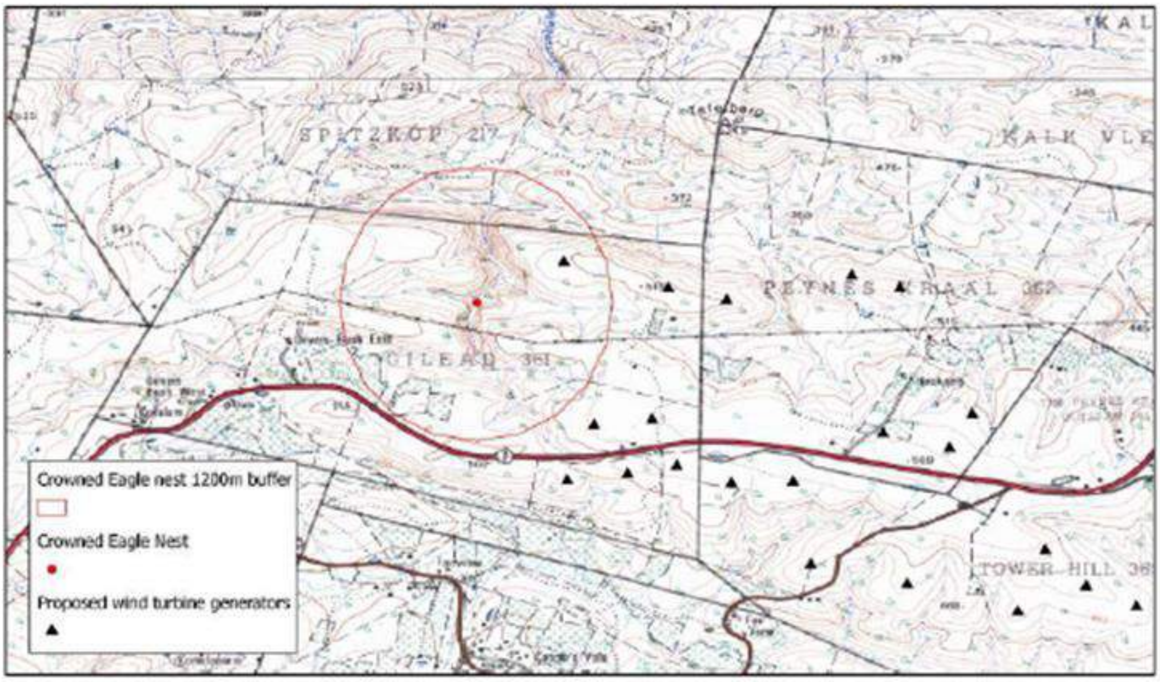


Figure 3. African Crowned Eagle nest and proposed 1.2 kilometre buffer.

4. Conclusion

This programme is proceeding well, with the exception of some weather interruptions. Several target bird species have been recorded flying on site to date, and with time we will be able to estimate how much collision risk these species will face once turbines are constructed. Three key small gorges on the periphery of the site have been found and searched several times. The most significant finding in these gorges is an African Crowned Eagle nest. An appropriate buffer around this nest has been identified in order to provide protection for this species.

These should be considered preliminary findings and will be refined, added to or overruled based on additional data still to be collected on site. The next site visit will be in approximately January to February 2015.

5. References

Bright, J.A., R. H. W. Langston, S. Anthony 2009 Mapped and written guidance in relation to birds and onshore wind energy development in England. A report by the Royal Society for the Protection of Birds, as part of a programme of work jointly funded by the RSPB and Natural England. 173 pp.

Jenkins, A.R., van Rooyen, C., Smallie, J., Anderson, M.D. & Smit, H. 2012. Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy developments in Southern Africa". Unpublished Endangered Wildlife Trust and BirdLife South Africa document.

Jordan, M., & Smallie, J. 2010. A briefing document on best practice for pre-construction assessment of the impacts of onshore wind farms on birds. Endangered Wildlife Trust , Unpublished report

Kaisanlahti-Jokimäki, M.L. *et al*. 2008. Territory occupancy and breeding success of the Golden Eagle (Aquila chrysaetos) around tourist destinations in northern Finland. Ornis Fennica 85:00–00.

Retief, E, Anderson, M., Diamond, M., Smit, H., Jenkins, A. & Brooks, M. 2011. Avian Wind Farm Sensitivity Map for South Africa: Criteria and Procedures used.

Rydell, J. H. Engström, A. Hedenström, J. K. Larsen, J. Pettersson and M. Green. 2012. The effect of wind power on birds and bats – A synthesis.. SWEDISH ENVIRONMENTAL PROTECTION AGENCY. Report 6511. 152 pp.

Ruddock, M. & D.P. Whitfield. 2007. A Review of Disturbance Distances in Selected Bird Species. A report from Natural Research (Projects) Ltd to Scottish Natural Heritage.

Taylor, M. (ed). 2014. The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. BirdLife South Africa, Johannesburg. In press.

www.iucnredlist.org, Accessed November 2013

Appendix 2d: Fourth (Final) Progress Report 2nd February 2015

Grahamstown Wind Energy Facility

Plan8 Infinite Energy (Pty) Ltd

Final pre-construction bird monitoring report

February 2015

Compiled by:

Jon Smallie Zuben Jessa

WildSkies Ecological Services

Jon@wildskies.co.za

Submitted to:

Plan8 Infinite Energy (Pty) Ltd

zuben.jessa@plan-8.co.za

EXECUTIVE SUMMARY

Plan8 Infinite Energy (Pty) Ltd, (hereafter referred to as Plan8) wish to construct the Grahamstown Plan8 Wind Energy Facility (WEF) between Grahamstown and Peddie in the Eastern Cape. The facility comprises an array of up to 22 turbines and associated infrastructure such as internal access roads, an overhead power line linking the facility to the national grid and an electrical substation.

Four seasons of pre-construction bird monitoring have been conducted on site in order to collect data on bird abundance, behaviour and movement on site, and inform this final preconstruction monitoring report. Key findings of this monitoring programme are as follows:

A total of 24 target bird species were identified for the site at the outset of the programme. These are the species considered most important, on the basis of their likely susceptibility to wind farm impacts and their conservation status. Eighteen of these species were confirmed on site during this programme.

A total of 102 small bird species were recorded on site by Walked Transects, with a peak in species richness in spring and summer. A number of southern African endemics were included in this set of species, but no Red Listed species were recorded. No particularly sensitive avifaunal aspects are evident from this data set. Eight large bird species were recorded on and near the site by Vehicle Transects, with a peak in spring once again. Martial Eagle (Endangered) was the only Red Listed species recorded by this method.

An African Crowned Eagle nest site was found in a small gorge immediately to the west of the site. This nest is approximately 820 metres from the nearest turbine position (T19). As of late January 2015, a large chick was on the nest, not yet fledged. This is the most sensitive avifaunal aspect of this project and requires careful management, as recommended below. Verreaux's Eagle was not recorded on or near site during the duration of this programme. No evidence of either current or historic nests was found in the gorges that were surveyed. Martial Eagle was recorded on site several times in spring, but no breeding sites for this species were found in the gorges.

Fifteen target bird species were recorded flying on site during Vantage Point observations, five of which are Red Listed: the Martial Eagle (Endangered); Lanner Falcon (Vulnerable); Black Harrier (Endangered); African Crowned Eagle (Vulnerable) and African Marsh-Harrier (Endangered). The most frequently recorded species was Jackal Buzzard, followed by Rock Kestrel and Booted Eagle. Based on the species' mean flight height above ground, and percentage of flight time spent at rotor height (approximately 30 – 150m), the species likely to be most at risk of collision with turbines appear to be Jackal Buzzard and Rock Kestrel. A spatial 'collision risk index' was created for the site, and indicates two key areas of higher collision risk, close to Turbines 19 and 20 and Turbine 08. Since the flight records responsible for these scores are mostly long flights of Booted Eagle, Rock Kestrel and Jackal Buzzard (none of which are Red Listed), no mitigation action in these areas is required.

The following recommendations are made for the management of risk to avifauna at this site:

1. No infrastructure should be built in the area identified as HIGH sensitivity in this report. This is a buffer area of 1.2 kilometre radius around the African Crowned Eagle nest site. Turbine 19 will need to be either discarded or moved approximately 250 metres east to avoid this area. No changes should be made to the layout of infrastructure which may infringe on the MEDIUM sensitivity areas.

2. During construction, a specialist should monitor the effect of construction activities on the African Crowned

Eagle during breeding season to measure the effectiveness of the above mitigation measure.

3. All power line linking the turbines and linking turbine strings to the on-site substation should be placed underground. Where this is not possible this should be discussed with the specialist and a compromise reached that provides acceptable protection for birds.

4. The power line linking the site to the Eskom grid will be above ground but must conform to all Eskom standards in terms of bird-friendly monopole structures with Bird Perches on every pole top (to mitigate for bird electrocution), and anti-bird collision line marking devices (to mitigate for bird collision). It is particularly important that the collision mitigation devices used are durable and remain in place on the line for the full lifespan of the power line. It will be Plan8/Eskom's responsibility to maintain these devices in effective condition for this period. Systematic patrols of this power line should be conducted during post construction bird monitoring for the wind energy facility, in order to monitor the impacts, the effectiveness of mitigation, and the durability of the mitigation measures.

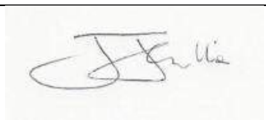
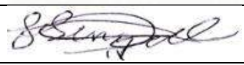
5. A final avifaunal walk through should be conducted prior to construction to ensure that all the avifaunal aspects have been adequately managed and to ground truth the final layout of all infrastructure. This will most likely be done as part of the site specific Environmental Management Plan. This will also allow the development of specific management actions for the Environmental Control Officer during construction and training for relevant on site personnel if necessary.

6. The 'during' construction and post-construction bird monitoring programme outlined by this report should be implemented by a suitably qualified avifaunal specialist. In particular the post construction monitoring of live birds should be conducted for at least 1 year and the measurement of bird fatalities through carcass searches for at least 3 years, and repeated in years 5, 10, 15 etc. after the commissioning of the facility (see Jenkins *et al,* 2014). As mentioned above this monitoring should include the grid connection power line.

7. The findings of post-construction monitoring should be used to measure the effects of this facility on birds. If significant impacts are identified the wind farm operator will have to identify and implement suitable mitigation measures.

If these recommendations are implemented, this facility can be allowed to proceed.

REPORT REVIEW & TRACKING

Document title	Grahamstown Plan8 Wind Energy Facility – Final Preconstruction Monitoring Report	
Client name & address	Plan8 Infinite Energy (Pty) Ltd PO Box 3804 Cape Town, 8000	
Status	Draft – pending client comment	
Issue date	2 February 2015	
Lead author	Jon Smallie – SACNASP 400020/06	
Internal review	Luke Strugnell – SACNASP 400181/09	

WildSkies Ecological Services (Pty) Ltd
36 Utrecht Avenue, East London, 5241
Jon Smallie
E: jon@wildskies.co.za
C: 082 444 8919
F: 086 615 5654

SPECIALIST DETAILS

Professional registration

The Natural Scientific Professions Act of 2003 aims to "Provide for the establishment of the South African Council of Natural Scientific Professions (SACNASP) and for the registration of professional, candidate and certified natural scientists; and to provide for matters connected therewith."

"Only a registered person may practice in a consulting capacity" – Natural Scientific Professions Act of 2003 (20(1)-pg 14)

Investigator: Jon Smallie (*Pri.Sci.Nat)*
Qualification: BSc (hons) Wildlife Science – University of Natal
Msc Env Sc – University of Witwatersrand
Affiliation: South African Council for Natural Scientific Professions
Registration number: 400020/06
Fields of Expertise: Ecological Science
Registration: Professional Member

Professional experience

Jon Smallie has been involved in bird interactions with energy infrastructure for 14 years. During this time he has completed impact assessments for more than 100 projects, at least thirty of which involved wind energy generation. He is a founding member of the Birds and Wind Energy Specialist Group and co-author of the best practice guidelines for wind energy and birds. A full Curriculum Vitae can be supplied on request.

Declaration of Independence

The specialist investigator (WildSkies Ecological Services) declares that:

- We act as independent specialists for this project.
- We consider ourselves bound by the rules and ethics of the South African Council for Natural Scientific Professions.
- We do not have any personal or financial interest in the project except for financial compensation for specialist investigations completed in a professional capacity as specified by the Environmental Impact Assessment Regulations, 2006.
- We will not be affected by the outcome of the environmental process, of which this report forms part of.
- We do not have any influence over the decisions made by the governing authorities.
- We do not object to or endorse the proposed developments, but aim to present facts and our best scientific and professional opinion with regard to the impacts of the development.
- We undertake to disclose to the relevant authorities any information that has or may have the potential to influence its decision or the objectivity of any report, plan, or document required in terms of the Environmental Impact Assessment Regulations, 2006.

Terms and Liabilities

- This report is based on four seasons of pre-construction bird monitoring on site, and other available information and data related to the site to be affected.
- The Precautionary Principle has been applied throughout this investigation.
- Additional information may become known or available during a later stage of the process for which no allowance could have been made at the time of this report.
- The specialist investigator reserves the right to amend this report, recommendations and conclusions at any stage should additional information become available.
- Information, recommendations and conclusions in this report cannot be applied to any other area without proper investigation.
- This report, in its entirety or any portion thereof, may not be altered in any manner or form or for any purpose without the specific and written consent of the specialist investigator as specified above.
- Acceptance of this report, in any physical or digital form, serves to confirm acknowledgment of these terms and liabilities.

Assessment philosophy

The specialist has 14 years of experience in bird conservation in South Africa, and is passionate about ensuring the protection of our bird species, particularly outside of protected areas. He also has a sound knowledge of the different forms of energy generation employed to date in SA, and the implications of these choices for our birds. This assessment is therefore conducted with a pragmatic approach founded on the firm belief that in national terms, renewable energy is a positive move for South Africa’s environment and birds in the longer term. This does not mean however that renewable energy projects should be exempt from thorough impact assessment or management, but rather that any potential impacts be viewed against the broader implications of continuing on a fossil fuel based energy mix.

Signed in February 2015 by Jon Smallie, in his capacity as avifaunal specialist for this project.

TABLE OF CONTENTS

INTRODUCTION

Plan8 Infinite Energy (Pty) Ltd, (hereafter referred to as Plan8) wish to develop, construct and operate the Grahamstown Plan8 Wind Energy Facility (WEF) which is located on either side of the N2 national road between Grahamstown and Peddie in the Eastern Cape. The Grahamstown Plan8 WEF will consist of an array of up to 27 turbines and associated infrastructure (i.e. internal access roads, an overhead power line linking the facility to the national grid and an electrical substation) covering an area of approximately 68 hectares depending on the final layout design.

WildSkies Ecological Services (Pty) Ltd (Jon Smallie) was contracted by Plan8 to conduct pre-construction bird monitoring on the site. This monitoring programme was conducted post the Environmental Impact Assessment, which was conducted in 2012 (Smallie, 2012).

Typically a wind energy facility of this nature can be expected to impact on avifauna as follows: disturbance of birds; habitat destruction during construction and maintenance of the facility and associated infrastructure; displacement of birds from the area, or from flying over the area; collision of birds with turbine blades during operation; and collision and electrocution of birds on associated electrical infrastructure. The pre-construction bird monitoring carried out on site over four seasons collected the data required to assess this risk.

Topographically the site is characterised by undulating ground and is varied in vegetation, with some open grassland on the higher ground, and thicket in the valleys. This presents a diverse habitat for use by birds and we can expect a high diversity of bird species to utilise the site. An approximate total of 265 bird species could occur in the broader area, based on what has been recorded in the relevant quarter degree square by the first bird atlas project (Harrison *et al* 1997), and in the relevant pentads by the second atlas project (www.sabap2.adu.org.za). This pre-construction monitoring programme recorded a total of 172 species on the site itself. This is a good diversity of species, reflecting the diversity of habitats in the broader study area.

Description of the proposed wind energy facility

An area of approximately 2 550 hectares is being considered for the development of up to 22 turbines. Each turbine will have a likely generating capacity of 3.0MW each, a hub height of 91 metres, and a rotor diameter of 117 metres. Ancillary infrastructure associated with the facility include: cabling between the turbines, to be laid underground where practical, which will connect to an on-site substation; an on-site substation to facilitate the connection between the WEF and the electricity grid; internal access roads to each turbine and buildings for operations, maintenance and storage.

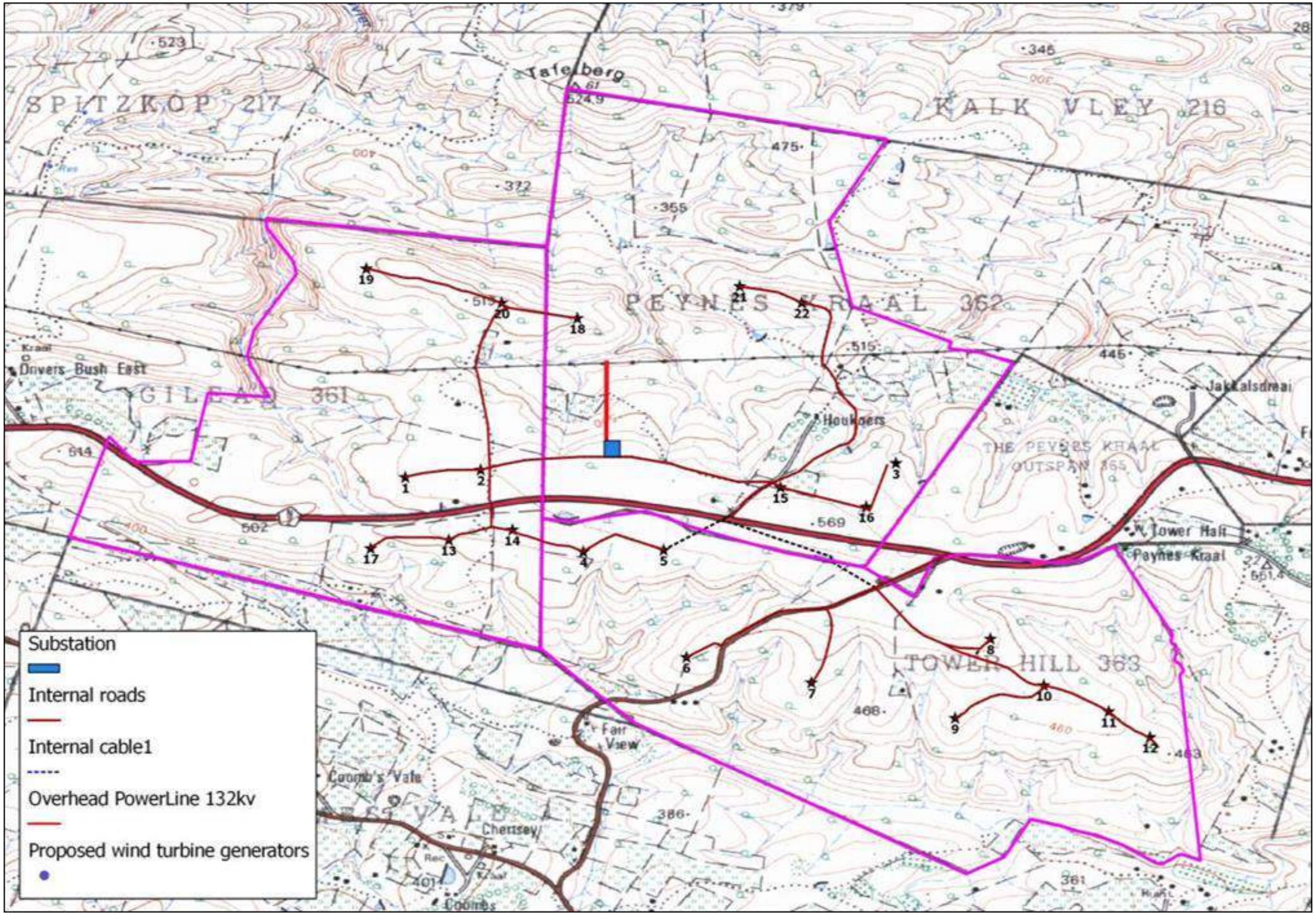


Figure 1. The location and layout of the proposed Grahamstown Plan8 Wind Energy Facility.

Background to wind energy facilities and birds

The South African experience of wind energy generation is limited to date with only eight commercial scale wind turbines having been operational for several years in the country at the time of writing. Although a handful of facilities have recently been commissioned and numerous others are currently under construction, the results of post construction bird monitoring at these sites are not yet available. A monitoring programme at the Klipheuwel demonstration facility (3 turbines) found two bird collisions equating to an estimated 1 bird/turbine/year fatality rate (Kuyler, 2004). Doty & Martin (2013) monitored one turbine at Port Elizabeth (3 searches per week for 52 weeks) and found one Little Swift *Apus affinis* collision victim over a period of a year. Much of what we know about the interaction between birds and wind energy facilities is therefore learnt from international literature, mostly from the United States, United Kingdom, and Europe. Unfortunately much of this literature is grey literature, and focuses on the impact of collision. Two important sources used for the below discussion were a review by Rydell *et al* (2012) and assorted information on the "Good Practice Wind" website at www.project-gpwind.eu.

The interaction between birds and wind farms first documented was that of birds killed through collisions with turbines, dating back to the 1970's. Certain sites in particular, such as Altamont Pass – California, and Tarifa – Spain, killed a lot of birds and focused attention on the issue. However it appears that sites such as these are the exception rather than the rule, with most facilities causing low fatality rates (Kingsley & Whittam, 2005). Expressed relative to other anthropogenic mortality factors, wind farms also cause relatively low fatality rates (Erickson *et al*, 2001; Gill *et al*, 2006), although there are some inherent challenges in making these comparisons as explained later in this report.

With time it has become apparent that there are actually three ways in which birds can be affected by wind farms: collisions – which is a direct mortality factor; habitat alteration or destruction (less direct); and displacement and barrier effects (various authors including Rydell *et al* 2012). Whilst the impact of habitat alteration is probably fairly similar to that associated with other forms of development, the displacement and barrier effects are unique to wind energy. It is not yet known whether it is the noise, visual, flicker or shadow effects that may disturb and displace birds. Whatever the cause is, if birds are displaced from the site it is lost as habitat. Without doubt the impact of collision has received the most attention to date amongst researchers, operators, conservationists, and the public.

1.2.1 Collision of birds with turbine blades

That birds collide with human developed infrastructure has been well documented over the years (for e.g. Drewitt & Langston, 2008). Since the first birds were found under wind turbines it has more or less been assumed that the birds collided with turbine blades because they did not see them. Much of the earlier work was therefore based on the assumption that this was a visual problem. The logical consequence then was to develop mitigation measures that made the turbines more visible to birds. It was suggested that the primary reason for birds failing to see turbine blades was the phenomenon of motion smear or retinal blur (Hodos, 2002), whereby an identical image (such as the three turbine blades) passing over the retina repeatedly and fast enough can actually become invisible (such as the propeller of a light aircraft). A suggested solution to this was to paint one blade black so that the images would alternate between white and black thereby reducing the likelihood of retinal blur. Although vision certainly has a lot to do with the collision, more recently it seems likely that various other factors also play a part. In recent research on bird vision (Martin, 2011; Martin & Shaw, 2010) suggest that birds may have reduced visual acuity in front of them when in flight, or in the case of vultures may even be blind for a significant portion of their frontal vision. This would necessitate a different approach to mitigation than has so far been the case.

Fatality rates

It is important to first understand the scale of this effect before delving into the details of factors influencing it. Not surprisingly as soon as dead birds were discovered at wind farms, researchers started to count them. With time the need arose to standardise metrics across multiple sites, countries and continents. The two most common measures used to date are number of birds killed per turbine per year, and number of birds killed per megawatt installed per year. Rydell *et al* (2012) reviewed studies from 31 wind farms in Europe and 28 in North America and found a range between 0 and 60 birds killed per turbine per year, with a median of 2.3. European average bird fatality rates were much higher at 6.5 birds/turbine/year compared to the 1.6 for North America. These figures include adjustment for detection (the efficiency with which monitors detect carcasses in different conditions) and scavenger bias (the rate at which birds are removed by scavengers between searches). These are important biases which must be accounted for in any study of mortality.

Cumulative effects

Even where fatality rates may appear low there should be adequate attention given to the situation. The cumulative effects of several facilities on the same species could be considerable, particularly if these are sited in the same region and impact on the same regional population of the species. Also most long lived slow reproducing Red List species may not be able to sustain any additional mortality factors over and above existing factors.

Bird related factors affecting collision with turbines

Whilst all birds face some inherent risk of collision with wind turbines, certain groups are definitely more susceptible (Jordan & Smallie, 2010; Rydell *et al,* 2012). Taxonomic groups most commonly affected include: Podicipediformes; Pelicaniformes; Ciconiiformes; Anseriformes; Falconiformes; Charadriformes; Strigiformes; Caprimulgiformes; Gruiformes; Galliformes; Psittaciformes; and Passeriformes (Jordan & Smallie, 2010). A number of factors (and various combinations thereof) are believed to be important in determining a bird species susceptibility to collision, described below:

Behavioural factors

The most important behavioural characteristic suggested so far as influencing collision risk is the birds reaction to the presence of turbines (Rydell *et al*, 2012). Certain bird species have been observed to display avoidance behaviour from a significant distance from turbines, thereby ensuring safety, whilst other species appear to be comfortable foraging in amongst turbines. Birds also tend to fly lower during strong headwinds (Richardson, 2000) thereby possibly increasing the risk of collision since turbines are also functioning at a maximum in strong winds (Drewitt & Langston, 2008).

Raptor’s susceptibility to collision with turbines is difficult to explain given their apparent excellent eye sight and mostly good maneuverability. It has been suggested that due to these two factors raptors do not avoid obstacles at a far enough distance to ensure safety (in Rydell *et al*, 2012). Obstacles that are moving, such as the three blades of a turbine, need to be avoided at further distances (or earlier) than stationary ones (Martin, 2011)

Morphological factors

Flight prowess and maneuverability have been suggested to be two of the primary morphological factors (Barrios & Rodrigues, 2004; Drewitt & Langston, 2006). This is similar to other forms of collision (such as power lines) where it is believed that large birds (and with high wing loading – the ratio of wing area to mass) may be less able to adjust flight quickly when they perceive an obstacle (Jenkins *et al,* 2010; de Lucas *et al*, 2008). Jenkins *et al* (2010) make a useful distinction between a birds’ ‘susceptibility’ to collision, and its 'exposure'. Susceptibility is determined by factors including: physical size; wing loading; maneuverability; speed of flight; height of flight; open or closed habitat; aerial foraging; aerial displays; frequent flight at night or in low light; and narrow binocular field of vision (Martin & Shaw, 2010). Exposure is determined by how often, far and for how long a bird flies, and whether it flocks. This distinction is relevant to bird-wind turbine collision theory and has been used indirectly to assess risk in this report.

Seasonal factors

According to Drewitt & Langston (2008) bird collisions could be dependent on the season and weather. Raptor fatalities in particular are clumped into certain seasons, perhaps when flight activity is higher due to courtship, nest building, and provisioning of young.

Habituation

Although it has been suggested that birds will get accustomed to a wind energy facility with time and that they will then avoid collisions, there is no evidence to support this (Rydell *et al*, 2012; de Lucas *et al*, 2008; Smallwood & Thelander 2008, Bevanger *et al*, 2010). Likewise with age of bird, young birds do not seem to be disproportionately affected.

Facility related factors affecting collisions with turbines

Turbine size

Several authors have found that taller turbines with longer blades (and hence larger rotor swept area) did not kill more birds (e.g. Barclay *et al,* 2007). As turbine size increases fewer birds are killed when expressed per megawatt, since fewer turbines are required in order to generate the same power.

Lighting

Although it has been suggested previously that lighting at turbines will increase the collision risk (seemingly on the basis of recorded incidents of mass collisions of birds with other lit infrastructure – Erickson, 2001) there does not seem to be any evidence to substantiate this (Rydell *et al,* 2012). It has also been suggested that if flashing or intermittent light is used this may reduce the risk (Drewitt & Langston, 2008).

Size of facility or number of turbines

Rydell *et al* (2012) found that larger wind farms do not necessarily kill more birds per turbine. The absolute number of birds killed by the facility will of course be greater for a larger facility if all other factors are equal. Of course larger facilities would also have greater impacts through habitat destruction and displacement and barrier effects.

There appears to typically be an uneven distribution of collisions across the turbines on site, with 13% of the 5 000 turbines at Altamont Pass killing all Golden Eagle *Aquila chrysaetos* and Red-tailed Hawk *Buteo jamaicensis* (Curry & Kerlinger, 2000), and more than 50% of vulture casualties at Tarifa being on 15% of the turbines (Acha, 1997).

Spacing of turbines

Conflicting information exists on the effect of turbine spacing on collision risk, some authors suggesting that spaces should be left for safe passage of birds (Drewitt & Langston, 2006; 2008), but the same authors also suggest that perhaps birds should be discouraged from flying through a facility and should rather be encouraged to avoid the entre facility. This would clearly result in a greater displacement effect on the species.

Site related factors affecting collision with turbines

Rydell *et al* (2012) conclude from their analysis that the most important factor determining collision risk is the location of turbines relative to bird occurrence, and the surrounding environment. Collision frequency has so far been highest at facilities near wetlands and the coast, and also on the top of ridges or areas with significant variation in topography. Certain landscape features may also channel bird flight into flight paths that are used more frequently. In general, high density of birds in an area will mean that the risk of collision is high although studies are conflicting in this regard (Rydell *et al,* 2012). Several authors found that density and activity of birds near wind farms is related to collision risk (Barrios & Rodrigues, 2004; Everaert & Kuijken, 2007), whilst certain studies found that this is not the case (de Lucas *et al*, 2008; Krijgsveld *et al*, 2009). It seems logical that for collision risk to be high then usage of the site must be high, either by lots of birds or few birds repeatedly. It is also clear that this is not the only factor determining collision risk.

1.2.2 Loss or alteration of habitat during construction

The area of land directly affected by a wind farm and associated infrastructure is relatively small. As a result in most cases, habitat destruction or alteration in its simplest form (removal of natural vegetation) is unlikely to be of much significance. However fragmentation of habitat can be an important factor for some smaller bird species. Construction and operation of a wind farm results in an influx of human activity to areas often previously relatively uninhabited (Kuvlesky *et al* 2007). This disturbance could cause certain birds to avoid the entire site, thereby losing a significant amount of habitat effectively (Langston & Pullan, 2003). In addition to this, birds are aerial species, spending much of their time above the ground. It is therefore simplistic to view the amount of habitat destroyed as the terrestrial land area only. Loss of aerial habitat is discussed in more detail below under displacement and barrier effects.

1.2.3 Disturbance of birds and barrier effects (or displacement)

Disturbance effects can occur at differing levels and have variable levels of effect on bird species, depending on their sensitivity to disturbance and whether they are breeding or not. For smaller bird species, with smaller territories, disturbance may be absolute and the birds may be forced to move away and find alternative territories, with secondary impacts such as increased competition. For larger bird species, many of which are typically the subject of concern for wind farms, larger territories mean that they are less likely to be entirely displaced from their territory. For these birds, disturbance is probably likely to be significant only when breeding.

A barrier effect or displacement occurs when a wind energy facility acts as a barrier for birds in flight, which then avoid the obstacle and fly around it. This can reduce the collision risk, but will also increase the distance that the bird must fly. This has consequences for the birds' energy balance. Obviously the scale of this effect can vary hugely and depends on the scale of the facility, the species territory and movement patterns and the species reaction.

1.2.4 Associated infrastructure

Infrastructure associated with wind energy facilities also has the potential to impact on birds, in some cases more than the turbines themselves. Overhead power lines pose a collision and possibly an electrocution threat to certain bird species (depending on the pole top configuration). Furthermore, the construction and maintenance of the power lines will result in some disturbance and habitat destruction. New access roads, substations and offices constructed will also have a disturbance and habitat destruction impact. Collision with power lines is one of the biggest single threats facing birds in southern Africa (van Rooyen 2004). Most heavily impacted upon are bustards, storks, cranes and various species of water birds. These species are mostly heavy-bodied birds with limited maneuverability, which makes it difficult for them to take the necessary evasive action to avoid colliding with power lines (van Rooyen 2004, Anderson 2001). Unfortunately, many of the collision sensitive species are considered threatened in southern Africa. The Red List species vulnerable to power line collisions are generally long living, slow reproducing species under natural conditions. 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 larger bird species are most affected since they are most capable of bridging critical clearances on hardware.

1.2.5 Mitigation

Whilst bird mortalities have been comprehensively documented at numerous sites world-wide, very little has been written about the potential methods of reducing the level of mortalities, perhaps because little mitigation has been implemented post construction. Potential mitigation measures include: alternative turbine designs (such as vertical axis turbines); painting turbine blades (tested only in laboratory conditions to date); anti perching devices; construction of shielding pylons; curtailment of turbines during high risk periods; shutdown of certain high risk turbines; and altering blade height to pose less risk within the birds' preferred height strata. Most of these suggested mitigation measures are either not tested, impractical or unlikely to be implemented by the operator post construction. The primary means of mitigating bird impacts therefore remains correct siting, both of the entire facility, and of the individual turbines themselves. Whichever mitigation measures are identified as necessary, this should be informed by a thorough pre and post construction bird monitoring programme.

1.2.6 Contextualising wind energy impacts on birds

Several authors have compared causes of mortality of birds (American Bird Conservancy, 2012; Sibley Guides, 2012; National Shooting Sports Foundation 2012; Drewitt & Langston 2008) in order to contextualise possible mortality at wind farms. In most of these studies, apart from habitat destruction which is the number one threat to birds (although not a direct mortality factor) the top killers are collision with building windows and cats. Overhead power lines rank fairly high up, and wind turbines only far lower down the ranking. These studies typically cite absolute number of deaths and rarely acknowledge the numerous biases in this data. For example a bird that collides with a high rise building window falls to a pavement and is found by a passer-by, whereas a bird colliding with a wind turbine falls to the ground which is covered in vegetation and seldom passed by anyone. Other biases include: the number of windows; kilometres of power line; or cats which are available to cause the demise of a bird, compared to the number of wind turbines. Biases aside the most important short coming of these studies is a failure to recognise the difference in species affected by the different infrastructure. Species such as those of concern at wind farms, and particularly Red List species in South Africa are unlikely to frequent tall buildings or to be caught by cats. Since many bird species are already struggling to maintain sustainable populations, we should be striving to avoid all additional, new and preventable impacts on these species, and not permitting these impacts simply because they are smaller than those anthropogenic impacts already in existence.

METHODOLOGY

Project objectives

The aims of this study are as follows:

1. To estimate the abundance of the priority species within the wind farm affected area. This will be used as a baseline against which to measure potential displacement and disturbance of these species due to the construction and operation of the WEF. This objective is reported on in Section 3.
2. To document patterns of bird movement on site and flight behaviour that is relevant to understanding the risk of collision of these birds with wind turbines once constructed. This objective is achieved in Section 3.
3. To identify potential risks of interaction between avifauna and the facility once constructed. This is achieved in Sections 4 and 5.
4. To develop management recommendations for the mitigation of these risks. This could include providing spatial input into the final design (including the siting of turbines), construction and management strategy of the development. This is presented in Section 7.
5. To develop a framework or outline for during construction and post construction bird monitoring at this site. This is presented in Section 6.
6. More broadly speaking, bird monitoring at WEF's in South Africa aims to develop an understanding of the interactions between birds and WEF's; and to develop means of mitigating impacts where necessary. This will ensure that the industry remains sustainable into the future.

General approach

This study followed the following general steps. The detailed methodology is presented in Section 2.7:

- An extensive review of available international literature pertaining to bird interactions with wind energy facilities was undertaken in order to fully understand the issues involved and the current level of knowledge in this field. This international knowledge was then adapted to local conditions and species as far as possible in order to identify important or target species for this study.
- The various data sets listed below and the study area were examined to determine the likelihood of these relevant species occurring on or near the site.
- A pre-construction bird monitoring programme was conducted covering four seasons, in order to obtain the necessary data to make a more confident assessment of the impacts.
- Sensitive areas within the proposed site, where the above impacts are likely to occur, were identified using various GIS (Geographic Information System) layers and Google Earth.
- Recommendations were made for the management and mitigation of risk to birds.

Data sources used

Various existing data sources have been used in the design and implementation of this programme, including the following:

- The Southern African Bird Atlas Project data (SABAP1 - Harrison *et al*, 1997) for the single quarter degree square considered relevant i.e. 3326BD - 87 cards (228 species). The Southern African Bird Atlas Project 2 data was also consulted at http://sabap2.adu.org.za/coverage.php#menu_top. Two cards, each recording 239 species, have been submitted for the 3315_2645 and 3315_2650 pentads. This data from both atlas projects was obtained from www.mybirdpatch.adu.org.za. This data was used in the preparation of this monitoring programme and to identify priority species, but was over ruled once the monitoring programme itself had collected more comprehensive data on site.
- The Important Bird Areas report (IBA - Barnes 1998) was consulted to determine the location of the nearest IBA's and their importance for this study. There are three IBAs (SA094 Alexandria Coastal Belt and SA092 Amatole Forest Complex and the SA 091 Katberg Readsdale Forest Complex) within a 60km radius of the proposed site. Although birds are highly mobile, this distance is fairly significant and therefore this dataset will not be assessed further.
- The conservation status of all relevant bird species was determined using Taylor (2014) for southern Africa and IUCN (2013) for global status.
- The latest vegetation classification of South Africa (Mucina & Rutherford, 2006) was consulted in order to determine which vegetation types occur on site.
- Google Earth Imagery was used extensively for planning purposes.
- Aerial photography from the Surveyor General was used.
- The recent document "Avian Wind Farm Sensitivity Map for South Africa: Criteria and Procedures Used" by Retief, Diamond, Anderson, Smit, Jenkins & Brooks (2011) was used for the species listing.
- The "BirdLife South Africa/Endangered Wildlife Trust - Best practice guidelines for assessing and monitoring the impacts of wind energy facilities on birds in southern Africa (2nd revision. Jenkins, van Rooyen, Smallie, Harrison, Diamond, Smit-Robinson & Ralston, 2014)" was used extensively to guide this project.
- Various documentation on the Good Practice Wind website was used (www.project-gpwind.eu), particular guidance on assessment of impacts.
- The Birdlife International "Position statement on wind farms and bird' (2005).
- The Endangered Wildlife Trust and BirdLife South Africa "Position statement on wind farms and birds (2012).

Relevant legislation

The legislation relevant to this specialist field and development include the following:

The Convention on Biological Diversity: dedicated to promoting sustainable development. The Convention recognizes that biological diversity is about more than plants, animals and micro-organisms and their ecosystems – it is about people and our need for food security, medicines, fresh air and water, shelter, and a clean and healthy environment in which to live. It is an international convention signed by 150 leaders at the Rio 1992 Earth Summit. South Africa is a signatory to this convention.

An important principle encompassed by the CBD is the precautionary principle which essentially states that where serious threats to the environment exist, lack of full scientific certainty should not be used a reason for delaying management of these risks. The burden of proof that the impact will *not* occur lies with the proponent of the activity posing the threat.

The Convention on the Conservation of Migratory Species of Wild Animals (also known as CMS or Bonn Convention) aims to conserve terrestrial, aquatic and avian migratory species throughout their range. It is an intergovernmental treaty, concluded under the aegis of the United Nations Environment Programme, concerned with the conservation of wildlife and habitats on a global scale. Since the Convention's entry into force, its membership has grown steadily to include 117 (as of 1 June 2012) Parties from Africa, Central and South America, Asia, Europe and Oceania. South Africa is a signatory to this convention.

The African-Eurasian Waterbird Agreement. The Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) is the largest of its kind developed so far under the CMS. The AEWA covers 255 species of birds ecologically dependent on wetlands for at least part of their annual cycle, including many species of divers, grebes, pelicans, cormorants, herons, storks, rails, ibises, spoonbills, flamingos, ducks, swans, geese, cranes, waders, gulls, terns, tropic birds, auks, frigate birds and even the South African penguin. The agreement covers 119 countries and the European Union (EU) from Europe, parts of Asia and Canada, the Middle East and Africa.

The National Environmental Management – Biodiversity Act - Threatened Or Protected Species list (TOPS) (see Table 1 for relevant species).

The Nature and Environmental Conservation Ordinance (19 of 1974) is relevant in the Eastern Cape, although outdated, and somewhat illogical in the species it protects. Schedule 2 of this ordinance lists protected bird species including, relevant to this site: all crows; Cape Sparrow; Cape Weaver; Cape Bulbul; Red-faced Mousebird and Speckled Mousebird.

The Civil Aviation Authority's regulations are relevant to the issue of lighting of wind energy facilities, and to painting turbine blades, both of which are relevant to bird collisions with turbine blades.

Limitations and assumptions

Typically a study of avifauna at a site such as this would be heavily dependent on secondary data sources such as those listed above. In this case however, a significant amount of primary data was collected on site – rendering the above data sources useful only for preliminary planning. Limitations of this study then apply more to the primary data collection methods. A potential limitation exists in the quality and skill levels of the observers used. The data obtained can only be as good as those people capturing it. Experience with the observer team used on this project has shown that their bird identification and data capture skills are excellent.

Certain biases and challenges are inherent in the methods that have been employed to collect data in this programme. It is not possible to discuss all of them here, and some will only become evident with time, but the following are some of the key points: The presence of the observers on site is certain to have an effect on the birds itself. For example during vantage point counts, it is extremely unlikely that two observers sitting in position for three hours will have no effect on bird flight. Some species may avoid the vantage point position, because there are people there, and others may approach out of curiosity. In almost all data collection methods large bird species will be more easily detected, and their position in the landscape and flight height more easily estimated. This is particularly relevant at the vantage points where a large eagle may be visible several kilometres away, but a smaller Rock Kestrel perhaps only within 800 metres. Similarly birds are spotted more easily closer to the observers. A particularly important challenge is that of estimating the height at which birds fly above the ground. With no reference points against which to judge this it is exceptionally difficult and subjective. It is for this reason that this data has been treated cautiously by this report, and much of the analysis conducted using flights of all height. With time, and data from multiple sites it will be possible to tease out these relationships and establish indices or measures of these biases.

The selection of vantage point positions is often challenging, and this site was no different. Because of the dense nature of the thicket vegetation, it was difficult to find vantage points with clear views above this vegetation. The final positions were positioned in open grassland vegetation so as to address this challenge.

It is not possible to eliminate all risk of impacts of a proposed facility such as this on avifauna. In our South African landscape a vertical structure of 150 metres is almost unprecedented, multiple such structures even more so. Our best possible efforts can probably not ensure zero impact on birds. Studies such as this attempt to minimise the risk as far as possible, but it is probably unavoidable that the facilities will impact on birds, and perhaps in ways not yet understood. This study however concludes that the risk of these impacts is at an acceptable level.

The questions that one can ask of the data collected by this programme are almost endless. Most of these questions however become far more informative once post construction data has been collected and effects can be observed. For this reason some of the analysis in this report is relatively crude. The raw data has however been collected and will be stored until such time as more detailed analysis is possible and necessary.

An overarching limitation is that since it is early days for wind energy in South Africa we have multiple and often quite different goals for this monitoring. This means that the pre-construction monitoring programme has not been as focused as it would possibly be for a project a few years into the future. Collecting diverse and substantial amounts of data is obviously an advantage on some levels, but perhaps may also dilute the focus somewhat.

The above limitations need to be stated as part of this study so that the reader fully understands the complexities. However they do not detract from the confidence that this author has in the findings of this study and subsequent management recommendations for this project. It has to be noted that the collection of vast amounts of data through pre-construction monitoring places us in a far better position to assess impacts than was the case 4-5 years ago when only a very short once off site inspection was typically conducted.

Preparatory analysis

In preparation for this programme, the following steps have been taken by the author:

2.6.1 Definition of the 'inclusive impact zone' (monitoring study area)

Due to their mobility, and the fact that one of the main possible impacts of the wind energy facility, that of bird collision, occurs whilst birds are mobile, the zone within which bird activity is relevant to the WEF is potentially far larger than the WEF itself. An important step in designing a monitoring programme is therefore defining this zone. Ideally this zone would encompass the likely range of all bird species likely to be affected by the WEF. However in the case of large birds of prey for example this could be tens of kilometres, and it is not considered feasible to monitor all of this. For the purpose of this study this area was defined as the area within an approximate two kilometre buffer around the proposed turbine positions.

2.6.2 Description of the study area and bird micro habitat delineation

Vegetation and the micro habitats available to birds on site are important in determining avifaunal abundance and movement on site. The vegetation on site has been described based on the work of Mucina & Rutherford (2006), and micro habitats available to birds were classified based on field work on site and the specialists' experience.

2.6.3 Development of a target species list

Determining the target species for this study, i.e. the most important species to be considered for the impact assessment, is a three step process. The above data represents the first step, i.e. which species occurs or could occur in the area at significant abundances, and the importance of the study area for those species. Secondly, the recent document "A briefing document on best practice for pre-construction assessment of the impacts of onshore wind farms on birds" (Jordan & Smallie, 2010) was consulted to determine which groups of species could possibly be impacted on by wind farms. This document summarises which taxonomic groups of species have been found to be vulnerable to collision with wind turbines in the USA, UK, EU, Australia and Canada. The taxonomic groups that have been found to be vulnerable in two or more of these regions are as follows: Pelicaniformes (pelicans, gannets, cormorants); Ciconiiformes (storks, herons, ibises, spoonbills); Anseriformes (swans, ducks, geese); Falconiformes (birds of prey); Charadriiformes (gulls, terns, waders); Strigiformes (owls); Caprimulgiformes (nightjars); Gruiformes (cranes, bustards, rails); Galliformes (pheasants, grouse, francolins); and Passeriformes (songbirds). The third step is to consider the species conservation status or other reasons for protecting the species. This involved primarily consulting the Red List bird species (Taylor 2014) as in Table 1.

In addition to the above sources of information, the recent document entitled "Avian Wind Farm Sensitivity Map for South Africa: Criteria and procedures used" (Retief, Diamond, Anderson, Smit, Jenkins & Brooks, 2011) combines all three above steps in order to identify sensitive areas of the country. The methods used by this project (Retief *et al*, 2011) are far more thorough and comprehensive than is possible during the scope of an EIA, and serves as a useful resource, and in particular includes assessment of non-Red List bird species. The current Grahamstown Plan8 study has therefore used the various information sources above to develop a target species list for the project.

2.6.4 Determination of monitoring effort

Two factors were considered in determining the monitoring effort: the facility size (in hectares and turbine number); and the perceived avifaunal sensitivity of the site. In addition the guidance offered in Jenkins *et al* (2014) was applied.

Sampling activities

2.7.1 Sample counts of small terrestrial species

Although not traditionally the focus of wind farm–bird studies and literature, small terrestrial birds are an important component of this programme. Due to the rarity of many of our threatened bird species, it is anticipated that statistically significant trends in abundance and density may be difficult to observe. More common, similar species could provide early evidence for trends and point towards the need for more detailed future study. Given the large spatial scale of WEF's, these smaller species may also be particularly vulnerable to displacement and habitat level effects. Sampling these species is aimed at establishing indices of abundance for small terrestrial birds in the study area. These counts should be done when conditions are optimal. In this case this means the times when birds are most active and vocal, i.e. early mornings. A total of six walked transects (WT) totalling approximately 5.54 kilometres were established in areas that are representative of the bird habitats available on the main site. These transects were conducted at first light and all bird species seen or heard, and their position relative to the transect line were recorded. For more detail on the exact methods of conducting Walked Transects see Jenkins *et al* (2014).

2.7.2. Counts of large terrestrial species and raptors

This is a very similar data collection technique to that above, the aim being to establish indices of abundance for large terrestrial species and raptors. These species are relatively easily detected from a vehicle, hence vehicle based transects (VT) were conducted in order to determine the number of birds of relevant species in the study area. Detection of these large species is less dependent on their activity levels and calls, so these counts can be done later in the day. Four VTs were established along suitable roads on the site, totalling approximately 26.8 kilometres. These transects were each counted once on each site visit. For more detail on the exact methods of conducting Vehicle Based transects see Jenkins *et al* (2014).

2.7.3. Focal site surveys and monitoring

The obvious bird resource areas on this site were three small gorges which have potential breeding habitat for cliff nesting bird species in addition to roosting and perching substrate, and general refugia. These three gorges were established as Focal Sites 1 to 3. The fourth Focal site identified was the meteorological mast stay wires, where surveys of the area surrounding the mast were conducted at each seasonal visit to detect any bird collision casualties.

2.7.4. Incidental observations

This monitoring programme comprises a significant amount of field time on site by the observers - much of it spent driving between the above activities. It is important to maximise the benefit from this time on site by record any other relevant information observed. All other incidental sightings of priority species (and particularly those suggestive of breeding or important feeding or roosting sites or flight paths) within the broader study area were carefully plotted and documented.

The above efforts allow us to arrive at an estimate of the abundance or density of the relevant species on site. This will allow the identification of any displacement and disturbance effects on these species post construction. However in evaluating the likelihood of these species colliding with turbine blades, their abundance is not sufficient. We also need to understand their flight behaviour. It is the flight behaviour which determines their exposure to collision risk. A bird which seldom flies, or typically flies lower than blade height is at lower risk than a frequent flier that typically flies at blade height. In order to gather baseline data on this aspect, direct observations of bird flight behaviour are required. This is the most time consuming and possibly the most important activity conducted on site, and is elaborated on below in Section 2.7.5.

2.7.5. Direct observation of bird movements

The aim of direct observation is to record bird flight activity on site. An understanding of this flight behaviour will help explain any future interactions between birds and the WEF. Spatial patterns in bird flight movement may also be detected, which will allow for input into turbine placement. Direct observation was conducted through counts at two vantage points (VP) in the study area. These VP's provided coverage of a reasonable and representative proportion of the entire study area (total coverage being unnecessary and impractical given resource constraints). VP's were identified using GIS (Geographic Information Systems), and then fine-tuned during the project setup, based on access and other information. Since these VP's aim at capturing both usage and behavioural data, they were positioned mostly on high ground to maximise visibility. The survey radius for VP counts was two kilometres. VP counts were conducted by two observers, seated at the VP, taking care not to make their presence overtly obvious as to effect bird behaviour. Data should be collected during representative conditions, so the sessions were spread throughout the day, with each VP being counted over 'early to mid-morning', 'mid to late morning', 'early to mid-afternoon', and 'mid-afternoon to evening'. Each session was three hours in duration, resulting in a total of 12 hours of observation being conducted at each vantage point on each site visit. Three hours is believed to be towards the upper limit of observer concentration span, whilst also maximising duration of data capture relative to travel time required accessing the VPs. A maximum of two VP sessions were conducted per day, to avoid observer fatigue compromising data quality. For more detail on the exact criteria recorded for each flying bird observed, see Jenkins *et al* (2014).

One of the most important attributes of any bird flight event is its height above ground, since this will determine its risk of collision with turbine blades. Since it is possible that the turbine model (and hence the exact height of the rotor swept zone) could still change on this project, actual flight height was estimated rather than assigning flight height to broad bands (such as proposed by Jenkins *et al* 2014). This 'raw' data will allow flexibility in assigning to classes later on depending on final turbine specifications.

Spatial analysis of the bird flight data was conducted as follows:
A Viewshed Analysis of the two kilometre radius around each Vantage Point was undertaken to identify the areas that can actually be seen by the observers from the Vantage Point. This was done by using 20 metre contours to create a Triangular Irregular Network. Birds in flight above the ground surface can often be seen despite the ground itself not being visible. In order to account for this a point 30 metres above the ground was used to correspond with the lower edge of the rotor zone. The final viewshed then includes areas where birds 30 metres or more above the ground could be seen from the Vantage Points. Only data from areas deemed visible were displayed in the final figures. The recorded flight paths within this viewshed were vectorized to create lines for each flight record. A 200 x 200 metre grid was created of the relevant area. Each flight record or line was assigned a collision risk score as follows: The collision risk score for each record equals the flight height score multiplied by flight mode score multiplied by species conservation score, multiplied by number of birds recorded flying. Flight height scores were assigned as follows: 0 – 30 metres above ground = 1; 30 – 150 metres = 2; >150 metres =1. Birds flying at rotor height (approximately 30 to 150 metres) are deemed to be at greater collision risk than those above or below this zone. Scores were assigned for flight mode as follows: direct commuting = 1; soaring or hovering = 2 (soaring and hovering being considered a higher risk flight mode). A conservation score was assigned to each species as follows: common and non-threatened species = 1; 'Near-threatened' species and medium to large raptors = 2; 'Vulnerable' species = 3; and 'Endangered' species = 4. The survey area was divided into a grid of 200m x 200m cells, and a collision risk score for each cell was calculated by summing the collision risk scores for all flight records in that cell. The results of this analysis were superimposed on the latest available turbine layout to determine collision risk at specific turbines.

Control sites

A suitable control site was identified approximately five kilometres south-east of the main site. This site was chosen as it is one of the few areas at comparable altitude and with similar open plateau grassland to the Grahamstown Plan8 site. Activities on the control site consist of a single Vantage Point and three walked Transects.

Figure 2 shows the layout of the above described monitoring activities on the Grahamstown Plan8 site.

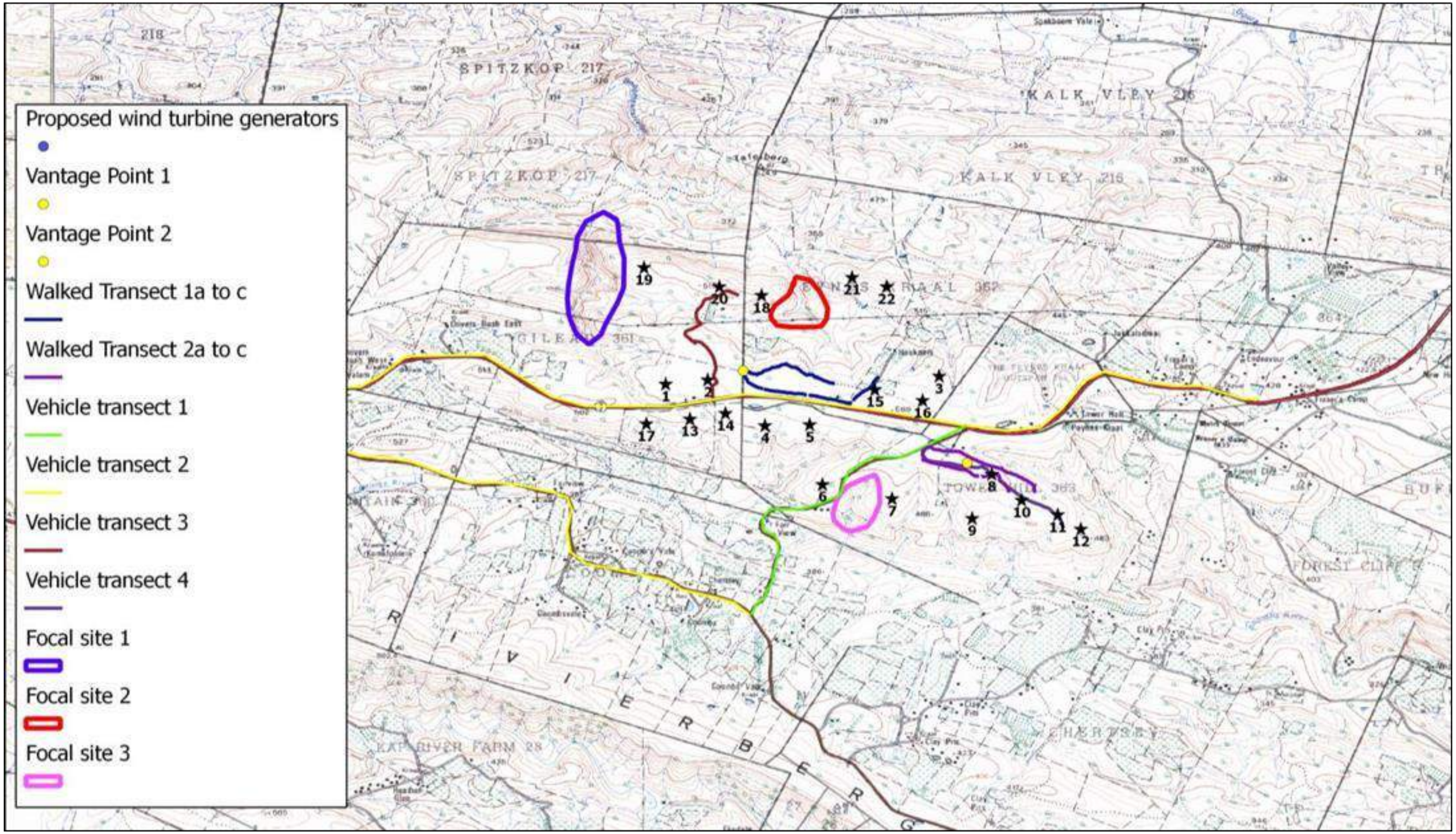


Figure 2. The layout of the pre-construction bird monitoring activities on the Grahamstown Plan8 Wind Energy Facility site.

PRE CONSTRUCTION MONITORING RESULTS & DISCUSSION

The findings from the pre-construction bird monitoring programme have been reported on below. In summary, this programme has comprised of approximately 26 days on site by a skilled field team of two observers, and several shorter site visits by the avifaunal specialist.

Definition of the inclusive impact zone

At this site, the zone has been delineated by buffering the site by approximately two kilometres. Where specific reasons exist to survey further abroad, such as possible raptor breeding sites, this zone has been increased.

Description of the study area

Vegetation is one of the primary factors determining bird species distribution and abundance in an area. The following description of the vegetation on the site focuses on the vegetation structure and not species composition. It is widely accepted within ornithological circles that vegetation structure is more important in determining bird species diversity. The classification of vegetation types is from Mucina & Rutherford (2006).

The majority of the affected area within which turbines are planned is classified as “Bhisho Thornveld”. To the north and south of that there are bands of “Kowie Thicket” (see Figure 3). Field work revealed that there are also some relatively open areas of ‘grassland’ present on site. The relevance of this vegetation classification to the avifauna of the area is that a variety of habitat is provided, which can accommodate both the species mostly dependant on shorter grassland, and those dependant on the taller thicket and woodland. This is reflected in the species composition for the study area, shown in Table 1 below. Woodland species such as Martial Eagle *Polemaetus bellicosus* and African Crowned Eagle *Stephanoaetus coronatus*, and grassland species such as Black Harrier *Circus maurus* and White-bellied Korhaan *Eupodotis senegalensis* have been recorded in the broader area.

The vegetation description partially describes the habitat available and hence the bird species likely to occur in the study area. However, more detail is required in order to understand exactly where within the study area certain species will occur and how suitable these areas are for the relevant species. The habitats available to birds at a smaller spatial scale are known as micro habitats. These micro habitats are formed by a combination of factors such as vegetation, land use, anthropogenic factors, topography and others. These micro habitats are typically important for judging the suitability of the site for relevant bird species. The identified micro habitats on the Grahamstown Plan8 site are therefore: thicket, grassland, drainage lines, small dams, ridges, stands of exotic trees and mining activities. Examples of these are shown in Figure 4, and species likely to utilise each habitat are shown in Table 1.

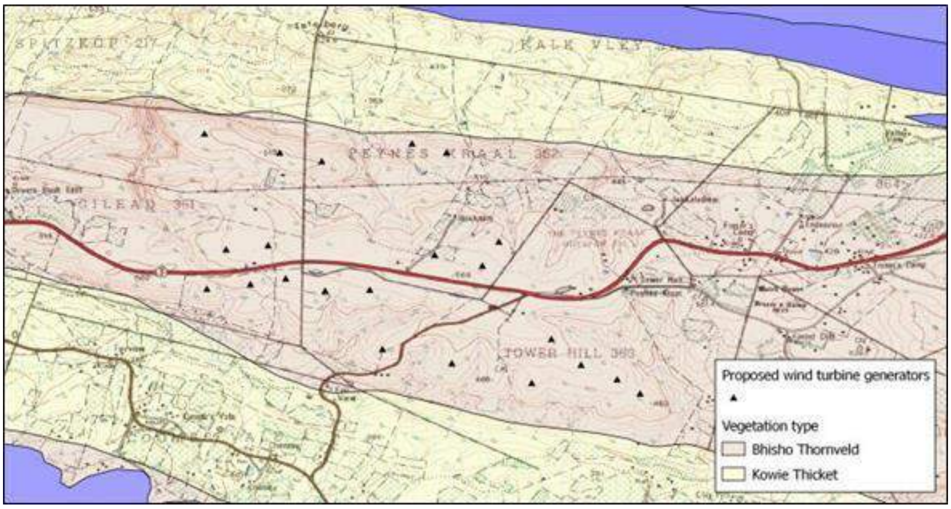


Figure 3. The vegetation composition of the Grahamstown Wind Energy Facility site (Mucina & Rutherford, 2006).

Figure 4. Examples of bird micro habitats available on the Grahamstown Plan8 Wind Energy Facility site***.***

Development of the target species list

A total of 21 target bird species were identified as being of particular relevance on this site and formed the early focus of the monitoring programme and this final preconstruction monitoring report. Based on data collected on site a further three species were added: Amur Falcon; African Goshawk and Long-crested Eagle (Table 1). A number of species were not recorded on site at all during this programme, and these are shown in Table 1. In each case the species' regional (Taylor, 2014) and global (IUCN 2013) conservation status is presented, and whether it has been confirmed on the site. In the case of Red List species an indication of whether they are believed likely to breed on site is also presented as well as each species' preferred habitat. In addition to the target species, endemic species are worthy of mention. South African endemic species are those which occur only in South Africa, and are important to conserve on that basis. Those endemic species recorded on site during this monitoring programme have been presented in Appendix 2.

Sample counts of small terrestrial species

A total of 102 small bird species were recorded by walked transects during this programme. A peak in species richness was recorded in spring (64 species) and summer (57 species), with lower species richness in autumn (46) and winter (51). The full data set for all species is presented in Appendix 2. For each species, the: number of birds; number of records; and number of birds per kilometre are presented. Of these 102 species recorded, none are Red Listed or target species for this site (see Table 1).

Table 2 presents the data for the top 20 most frequently recorded species. The most frequently recorded species were: Barn Swallow *Hirundo rustica*; Dark-capped Bulbul *Pycnonotus tricolor*; Neddicky *Cisticola fulvicapilla*; Cape Glossy Starling *Lamprotornis nitens*; and Speckled Mousebird *Colius striatus*.

A number of southern African endemic and near-endemic species were recorded frequently on site. Those in the top 20 species include: Dark-capped Bulbul; Cape Glossy Starling; Bokmakierie *Telophorus zeylonus*; Cape Longclaw *Macronyx capensis*; Yellow Canary *Crithagra flaviventris*; Greater Double-collared Sunbird *Cinnyris afer*; Southern Boubou *Laniarius ferrugineus*; and Southern Double-collared Sunbird *Cinnyris chalybeus*.

This information represents a useful baseline against which to measure any effects of the proposed facility. At this stage there are no sensitive aspects emerging from this data which require management or attention.

Table 1. Target species for the Grahamstown Plan8 Wind Energy Facility pre-construction bird monitoring programme

Common name	Taxonomic name	Ecological group	Taylor 2014	IUCN 2013	TOPS status	SABAP 1	SABAP 2	Presence on site	Preferred micro habitat
African Crowned Eagle	*Stephanoaetus coronatus*	Raptor	VU	NT		✓		Confirmed	Indigenous forest, gorges
African Fish-Eagle	*Haliaeetus vocifer*	Raptor	-	LC		✓	✓	Confirmed	Open water sources
African Goshawk	*Accipiter tachiro*	Raptor	-	-		✓	✓	Confirmed	Thicket
African Harrier-Hawk	*Polyboroides typus*.	Raptor	-	LC		✓	✓	Confirmed	Generalist
African Marsh-Harrier	*Circus ranivorus*	Raptor	EN	LC	Protected	✓		Confirmed	Grassland, wetland
Amur Falcon	*Falco amurensis*	Raptor	-	-				Confirmed	Grassland
Black Harrier	*Circus maurus*	Raptor	EN	VU		✓	✓	Confirmed	Grassland, wetland, Fynbos
Black (Yellow-billed) Kite	*Milvus migrans*	Raptor	-	LC		✓		Confirmed	Generalist
Black Stork	*Ciconia nigra*	Water bird	VU	LC	VU	✓		Not recorded	Riverine, cliffs
Black-shouldered Kite	*Elanus caeruleus*	Raptor	-	LC		✓	✓	Confirmed	Generalist
Black-winged Lapwing	*Vanellus melanopterus*	Small terrestrial	-	LC		✓		Not recorded	Short grassland
Booted Eagle	*Aquila pennatus*	Raptor	-	LC		✓	✓	Confirmed	Generalist
Steppe Buzzard	*Buteo vulpinus*	Raptor	-	LC		✓		Confirmed	Generalist
Denham's Bustard	*Neotis denhamii*	Large terrestrial	VU	NT	Protected	✓		Not recorded	Grassland
Jackal Buzzard	*Buteo rufofuscus*	Raptor	-	LC		✓	✓	Confirmed	Generalist
Long-crested Eagle	*Lophaetus occipitalis*	Raptor	-	-		✓		Confirmed	Thicket, alien trees
Lanner Falcon	*Falco biarmicus*	Raptor	VU	LC		✓		Confirmed	Generalist, open vegetation, cliffs
Martial Eagle	*Polemaetus bellicosus*	Raptor	EN	VU	VU	✓	✓	Confirmed	Woodland
Rock Kestrel	*Falco rupicolus*	Raptor	-	-		✓	✓	Confirmed	Generalist
Peregrine Falcon	*Falco peregrinus*	Raptor	-	LC	VU			Confirmed	Open habitat, cliffs
Secretarybird	*Sagittarius serpentarius*	Large terrestrial	VU	VU		✓		Not recorded	Grassland, open woodland
Verreaux's Eagle	*Aquila verreauxi*	Raptor	VU	LC		✓		Not recorded	Mountainous rocky areas
White-bellied Korhaan	*Eupodotis senegalensis*	Large terrestrial	VU	LC		✓	✓	Confirmed	Grassland
White Stork	*Ciconia ciconia*	Water bird	BONN	LC		✓		Not recorded	Arable, grassland, wetland, dams

EN = Endangered, VU = Vulnerable, NT = Near-threatened, LC = Least Concern

Counts of large terrestrial species and raptors

A total of 8 large bird species were recorded by the vehicle transects through the year. A peak in species richness was recorded in spring (5 species), followed by autumn (4), summer (3) and winter (2). The most frequently recorded species was the Jackal Buzzard *Buteo rufofuscus*, by some margin. This species was recorded at an abundance of 0.11 birds per kilometre over the year. Steppe Buzzard *Buteo vulpinus* was recorded at 0.07 and Rock Kestrel *Falco rupicolus* at 0.04 birds per kilometre. The only Red Listed species to be recorded by this method was the Martial Eagle, recorded once in spring.

Focal sites

Each of the three Focal Sites (small gorges/valleys – see Figure 2) were visited at least once on each site visit to search for nests of priority bird species. Two significant findings were made: an active White-necked Raven *Corvus albicollis* nest at Focal Site 2; and far more importantly, an active African Crowned Eagle *Stephanoaetus coronatus* nest at Focal Site 1. The ravens are not a Red Listed species or of any other conservation concern, and do not require any further attention. The African Crowned Eagle is listed as Vulnerable by Taylor (2014) and the presence of an active nest close to site is the most important finding of this programme. This pair of birds bred successfully (at least up until the time of writing) in the 2014/15 breeding season, two eggs being recorded in spring and a large chick being recorded on the nest in January 2015 (see Figure 5). This nest is approximately 820 metres from the nearest proposed turbine (T01). The management recommendations for this situation are described in Section 4.

Verreaux's Eagle was not recorded on or near the site at all during the course of this programme. During the surveys of the gorges no evidence was found of any breeding sites of this species, either current or historic.

Martial Eagle was recorded several times on site during spring, but no evidence of nearby breeding was observed, and the gorge surveys did not find any nest sites for this species.

The stay wires of the met mast on site were searched on each site visit for collision casualties, but none were found. Also – the area west of Vantage Point 2 was searched thoroughly during the summer site visit but no sensitive breeding sites were found.

Figure 5. The African Crowned Eagle nest at Focal Site 1 (Photographs – Garden Route Birding).

Incidental observations

A total of 15 target bird species were recorded on site by incidental observations. Species richness peaked in spring (12 species) and summer (11 species), with autumn (5) and winter (4) producing less species. The most frequently recorded of these were the: Jackal Buzzard; Steppe Buzzard; and Rock Kestrel. Five Red Listed bird species were recorded on site by this method: Black Harrier *Circus maurus* (Endangered); African Crowned Eagle (Vulnerable); Martial Eagle (Endangered); White-bellied Korhaan *Eupodotis senegalensis* (Vulnerable); and Lanner Falcon *Falco biarmicus* (Vulnerable). Many of these species were recorded in only 1 season on site, which may indicate that they do not utilise the site year round.

During the course of this monitoring programme, a total of 170 bird species were recorded on site by all data collection methods (see Appendix 2). A peak in species richness was recorded in spring (137 species), followed by summer (95), winter (84) and autumn (75). Twenty-nine of the species recorded on site are endemic or near-endemic to southern Africa. These species are shown in Appendix 2.

Table 2. Summary statistics for the top 20 most frequently recorded bird species during Walked Transects on the Grahamstown Plan8 site.

	Full year			Autumn			Winter			Spring			Summer		
Total species	**102**			**46**			**51**			**64**			**57**		
	# birds	**# records**	**# birds/km**	**# birds**	**# records**	**# birds/km**	**# birds**	**# records**	**# birds/km**	**# birds**	**# records**	**# birds/km**	**# birds**	**# records**	**# birds/km**
Barn Swallow	121	13	5.46	4	3	0.72							117	10	21.12
Dark-capped Bulbul	106	60	4.78	19	13	3.43	59	24	10.65	14	10	2.53	14	13	2.53
Neddicky	89	82	4.02	15	15	2.71	21	19	3.79	33	29	5.96	20	19	3.61
Cape Glossy Starling	76	25	3.43	42	10	7.58	23	12	4.15	6	2	1.08	5	1	0.90
Speckled Mousebird	69	20	3.11	33	7	5.96	9	4	1.62	25	7	4.51	2	2	0.36
Bokmakierie	68	37	3.07	18	9	3.25	22	13	3.97	11	6	1.99	17	9	3.07
Sombre Greenbul	66	52	2.98	16	13	2.89	20	14	3.61	21	16	3.79	9	9	1.62
Rufous-naped Lark	63	57	2.84	1	1	0.18	29	26	5.23	21	18	3.79	12	12	2.17
Malachite Sunbird	56	43	2.53	6	5	1.08	21	14	3.79	16	14	2.89	13	10	2.35
Cape Turtle-Dove	53	39	2.39	23	15	4.15	19	15	3.43	1	1	0.18	10	8	1.81
Wailing Cisticola	50	42	2.26	2	1	0.36	8	6	1.44	28	24	5.05	12	11	2.17
Cape Longclaw	47	30	2.12	10	8	1.81	12	7	2.17	16	8	2.89	9	7	1.62
Cape Canary	34	10	1.53	17	4	3.07				17	6	3.07			
Common Fiscal	34	26	1.53	11	7	1.99	14	11	2.53	4	4	0.72	5	4	0.90
Yellow Canary	34	12	1.53				19	6	3.43	15	6	2.71			
Greater Double-collared Sunbird	33	15	1.49	3	2	0.54	22	7	3.97	8	6	1.44			
Southern Boubou	31	20	1.40	7	5	1.26	5	3	0.90	10	6	1.81	9	6	1.62
Cape White-eye	29	13	1.31	19	8	3.43	2	2	0.36	5	1	0.90	3	2	0.54
Red-winged Starling	28	8	1.26	17	2	3.07	9	4	1.62				2	2	0.36
Southern Double-collared Sunbird	25	14	1.13	7	4	1.26	14	7	2.53	2	2	0.36	2	1	0.36

Table 3. Summary statistics for the species recorded during Vehicle Transects on the Grahamstown Plan8 site.

	Full year			Autumn			Winter			Spring			Summer		
Total # species	**8**			**4**			**2**			**5**			**3**		
	# birds	**# records**	**# birds/km**	**# birds**	**# records**	**# birds/km**	**# birds**	**# records**	**# birds/km**	**# birds**	**# records**	**# birds/km**	**# birds**	**# records**	**# birds/km**
Jackal Buzzard	12	10	0.11	6	5	0.22	2	1	0.07	1	1	0.04	3	3	0.11
Steppe Buzzard	7	7	0.07										7	7	0.26
Rock Kestrel	4	4	0.04	1	1	0.04	2	2	0.07	1	1	0.04			
Long-crested Eagle	3	3	0.03	1	1	0.04				2	2	0.07			
Peregrine Falcon	2	1	0.02	2	1	0.07									
Booted Eagle	1	1	0.01							1	1	0.04			
Martial Eagle	1	1	0.01							1	1	0.04			
Amur Falcon	1	1	0.01										1	1	0.04

Table 4. Summary statistics for the species recorded by Incidental Observations on the Grahamstown Plan8 site

	Full year		Autumn		Winter		Spring		Summer	
Total species	**15**		**5**		**4**		**12**		**11**	
	# birds	**# records**	**# birds**	**# records**	**# birds**	**# records**	**# birds**	**# records**	**# birds**	**# records**
Jackal Buzzard	53	50	10	10	6	6	16	15	21	19
Steppe Buzzard	11	8					5	2	6	6
Rock Kestrel	10	10	2	2			6	6	2	2
Amur Falcon	8	6							8	6
African Harrier-Hawk	6	4	1	1			4	2	1	1
Black Harrier	4	4					4	4		
African Crowned Eagle	4	4					1	1	3	3
Peregrine Falcon	4	3	1	1			2	1	1	1
White-bellied Korhaan	4	4					3	3	1	1
Martial Eagle	3	3					1	1	2	2
Booted Eagle	2	2					1	1	1	1
African Goshawk	1	1							1	1
Black-shouldered Kite	1	1	1	1						
Black (Yellow-billed) Kite	1	1					1	1		
Lanner Falcon	1	1					1	1		

Direct observation of bird movements

3.8.1 Quantitative data analysis

A total of 218 records of target bird species in flight were made during 96 hours of vantage point observation. Out of a total of 32 (3 hour) vantage point sessions, 4 sessions recorded no target bird species flight activity at all. Fifteen bird species were recorded flying in total, and their data are presented in Table 5. The highest diversity of species flying was recorded in spring and summer (8 species each), whilst 6 species were recorded in winter and 5 in autumn. The most frequently recorded species was Jackal Buzzard (64 records), followed by Rock Kestrel (49 records) and Booted Eagle *Aquila pennatus* (41 records). Five of the fifteen species are currently Red Listed species (Taylor, 2014). These are: Martial Eagle; Lanner Falcon; Black Harrier; African Crowned Eagle; and African Marsh-Harrier *Circus ranivorus*. A number of species were recorded only in one season. These include: Amur Falcon *Falco amurensis* (summer), Black Harrier (autumn), Black-shouldered Kite *Elanus caeruleus* (spring), Martial Eagle (spring), Steppe Buzzard (summer) and Black (Yellow-billed) Kite *Milvus migrans* (spring).

Eleven of the fifteen species recorded were recorded flying at a mean height above ground that is within the rotor zone (i.e. 30 -150 metres above ground). The remaining species were: African Crowned Eagle (above rotor – 160 metres); Black Harrier (below rotor - 19.67 metres); Amur Falcon (below rotor – 16.25 metres); and African Marsh Harrier (below rotor – 10 metres). Examination of the percentage of recorded flight duration at 'below', 'within' and 'above' rotor zone reveals a fairly similar split of species. One exception is the Martial Eagle, which despite having a mean flight height above ground of 120 metres (i.e. within rotor zone) spent a higher percentage of its flight time above rotor height.

The species with mean flight heights and majority of their flight time spent at rotor height can be expected to be at greater risk of collision with turbines than the remaining species, assuming all other factors are equal. Based on this data the species considered to be most at risk are the Jackal Buzzard and Rock Kestrel, which both flew frequently, for long duration, and predominantly at rotor height. The Booted Eagle had similar flight characteristics, but is considered likely to be a seasonal visitor to the site and therefore not at risk year round.

Of interest is the fact that only raptors were recorded flying on site. No records were made of large terrestrial species, such as Secretarybird *Sagittarius serpentarius* or White-bellied Korhaan.

African Crowned Eagle was recorded flying on site in spring and summer only. This may be related to increased activity during breeding (note that this pair appears to have bred relatively late, eggs being recorded on the nest in early November).

Table 5. Summary data of recorded target bird species flight activity on the Grahamstown Plan8 site.

Species	# records	Total flight duration	Mean height above ground	Mean flight duration	% of flight duration below rotor zone	% of flight duration within rotor zone	% of flight duration within above rotor zone
Jackal Buzzard	64	06:10:18	63.36	00:05:35	3.0%	96.5%	0.5%
Rock Kestrel	49	03:48:53	33.47	00:04:39	10.6%	89.4%	0.0%
Booted Eagle	41	02:02:14	63.17	00:02:59	7.6%	89.5%	2.9%
Martial Eagle	11	00:55:10	120.00	00:05:01	0.9%	18.7%	80.4%
Peregrine Falcon	10	00:18:08	50.50	00:01:19	4.8%	95.2%	0.0%
African Fish-Eagle	7	00:13:02	147.14	00:01:52	0.0%	54.9%	45.1%
Lanner Falcon	7	00:15:51	80.71	00:02:16	0.0%	83.5%	16.5%
Black Harrier	6	00:15:29	19.67	00:02:35	78.1%	21.9%	0.0%
African Crowned Eagle	5	00:15:24	160.00	00:03:05	0.0%	22.4%	77.6%
Amur Falcon	4	00:40:34	16.25	00:04:23	100.0%	0.0%	0.0%
African Harrier-Hawk	3	00:03:55	116.67	00:01:18	0.0%	48.9%	51.1%
Black-Shouldered Kite	3	00:07:42	36.67	00:02:34	0.0%	100.0%	0.0%
Steppe Buzzard	3	00:06:40	50.00	00:02:13	50.0%	50.0%	0.0%
Black (Yellow-billed) Kite	3	00:09:49	56.67	00:03:16	0.0%	100.0%	0.0%
African Marsh-Harrier	2	00:05:50	10.00	00:02:55	100.0%	0.0%	0.0%

3.8.2 Spatial data analysis

The position of the two vantage points on site has been shown in Figure 6. This figure shows the bird collision risk index for the site, calculated as described in Section 2. Each grid cell has been categorised and coloured according to the collision risk index for that cell. Data for all target bird species is included (see Table 5), with darker colours representing greater collision risk.

Vantage Point 1 covers the northern parts of the site, including the northernmost string of turbines. Vantage Point 2 covers the south-eastern parts of the site.

Figure 6 indicates higher bird collision risk in two areas. The first of these is on the ridge line in the north, between Turbines 19 and 20. This flight activity is most probably attributable to birds flying along the ridge line utilising favourable air currents produced by wind blowing up against the ridge (although the high flight activity does not seem to extend the full length of the ridge as one would expect). The second key area is immediately around Turbine 08 and the Vantage Point 2 position. This may be associated with the slightly higher kopje close to the Vantage Point, or the open habitat with good visibility for raptors to forage for prey. In both cases these higher collision risk scores are derived predominantly from several particularly long flights of non-Red Listed species, such as Booted Eagle, Jackal Buzzard and Rock Kestrel.

On this basis, no micro siting of these turbines is recommended at this stage. It is recommended that during post construction bird monitoring these turbines and their surrounds be prioritised for carcass searches in order to measure mortality rates, although all turbines will need to be searched in any case.

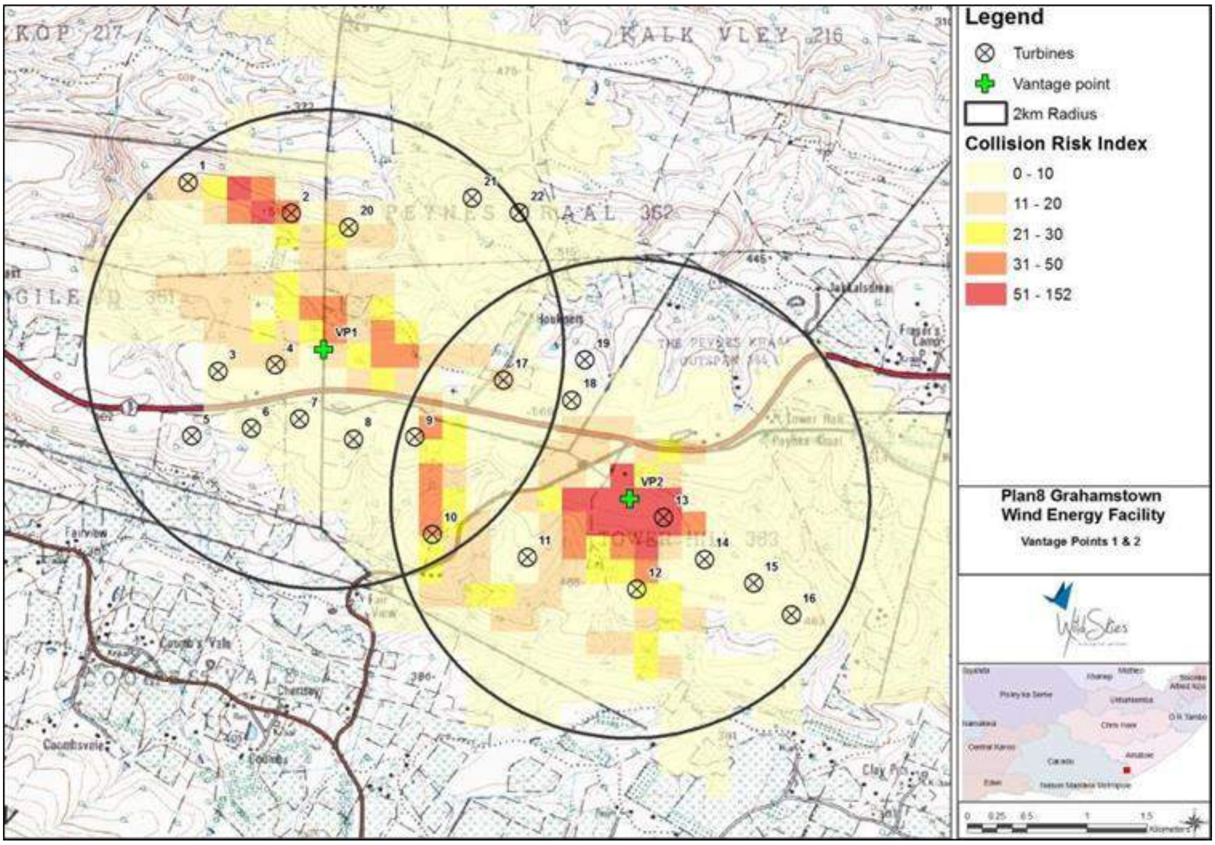


Figure 6. Collision risk index for all target bird species across the Grahamstown Plan8 site.

Scottish Natural Heritage (SNH) has written a guidance note on calculating theoretical collision rates for situations such as this (www.project-gpwind.eu). The SNH Collision Risk Model (also sometimes known as the Band model) makes several significant assumptions with respect to factors such as the speed that the bird flies at, the width of the turbine blade, and the dimensions of the turbine and the bird. At this stage in South Africa, at the very beginning of the learning curve, this author is of the opinion that calculations such as this would have limited use. A central factor to this calculation is the avoidance rate of the bird. That is, not every bird flight recorded through the rotor swept zone prior to construction will result in a collision with a turbine post construction. Birds take avoidance behaviour, either well before entering the facility or even at the last moment. SNH has published a set of avoidance rates and also advised that for species for which no avoidance rate is available (all species in South Africa currently) a rate of 99% should be used. This recommendation is based upon multiple sources. It is our opinion that in addition to the multiple tenuous assumptions involved in this calculation of collision rate, the fact that our entire calculation would represent only 1% of the true answer (given the 99% avoidance rate) this exercise would have little value. The type of qualitative interpretation of data presented elsewhere in this report is believed to be far more important for assessing the risk of the project.

ASSESSMENT OF RISK OF INTERACTION

In order to assess the risk of birds interacting with the proposed wind energy facility a risk matrix has been utilised (Allan, 2006; Smallie, 2011), whereby the following equation is used:

Risk of interaction = Probability of interaction x Severity of interaction

In this case the probability of interaction is in simple terms the outcomes of this monitoring programme combined with general knowledge and understanding of the species and its likelihood of interacting with the facility. Useful sources in making this assessment include: Jordan & Smallie (2010) and Retief *et al* (2011). Jordan and Smallie (2010) examined literature on the families of species affected elsewhere in the world by wind farms in order to identify families of birds which could be affected in South Africa. Retief *et al* scored a suite of South Africa bird species for a number of factors believed to be relevant to the species risk of interaction with wind farms, such as behavioural and morphological factors. Combining these scores they arrived at a final risk score per species and a list of 107 species believed most at risk.

The severity of interaction is the importance of the species involved, i.e. what are the implications of impacting on these species. This is based largely on the species conservation status (Taylor, 2014; IUCN 2013). These aspects are described in more detail below:

Probability of interaction

Based on the data emanating from the above described monitoring programme it is possible to now make an informed qualitative assessment of the importance of this site for the target species in order to narrow our focus down to species and interactions that are of most importance for this project. This is achieved through assessing each species in terms of how it utilises the site and how it could interact with the proposed facility.

4.1.1 Form of utilisation of site

Birds can utilise a site such as this in five ways: breeding, perching, roosting, foraging and overflying. Each of these is explained in more detail below:

Breeding

This is one of the most important forms of utilisation. Breeding is often the aspect of birds life history that they are most specialised in, requiring certain substrate and other conditions to be correct in order to breed. As a result, breeding habitat is probably the form of habitat most under threat for most threatened bird species in South Africa. The breeding phase is also a time when birds are particularly susceptible to disturbance, and any number of factors could result in failed breeding attempt. Once young birds are hatched they are also susceptible to impacts, particularly when recently fledged as their inexperience in flight renders them more at risk of collision with obstacles. On this site the only significant species found breeding is the African Crowned Eagle.

Perching

Raptors in particular spend a fair proportion of their time perching on various substrate such as trees, poles, fences, rocks, and any others suitable. Certain species hunt from the perch, whilst others merely rest on perches. Perch availability is therefore an important factor determining the distribution of various bird species.

Roosting

Most bird species roost at night in trees, cliffs or in the shallows of dams – all in an attempt to escape predation. Most large raptors roost at their nest site, whilst smaller gregarious raptors roost communally in trees or on overhead cables. Communal roosting is an important feature in determining the sensitivity of a site for birds since the congregation of numerous birds increases the likelihood of impacts occurring. Also – roosts are typically entered and exited in poor light conditions at the start and the end of the day, when the risk of collision with obstacles is greatest.

Foraging

Due to their energy needs, most birds spend most of their time foraging. This is done in a number of different ways by different groups of birds. The likelihood of bird species foraging over an area depends on the presence of their food source or prey in that area and the favourability of other factors such as topography and water availability.

Commuting

Of course almost all birds can and do fly. In the context of this project though we mean those species recorded flying for long durations, in large numbers or frequently, i.e. those species at risk of collision with obstacles on site. On certain sites birds may commute across the site, without actually utilising the site itself for anything else, and would still therefore be at risk of collision.

4.1.2 Form of interaction with facility

The likely interactions between birds and the proposed facility include: habitat destruction as a result of construction of wind turbines, roads, substations and power lines; disturbance of birds as a result of these activities and operation of the facility; displacement of birds from the site; collision and electrocution of birds with/on overhead power lines; and collision of birds with wind turbine blades. Each of these is discussed in more detail below:

Habitat destruction

Any destruction or alteration of natural habitat will have some negative effect on the various bird species present. However, many species will tolerate this and there will be little impact, so for many of the target species this is not considered to be significant. For species that may be breeding on site (i.e. the site provides breeding habitat in addition to foraging) this could be far more serious. These species have been identified in Table 6.

Disturbance

The situation with respect to this interaction is almost identical to that above for habitat destruction. Once again the species most likely to be affected in this regard are the species that breed on site.

Displacement of birds from site

Displacement refers to the scenario whereby a bird is forced to stop using a site or traversing it. This may result in a loss of habitat, or if the species was merely commuting across the site and now has to fly further around the site this may come with energetic costs to the bird. Key species in this regard are probably the large raptors and breeding species again. Breeding birds need to provide food for their young and are therefore already under pressure in terms of their energy balance. Any added travel distance could compromise the adults' well-being or its care for its young.

Collision & electrocution of birds with/on overhead power lines

Collisions are a significant threat posed to many bird species by overhead power lines. A collision occurs when a bird in flight does not see the cables, or sees them too late for effective evasive action. The bird is typically killed by the impact with the cable, or the subsequent impact with the ground. Most heavily impacted upon are bustards, storks, cranes and various species of water birds. 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). It is also important to note that any stay wires on met masts on site would pose a similar collision risk to an overhead power line. Although this monitoring programme did not detect such collisions on the

Grahamstown Plan8 site, Martin (pers.comm) has previously recorded a Denham's Bustard collision with such stay wires at a met mast, demonstrating that this is a real risk.

Electrocutions of birds on overhead lines are an important cause of unnatural mortality of raptors and storks. It has attracted plenty of attention in Europe, USA and South Africa (APLIC 1994; Alonso & Alonso 1999; van Rooyen & Ledger 1999). 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). Most at risk are the physically larger species such as eagles and vultures, which have more chance of bridging these clearances.

Collision of birds with wind turbines

Bird collisions with human developed infrastructure such as wind turbines have been well documented over the years (for e.g. Drewitt & Langston, 2008). Since the first birds were found under wind turbines it has more or less been assumed that the birds collided with turbine blades because they did not see them. Although vision certainly has a lot to do with the collision, it seems likely that various other factors also play a part. In recent research on bird vision (Martin, 2011; Martin & Shaw, 2010) suggest that birds may have reduced visual acuity in front of them when in flight, or in the case of vultures even be blind for a significant portion of their frontal vision.

Once again, Table 6 presents the assessment results for each species. A final probability score of 1 to 5 is assigned to each species based on the above information.

Severity of interaction

Conservation status (Taylor 2014, IUCN 2013) was taken as the primary index of severity of interaction, the assumption being that impacting on a threatened species is more severe than impacting on a common species. Although not all Red Listed currently, it is generally agreed in ornithological circles that almost all raptors (in particular the larger ones) require as much protection as possible. Scores were assigned to species as follows: Common and non-threatened species = 1; Most large to medium raptors, species protected under the Bonn Convention, certain korhaans and Near-threatened species = 2; Vulnerable species = 3; and Endangered = 4 (Taylor 2014).

Risk of interaction

The final risk score was obtained by multiplying the probability (1 to 5) and severity scores (1 to 4) to give a final risk score ranging between 0 and 15 (see final column in Table 6). These scores were then classed into High (10-15); Medium (5-9) and Low (0-4), or red, orange and yellow. Only one species, the African Crowned Eagle was judged to be at HIGH risk, with 5 species identified as MEDIUM risk. These species are all from two families: the Accipitridae (typical raptors) and Falconidae (falcons). The following section describes these species in more detail:

Accipitridae

Eagles in general are one of the groups of birds most affected by wind farms, with Golden Eagle *Aquila chrysaetos*; White-tailed Sea Eagle *Haliaeetus albicilla*; Bald Eagle *Haliaeetus leucocephalus*; Wedge-tailed Eagle *Aquila audax*; and White-bellied Sea Eagle *Haliaeetus leucogaster* all having been documented as colliding with turbines around the world (various authors). It certainly appears then that we should expect large eagles to be susceptible to collision with wind turbines on the proposed site if they utilise it frequently. The reason for this susceptibility probably lies mostly in behavioural aspects such as described earlier in this report, whereby birds such as this may approach turbines too closely even once they have seen them. Birds soaring typically hold their heads in a position looking downwards, and would be effectively blind above them - the direction from which a second or third blade may approach after the first blade has been successfully avoided.

African Crowned Eagle (29th most at risk species – Retief et al 2011)

The Crowned Eagle has been judged to be at HIGH risk at this site. This species was only recorded flying 5 times during this programme and is therefore not believed to be at very high risk of collision with turbines. This may be due to the birds foraging in forest in the valleys, rather than on the ridge tops or plateaus. However a breeding site for the species was found approximately 820 metres from Turbine 1. This places the birds at risk of disturbance impacts, as well as a collision risk for young birds that are raised and are likely to fly further afield when they disperse from the nest site.

In our opinion the appropriate mitigation measure for the risk posed to these birds by the facility is to identify a buffer area around the nest, within which turbines, roads and overhead lines should not be constructed. Large eagles such as this are often protected against wind farm impacts through the use of buffers. The radius of these buffers is mainly determined by the measured or estimated core foraging ranges of the affected birds (Martinéz *et al.* 2010). Where such information does not yet exist (such as for this project) a theoretical buffer area may be imposed to provide protection for the birds. A survey of literature available pertaining to eagle buffer sizes for various forms of development resulted in a range of recommended buffers from as little as 400 metres to 10 kilometres (see Ruddock & Whitfield 2007; Marja-Liisa Kaisanlahti-Jokimäki, *et al*. 2008; Colorado Division of Wildlife 2008; USFWS Utah Field Office's Guidelines for Raptor Protection From Human and Land Use Disturbances Guidelines; Bright, Langston, & Anthony – RSBP; Rydell, Engström, Hedenström, Larsen, Pettersson & Green, 2012). Some of this literature also points towards the importance of 'line of sight' in determining buffer size. The assumption is that if adult birds are able to see the proposed development (and presumably construction activities) from the nest this may disturb them or alter their behaviour. Informal discussion with other avifaunal specialists practising in SA reveals a range of buffers of between 800 and 2 000 metres. More recently the US Fish & Wildlife Service 2013 has recommended a buffer radius equal to half the inter nest distance for the species in the area.

In this case we believe a buffer of 1.2 kilometres to be appropriate, since: we have relatively few records of these birds flying on the site itself, implying that they may have a relatively small home range confined mostly within the gorge (which would make sense given their known behaviour, prey and foraging habits); and the topographic nature of the gorge means the nest is likely to be out of line of sight of turbines anyway, thereby probably reducing the likelihood of disturbance of the birds whilst on the nest. Figure 7 illustrates the implications of such a buffer for the proposed turbine layout. One turbine (T19) will need to be shifted eastwards to avoid this area.

It should be noted that this mitigation measure will be of general benefit to all bird species utilising this sensitive gorge, as it will provide greater clearance between the nearest turbine and the gorge.

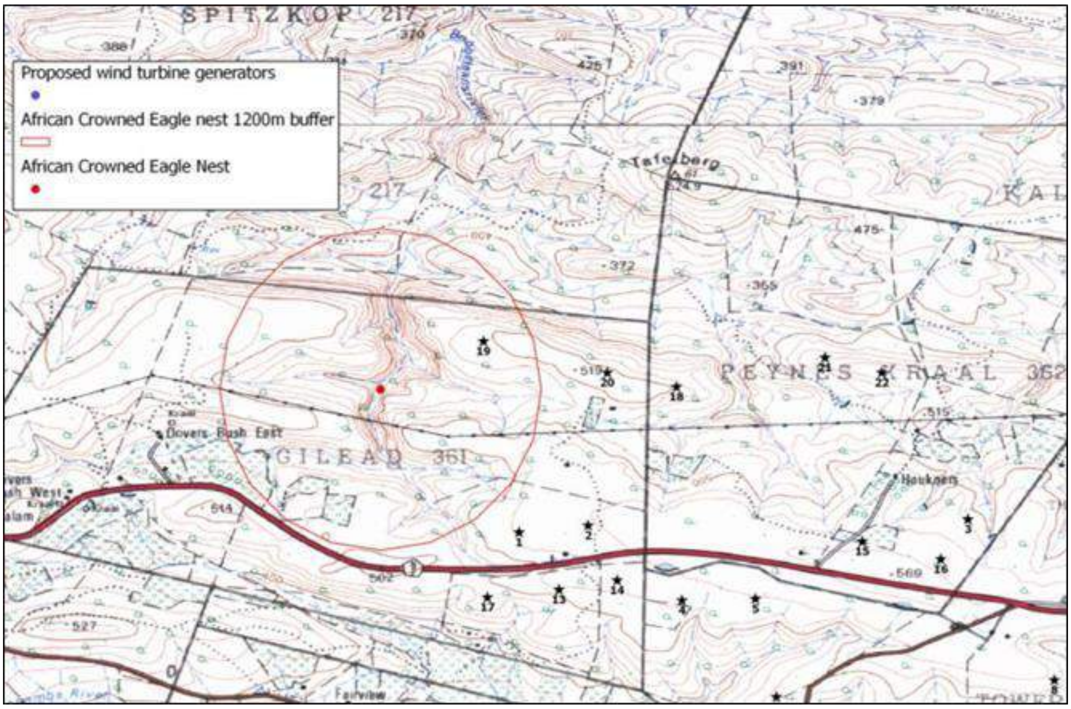


Figure 7. African Crowned Eagle nest and proposed 1.2 kilometre buffer.

Booted Eagle (55th most at risk species – Retief et al 2011)

The Booted Eagle was judged to be at MEDIUM risk, predominantly due to it being recorded flying frequently on site, mostly in spring. The mean height above ground of this species' flights was 63 metres (within rotor zone) and it spent 90% of its flight duration at rotor height. This is a fairly common species, with an estimated 700 breeding pairs in the Western, Northern and Eastern Cape provinces (Pepler *et al*, 2000, in Hockey *et al* 2005). Some Booted Eagles migrate, and are therefore present in South Africa approximately September to March, and others remain in the country longer and breed here. There is no specific mitigation required for this species.

Martial Eagle (5th most at risk species – Retief et al 2011)

Martial Eagle was judged to be at MEDIUM risk. Although it was recorded flying on site a number of times (all records in spring, and all on only 2 days), most of this flight time was spent at high altitude above rotor height. The species' Endangered conservation status (Taylor, 2014) drives its MEDIUM risk classification. This is an uncommon species, with an estimated 100-150 birds in the Western Northern and Eastern Cape combined. Although it is a species of high conservation concern, it does not seem to utilize this site regularly and no evidence of breeding on site was found. No specific mitigation is recommended for this species.

Jackal Buzzard (42nd most at risk species – Retief et al 2011)

The Jackal Buzzard has been adjudged to be at MEDIUM risk at this site. This is due to the frequent records of it flying on site, the mean flight height above ground of within rotor zone and the majority of its flight time being spent at rotor height, i.e. at risk of collision. This species common or non-threatened status is the only reason it is not a High risk species. This species occurs throughout South Africa and tends to be resident in a particular area, as is the case on this site where at least one pair probably resides in the broader area. It is a generalist in terms of habitat, although does favour shorter vegetation. It hunts mostly in flight, meaning that a large proportion of its time is spent flying, and thereby at some risk of collision with vertical obstacles. It is believed that this species will be susceptible to collision with wind turbines. There is no specific mitigation recommended for the management of this risk.

Falconidae

Lanner Falcon (22nd most at risk species – Retief et al 2011)

Lanner Falcon was judged to be at MEDIUM risk due to it having been recorded flying on site several times (almost all in spring), all at rotor height, and its Vulnerable conservation status (Taylor, 2014). This is a fairly common species, with a southern African population estimate of 9 000 to 18 000 breeding pairs (Cade 1982, in Hockey *et al* 2005). On this site, based on data collection to date, it would seem to be at some risk of collision with turbines, although this risk is not high enough to warrant any mitigation action.

Peregrine Falcon (45th most at risk species – Retief et al 2011)

The Peregrine Falcon was judged to be at MEDIUM risk, predominantly of collision with turbines, due to it being recorded flying ten times on site (all of which were in autumn and summer, and spread across a total of 3 days). Most of this flight duration was spent at rotor height. This species has recently been downgraded in conservation status, from Near-threatened in 2000 (Barnes, 2000) to not Red Listed in 2014 (Taylor, 2014). The southern African population is estimated at 800 – 1200 breeding pairs (Hartley, 2000; Jenkins unpublished; in Hockey *et al* 2005). No specific mitigation is required for this species.

Table 6. Target bird species for the Grahamstown Plan8 site and their form of utilisation of the site, likely interactions between each species and the facility, and final risk score for the species is presented.

Common name	*Species*	Ecological group	Severity score	Method which recorded species			Form of utilisation of site	Theoretical interactions with facility	Probability score	Risk score
				Driven Transect	Incid. Obs.	Vantage Point				
African Crowned Eagle	*Stephanoaetus coronatus*	Raptor	3		✓	✓	Forage, breed close to site	C E HD D	4	12
African Fish-Eagle	*Haliaeetus vocifer*	Raptor	2			✓	Commute	C E HD D	2	4
African Goshawk	*Accipiter tachiro*	Raptor	1		✓		Forage	C, HD, D	1	1
African Harrier-Hawk	*Polyboroides typus*.	Raptor	1		✓	✓	Forage, perch, roost	C HD D	2	2
African Marsh-Harrier	*Circus ranivorus*	Raptor	4			✓	Forage, commute	C HD D	1	4
Amur Falcon	*Falco amurensis*	Raptor	2	✓	✓	✓	Forage, commute	C	2	4
Black Harrier	*Circus maurus*	Raptor	4		✓	✓	Forage, commute	C HD D	1	4
Black (Yellow-billed) Kite	*Milvus migrans*	Raptor	1		✓	✓	Forage, commute	C	1	1
Black Stork	*Ciconia nigra*	Large terrestrial	3				-	C	-	-
Black-shouldered Kite	*Elanus caeruleus*	Raptor	1		✓	✓	Forage, commute, perch	C	1	1
Black-winged Lapwing	*Vanellus melanopterus*	Small terrestrial	1				-	C HD D	-	-
Booted Eagle	*Aquila pennatus*	Raptor	2	✓	✓	✓	Forage, commute, perch	C HD D	3	6
Steppe Buzzard	*Buteo vulpinus*	Raptor	1	✓	✓	✓	Forage, commute, perch	C	2	2
Denham's Bustard	*Neotis denhamii*	Large terrestrial	3				-	C HD D	-	-
Jackal Buzzard	*Buteo rufofuscus*	Raptor	2	✓	✓	✓	Forage, perch, commute, likely breed	C HD D	4	8
Lanner Falcon	*Falco biarmicus*	Raptor	3		✓	✓	Forage, commute	C	2	6
Long-crested Eagle	*Lophaetus occipitalis*	Raptor	2	✓			Forage, commute	C	1	2
Martial Eagle	*Polemaetus bellicosus*	Raptor	4	✓	✓	✓	Forage, commute	C E HD D	2	8
Rock Kestrel	*Falco rupicolus*	Raptor	1	✓	✓	✓	Forage, commute, perch, likely breed	C	4	4
Peregrine Falcon	*Falco peregrinus*	Raptor	2	✓	✓	✓	Forage, perch	C HD D	3	6
Secretarybird	*Sagittarius serpentarius*	Large terrestrial	3				-	C HD D	-	-
Verreaux's Eagle	*Aquila verreauxi*	Raptor	3				-	C E HD D	-	-
White-bellied Korhaan	*Eupodotis senegalensis*	Large terrestrial	3		✓		Forage	C HD D	1	3
White Stork	*Ciconia ciconia*	Water bird	2				-	C HD D	-	-

C = collision with either turbines or power lines, E = electrocution on power lines, D = disturbance, HD = habitat destruction, DISPL = displacement

SITE SENSITIVITY ANALYSIS

The primary means of minimising the potential impacts identified for a wind energy facility is typically the optimal placement of the proposed infrastructure. In order to achieve this, a sensitivity analysis is prepared for the site. This has been done below in Figures 8 and 9.

Avifaunal sensitivity for a project of this nature may be viewed at two spatial levels:

National level

At the national level two bird conservation initiatives are particularly relevant to this exercise: the BirdLife South Africa-Endangered Wildlife Trust "Avian wind farm sensitivity map for South Africa" (Retief *et al*, 2011); and the Important Bird Areas (IBA) programme of BirdLife South Africa (Barnes, 1998). The sensitivity map (Retief *et al*, 2011) consolidated multiple avifaunal spatial data sources for a list of priority species in order to categorise pentads (9 x 9 kilometre grid cells – as shown in Figure 8) across South Africa according to their risk of bird- wind farm interactions. The darker grid cells indicate higher risk and the lighter coloured cells indicate lower risk. It is clear from Figure 8 that the proposed site is classed in one of the lower sensitivity categories (Retief *et al*, 2011). It should be noted that since the primary data sources used to develop this map were the SABAP1 and 2, the map is affected by how well the areas of the country were covered by atlasing effort. It is therefore possible that areas of seemingly low sensitivity are actually data deficient. The proposed site is located within a 60 kilometre radius of the nearest IBAs, Alexandria Coastal Belt (SA094), Amatole Forest Complex (SA092) and the Katberg Readsdale Forest Complex (SA091). These IBA's will have little influence on the avifaunal sensitivity of the Grahamstown Plan8 site.

Based on these two data sources then, the Grahamstown Plan8 site is in a relatively low sensitivity area at the national scale.

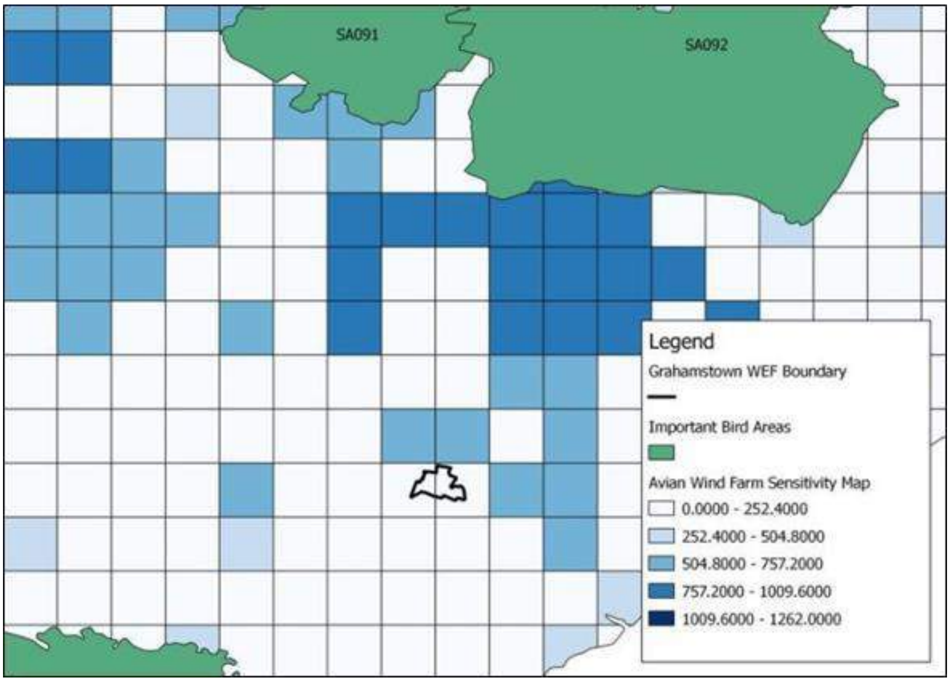


Figure 8. The proposed Grahamstown Plan8 Wind Energy Facility site (black polygon) relative to the Avian Wind Farm Sensitivity Map (Retief et al, 2011). Dark colours indicate higher sensitivity or risk and light colours indicate lower sensitivity. Important Bird Areas are shown in green polygons.

Local on- site level

On site, three factors can be considered in determining avifaunal sensitivity: habitat available to avifauna; specific avifaunal features; and the bird collision risk index. On the Grahamstown Plan8 site the most important of these is the 'specific avifaunal features', in this case an African Crowned Eagle nest. A buffer area of a radius of 1.2 kilometres around this nest has been identified as HIGH sensitivity. Within this area no new infrastructure should be built. One turbine, T01 is currently situated within this area and it is recommended that it be re-sited out of this zone or discarded. A number of other potentially important avian habitat areas, in small gorges, have been identified as MEDIUM sensitivity. Although these areas have been surveyed thoroughly during this programme, and no Red Listed species were identified breeding, they remain important avian habitat for a host of other non-threatened bird species. Ideally no infrastructure should be built in these areas either. These areas are currently avoided by most planned infrastructure. The exception to this is the overhead 132kV power line. This line is approximately 600 metres long, 400 metres of which is within the MEDIUM sensitivity zone. Due to the short length of this power line, and the fact that it will connect to an existing power line already in this zone, this is acceptable. It is recommended that no further changes to the layout of the infrastructure are made which will infringe on these areas. As explained in Section 3.8.2, the collision risk index has not been used as a factor in final sensitivity mapping on account of most of the collision risk being comprised of common bird species such as Jackal Buzzard and Rock Kestrel.

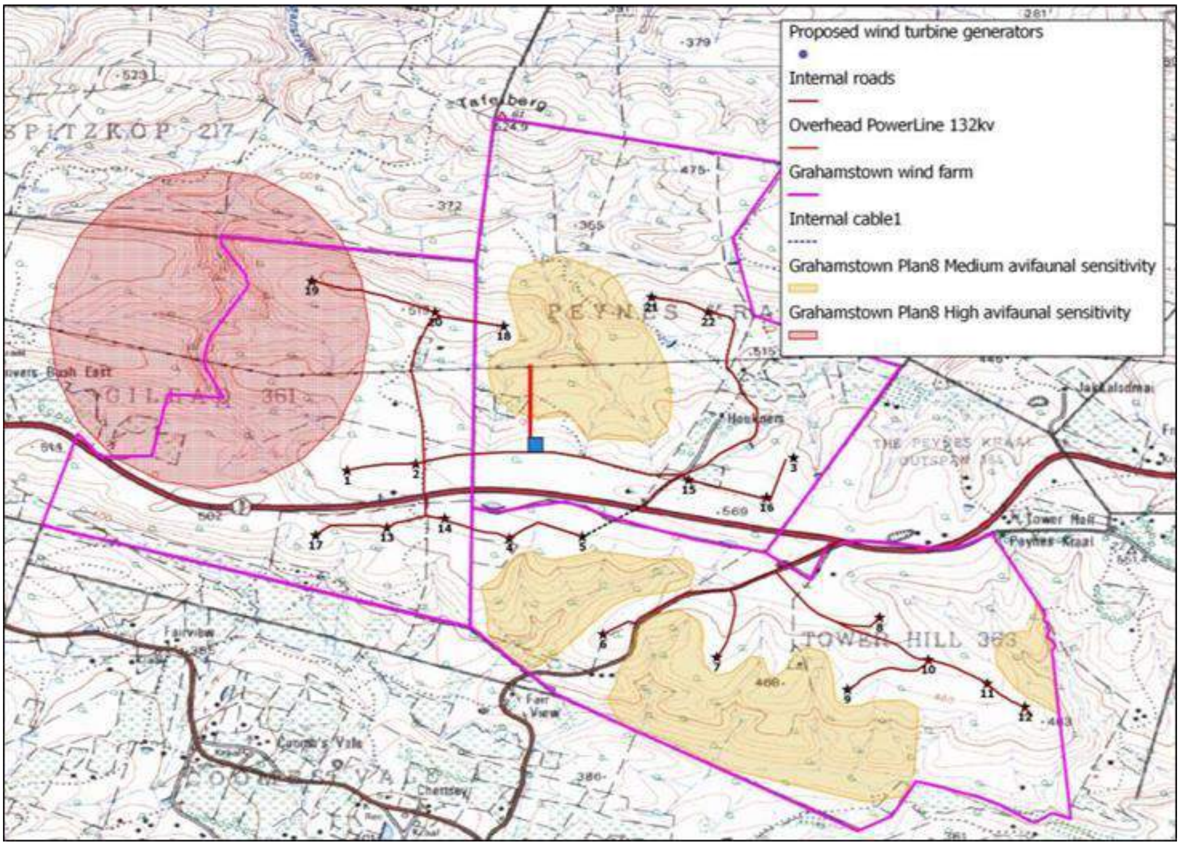


Figure 9. Avifaunal sensitivity analysis for the Grahamstown Plan8 Wind Energy Facility.

Grid connection power line options

One route exists for the construction of the required 132kV overhead grid connection power line (see Figure 9). This line will be approximately 600 metres long. Only one alternative route for this power line was presented for assessment. This route is acceptable for avifauna.

POST CONSTRUCTION BIRD MONITORING FRAMEWORK

The bird monitoring work done to date on the Grahamstown Plan8 WEF site has established a baseline understanding of the distribution, abundance and movement of key bird species on and near the site. If the project is authorized and constructed, the baseline information will need to be compared to data collected once the facility is operational. There will also be a need to measure the impacts of the facility on avifauna, particularly through collision mortality. The following programme outline has therefore been developed to meet these needs. It is recommended that this programme be implemented by the developer. It is recommended that the live bird monitoring be conducted for at least one year post construction, and that the mortality estimates be continued for at least 3 years, and be repeated in years 5, 10, 15 etc. The latest available version of the best practice guidelines (Jenkins *et al*, 2014) should be adhered to in this regard.

During construction bird monitoring

The primary avifaunal feature on site that will require assessment during construction is the African Crowned Eagle nest described elsewhere in this report. It is recommended that at least 3 brief site visits be conducted (by a suitably qualified and accredited avifaunal specialist) to the site during any construction activities that take place in the eagles breeding season. This season is preliminarily defined as August to January, although would need to be confirmed in the relevant year.

Post construction monitoring

The intention with post construction bird monitoring is to repeat as closely as possible the methods and activities used to collect data pre-construction. One very important additional component needs to be added, namely mortality estimates through carcass searches. The following programme has therefore been developed to meet these needs, and should start as soon as possible after the construction of the first phase of turbines (not later than 3 months):

The six walked transects of approximately one kilometre each that have been done during pre-construction monitoring should be continued, as should the four vehicle based road count routes. The focal sites already established as well as any new focal sites identified by the 'during construction monitoring' should be monitored. All other incidental sightings of priority species (and particularly those suggestive of breeding or important feeding or roosting sites or flight paths) within the broader study area will be carefully plotted and documented. The two Vantage Points already established should be used to continue data collection post construction. The exact positioning of these may need to be refined based on the presence of new turbines and roads. A total of 12 hours of observation will be conducted at each vantage point on each site visit, resulting in a total of 48 hours direct observation on site per site visit. The activities at the control site should be continued, i.e. one Vantage Point and three Walked Transects.

It is estimated that the above activities will require 6 days on site for four site visits in a 12 month period, including the control site.

Mortality estimates

This is a new component of the methodology. The area surrounding the base of turbines should be searched for collision victims. As an absolute minimum, the search area should be defined by a radius equal to 75% of the turbine height (ground to blade-tip). For the proposed turbine model this will mean a search radius of approximately 112 metres around the base of each turbine. The area around each turbine should searched using transects no greater than 10 meters apart, this width should be reduced where groundcover reduces visibility. Transects should be walked at a slow pace and carefully and methodically searched for any sign of a bird collision incident (carcasses, dismembered body parts, scattered feathers, injured birds). The period between searching individual turbines, the search interval, should be informed by assessments of scavenge and decomposition rates conducted in the initial stages of the monitoring period. Ideally the search interval should be shorter than the average carcass removal time. As a rule of thumb, a search interval of one to two weeks could be expected. On a facility of this size it will be feasible to search all turbines (22) at this frequency. Any suspected collision casualties should be comprehensively documented (for more detail see Jenkins *et al*, 2014). It is also important that associated infrastructure such as power lines and wind masts be searched for collision victims according to similar methods.

It is important that in addition to searching for carcasses under turbines, an estimate of the detection (the success rate that monitors achieve in finding carcasses) and scavenging rates (the rate at which carcasses are removed and hence not available for detection) is also obtained (Jenkins *et al*, 2014).

Both of these aspects can be measured using a sample of carcasses of birds placed out in the field randomly. The rate at which these carcasses are detected as well as the rate at which they decay or are removed by scavengers should be measured. It is important that at least 20 carcasses are used, and that this is done twice in a 12 month period, in summer and in winter. Although it is important to try to use carcasses similar in size and appearance to the target species for the site, this is unlikely to be achievable in practice. It is more likely that a readily obtainable species will be used, such as ducks or geese.

Since the mortality searches need to be done more frequently than the other monitoring), this will require a separate team with different skills and hopefully based closer to the site. This should be discussed with the supervising specialist as soon as the project is confirmed as going ahead. At this stage the time required for this component of monitoring is difficult to determine since it will also be dependent on the exact methods, i.e. dogs and other options. This should be discussed more with the developer as the time approaches.

CONCLUSION & RECOMMENDATIONS

A summary of the most important findings of the Grahamstown Plan8 pre-construction bird monitoring programme are as follows:

- A total of 24 target bird species were identified for the site at the outset of the programme. These are the species considered most important, on the basis of their likely susceptibility to wind farm impacts and their conservation status. Eighteen of these species were confirmed on site during this programme.

- A total of 102 small bird species were recorded on site by Walked Transects, with a peak in species richness in spring and summer. A number of southern African endemics were included in this set of species, but no Red Listed species were recorded. No particularly sensitive aspects are evident from this data set.

- Eight large bird species were recorded on and near site by Vehicle Transects, with a peak in spring once again. Martial Eagle (Endangered) was the only Red Listed species amongst these.

- Extensive surveys of the gorges and valleys adjacent to the site were conducted in all seasons. The only sensitive bird species found breeding in these areas was the African Crowned Eagle, which had reared a large (not yet fledged) chick at the time of writing. This is the most important finding of this programme and is discussed in more detail below. Verreaux's Eagle was not recorded at all on or near site during the duration of this programme, and previous field work for the EIA. No evidence of either current or historic nests were found in the gorges that were surveyed. Martial Eagle was recorded on site several times in spring, but no nests were found in the gorges.

- Fifteen target bird species were recorded on site by Incidental Observations, with a peak in species in spring again.

- Fifteen target bird species were recorded flying on site during Vantage Point observations, five of which are Red Listed: the Martial Eagle (Endangered); Lanner Falcon (Vulnerable); Black Harrier (Endangered); African Crowned Eagle (Vulnerable) and African Marsh-Harrier (Endangered). In all a total of 218 records were made during 96 hours of observation. The most frequently recorded species was Jackal Buzzard, followed by Rock Kestrel and Booted Eagle. Based on the species' mean flight height above ground, and percentage of flight time spent at rotor height (approximately 30 – 150m), the species likely to be most at risk of collision with turbines appear to be Jackal Buzzard and Rock Kestrel. A spatial collision risk index was created for the site, and indicates two key areas of higher collision risk, close to Turbines 19 and 20 and Turbine 08. Since the flight records responsible for these scores are mostly long records of Booted Eagle, Rock Kestrel and Jackal Buzzard (none of which are Red Listed), no mitigation action is deemed necessary.

- Taking all data collected on site into account, one species (African Crowned Eagle) is judged to be at HIGH risk if the facility is built, and five species are judged to be at MEDIUM risk (Booted Eagle, Martial Eagle, Jackal Buzard, Lanner Falcon and Peregrine Falcon).

- At a national level, the Grahamstown Plan8 site would appear to be one of relatively low avifaunal sensitivity. On site, a buffer area of 1.2km around the African Crowned Eagle nest has been identified as being of HIGH sensitivity, and the remaining small gorges have been identified as MEDIUM sensitivity.

The following management recommendations are made for the management of risk to avifauna at this site:

- No infrastructure should be built in the areas identified as HIGH sensitivity in this report. This means that Turbine 19 will need to be either discarded or moved approximately 250 metres east. No changes should be made to the layout of infrastructure which may infringe on the MEDIUM sensitivity areas.

- During construction, a specialist should monitor the effect of construction activities on the African Crowned Eagle breeding season.

- All power line linking the turbines and linking turbine strings to the on-site substation should be placed underground. Where this is not possible this should be discussed with the specialist and a compromise reached that provides acceptable protection for birds.

- The power line linking the site to the Eskom grid will be above ground but must conform to all Eskom standards in terms of bird friendly pole monopole structures with Bird Perches on every pole top (to mitigate for bird electrocution), and anti-bird collision line marking devices (to mitigate for bird collision). It is particularly important that the collision mitigation devices used are durable and remain in place on the line for the full lifespan of the power line. It will be Plan8/Eskom's responsibility to maintain these devices in effective condition for this period. Systematic patrols of this power line should be conducted during post construction bird monitoring for the wind energy facility, in order to monitor the impacts, the effectiveness of mitigation, and the durability of the mitigation measures.

- A final avifaunal walk through should be conducted prior to construction to ensure that all the avifaunal aspects have been adequately managed and to ground truth the final layout of all infrastructure. This will most likely be done as part of the site specific Environmental Management Plan. This will also allow the development of specific management actions for the Environmental Control Officer during construction and training for relevant on site personnel if necessary.

- The 'during' construction and post-construction bird monitoring programme outlined by this report should be implemented by a suitably qualified avifaunal specialist. In particular the post construction monitoring of live birds should be conducted for at least 1 year and the measurement of bird fatalities through carcass searches for at least 3 years, and repeated in years 5, 10, 15 etc after the commissioning of the facility (see Jenkins et al, 2014). As mentioned above this monitoring should include the grid connection power line.

- The findings of post-construction monitoring should be used to measure the effects of this facility on birds. If significant impacts are identified the wind farm operator will have to identify and implement suitable mitigation measures.

If these recommendations are adhered to, this project can proceed with acceptable levels of risk to avifauna.

ACKNOWLEDGEMENTS

The field team from Garden Route Birding are thanked for their excellent field work during this programme, and Andre Tucker of AJT Interactive Design & GIS Mapping is thanked for conducting the GIS analysis.

REFERENCES

Acha, A. 1997. Negative impact of wind generators on the Eurasian Griffon *Gyps fulvus* in Tarifa, Spain. Vulture News 38:10-18

Allan, J. 2006. A Heuristic Risk Assessment Technique for Birdstrike Management at Airports. Risk Analysis, Vol 26 No. 3. 723-729

Alonso, J. A., & Alonso, J. C. 1999. Collision of birds with overhead transmission lines in Spain. In: Ferrer M and Janss F E (eds), Birds and powerlines, Quercus, Madrid, pp57 - 82.

Anderson, M. D. 2001. The effectiveness of two different marking devices to reduce large terrestrial bird collisions with overhead electricity cables in the eastern Karoo, South Africa. Karoo Large Terrestrial Bird Powerline Project, Directorate Conservation & Environment (Northern Cape), Kimberley.

Avian power line interaction committee (APLIC). 1994. Mitigating Bird Collisions with Power Lines: The State of the Art in 1994. Edison Electric Institute. Washington D.C

Barclay, R.M.R., Baerwald, E.F., Gruver, J.C. 2007. Variation in bat and bird fatalities at wind energy facilities: assessing the effects of rotor size and tower height. Canadian Journal of Zoology 85: 381-387

Barnes, K.N. (ed.) 1998. The Important Bird Areas of southern Africa. BirdLife South Africa: Johannesburg.

Barrios, L. & Rodriguez, A. 2004. Behavioral and environmental correlates of soaring-bird mortality at on-shore wind turbines. Journal of Applied Ecology 41: 72-81

Bevanger, K. 1994. Bird interactions with utility structures: collision and electrocution, causes and mitigating measures. Ibis 136: 412-425. 184

Bevanger, K. 1998. Biological and conservation aspects of bird mortality caused by electricity power lines: a review. Biological Conservation 86: 67-76.

Bevanger, K. 1999. Estimating bird mortality caused by collision and electrocution with power lines; a review of methodology. In: Ferrer, M. and Janss, G.F.E. (Eds.) Birds and Power Lines. Collision, Electrocution and Breeding: pages 29-56. Servicios Informativos Ambientales/Quercus, Madrid.

Cade, T.J. 1982. Falcons of the world. Collins, London.

Colorado Division of Wildlife 2008. Recommended buffer zones and seasonal restrictions for Colorado raptors.

Curry, R.C. & Kerlinger, P. 2000. Avian mitigation plan: Kenetech model wind turbines, Altamont Pass WRA, California, In: Proceedings of the National Avian-Wind Power Planning Meeting III, San Diego California, May 1998

De Lucas, M., Janns, G.F.E., Whitfield, D.P., & Ferrer, M. 2008. Collision fatality of raptors in wind farms does not depend on raptor abundance. Journal of Applied Ecology 45: 1695-1703

Doty, A.C. & Martin, A.P. 2013. Assessment of bat and avian mortality at a pilot wind turbine at Coega, Port Elizabeth, Eastern Cape, South Africa New Zealand Journal of Zoology, Volume 40, Issue 1, 2013

Drewitt, A.L., & Langston, R.H.W. 2006. Assessing the impacts of wind farms on birds. Ibis 148:29-42

Drewitt, A.L., & Langston, R.H.W. 2008. Collision effects of wind-power generators and other obstacles on birds. Annals of the New York Academy of Science 1134: 233-266

Erickson, W.P., Johnson, G.D., Strickland, M.D., Kronner, K., & Bekker, P.S. 1999. Baseline avian use and behaviour at the CARES wind plant site, Klickitat county, Washington. Final Report. Prepared for the National Renewable Energy Laboratory.

Erickson, W.P., Johnson, G.D., Strickland, M.D., Young, D.P., Sernka, K.J., Good, R.E. 2001. Avian collisions with wind turbines: a summary of existing studies and comparison to other sources of avian collision mortality in the United States. National Wind Co-ordinating Committee Resource Document.

Erickson, W.P., Johnson, G.D., Strickland, M.D., Young, Good, R., Bourassa, M., & Bay, K. 2002. Synthesis and comparison of baseline avian and bat use, raptor nesting and mortality from proposed and existing wind developments. Prepared for Bonneville Power Administration.

Everaert, J. 2003. Wind turbines and birds in Flanders: Preliminary study results and recommendations. Natuur. Oriolus 69: 145-155

Gill, J.P., Townsley, M. & Mudge, G.P. 1996. Review of the impact of wind farms and other aerial structures upon birds. Scottish Natural Heritage Review 21.

Hartley RR. 2000. Ecology of Taita *Falco faschiinucha* Peregrine *Falco peregrinus* and Lanner Falcons *Falco biarmicus* in Zimbabwe. In Chancellor RD, Meyburg, BU (Eds). Raptors at risk. Pp 87 – 105.

Harrison, J.A., Allan, D.G., Underhill, L.G., Herremans, M., Tree, A.J., Parker, V & Brown, C.J. (eds). 1997. The atlas of southern African birds. Vol. 1&2. BirdLife South Africa, Johannesburg.

Hockey, P.A.R., Dean, W.R.J., Ryan, P.G. (Eds) 2005. Roberts – Birds of Southern Africa, VIIth ed. The Trustees of the John Voelcker Bird Book Fund, Cape Town.

Hodos, W. 2002. Minimization of motion smear: Reducing avian collisions with turbines. Unpublished subcontractor report to the National Renewable Energy Laboratory. NREL/SR 500-33249

Howell, J.A. Noone, J. 1992. Examination of avian use and mortality at a US Windpower wind energy development site, Montezuma Hills, Solano County, California. Final report. Prepared for Solano County Department of

Environmental Management, Fairfield, California.

Howell, J.A. 1995. Avian mortality at rotor sweep areas equivalents Altamont Pass and Montezuma Hills, California. Prepared for Kenetech Wind Power, San Francisco, California.

IUCN 2013. IUCN Red List of Threatened Species. Version 2012.2. <www.iucnredlist.org>. Downloaded on 26 March 2013.

Jenkins AR, Smallie J.J. and Diamond M. 2010. Avian collisions with power lines: a global review of causes and mitigation with a South African perspective. Bird Conservation International20: 263-278.

Jenkins, A.R., van Rooyen, C.S, Smallie, J.J, Harrison, J, Diamond, M, Smit-Robinson, H.A., & Ralston, S. 2014. Birdlife South Africa/Endangered Wildlife Trust Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa

Jordan, M., & Smallie, J. 2010. A briefing document on best practice for pre-construction assessment of the impacts of onshore wind farms on birds. Endangered Wildlife Trust, Unpublished report.

Kingsley, A & Whittam, B. 2005. Wind turbines and birds – A background review for environmental assessment. Unpublished report for Environment Canada/Canadian Wildlife Service.

Krijgsveld, K.L. Akershoek, K. , Schenk, F., Dijk, F., & Dirksen, S. 2009. Collision risk of birds with modern large wind turbines. Ardea 97: 357-366

Kuvlevsky, W.P., Brennan, L.A., Morrison, M.L., Boydston, K.K., Ballard, B.M. & Bryant, F.C. 2007. Wind energy development and wildlife conservation: challenges and opportunities. Journal of Wildlife Management 71: 2487-2498.

Küyler , E.J. 2004. The impact of the Eskom Wind Energy Demonstration Facility on local avifauna – Results from the monitoring programme for the time period June 2003 to Jan 2004. Unpublished report to Eskom Peaking Generation.

Madders, M. & Whitfield, D.P. 2006. Upland raptors and the assessment of wind farms impacts. Ibis 148: 43-56.

Marja-Liisa Kaisanlahti-Jokimäki, et al. 2008. Territory occupancy and breeding success of the Golden Eagle (Aquila chrysaetos) around tourist destinations in northern Finland. Ornis Fennica 85:00–00. 2008

Martinéz, J.E., Calco, J.F., Martinéz, J.A., Zuberogoitia, I., Cerezo, E., Manrique, J., Gómez, G.J., Nevado, J.C., Sánchez, M., Sánchez, R., Bayo, J. Pallarés, A., González, C., Gómez, J.M., Pérez, P. & Motos, J. 2010. Potential impact of wind farms on territories of large eagles in southeastern Spain. Biodiversity and Conservation 19: 3757-3767.

Martin G.R., & Shaw, J.M. 2010. Bird collisions with power lines: Failing to see the way ahead? Biological Conservation.

Martin. G.R. 2011.Understanding bird collisions with man-made objects: a sensory ecology approach. Ibis 2011, 153 – p 239.

Mucina, L; Rutherford, C. 2006. The Vegetation of South Africa, Lesotho and Swaziland, South African National Biodiversity Institute, Pretoria.

Pepler, D, Martin, R., van Hensbergen, HJ. 2000. Estimating the breeding population of Booted Eagles in the Cape Province, South Africa. Journal of Raptor Research 35:15-19.

Retief, E, Anderson, M., Diamond, M., Smit, H., Jenkins, A. & Brooks, M. 2011. Avian Wind Farm Sensitivity Map for South Africa: Criteria and Procedures used.

Richardson, W.J. 2000. Bird migration and wind turbines: Migration timing, flight behaviour and collision risk. In Proceedings of the National Avian-wind Power Planning Meeting III, San Diego, California, May 1998.

M. Ruddock & D.P. Whitfield. 2007. A Review of Disturbance Distances in Selected Bird Species. A report from Natural Research (Projects) Ltd to Scottish Natural Heritage

Rydell, J., Engstrom, H., Hedenstrom, A., Larson, J.K., Petterrson, J.& Green, M. 2012. The effect of wind power on birds and bats – a synthesis. Unpublished report by the Swedish Environmental Protection Agency. ISBN 978-91-620-6511-9

Smallwood, K.S. & Thelander, C. 2008. Bird mortality in the Altamont Pass Wind Resource Area, California. Journal of Wildlife Management 72: 215-223.

Smallie, J. 2011. A power line risk assessment for selected South African birds of conservation concern. Master of Science Thesis – Submitted to the University of the Witwatersrand.

Taylor, M.R. (ed.) 2014. The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. BirdLife South Africa, Johannesburg. In press.

Tuer V., & Tuer, J. 1974. Crowned Eagles in the Matopos. Honeyguide 80: 32-41

US Fish & Wildlife Service. 2013. Eagle conservation plan guidance; Module 1 - land-based wind energy. Version 2. Division of Migratory Bird Management. Unpublished guidance document.

Van Rooyen , C.S. & Ledger, J.A. 1999. Birds and utility structures: Developments in southern Africa. Pp 205-230 in Ferrer, M. & G..F.M. Janns. (eds.) Birds and Power lines. Quercus, Madrid, Spain. 238pp.

Van Rooyen, C.S. 2004. The Management of Wildlife Interactions with overhead lines. In: The Fundamentals and practice of Overhead Line Maintenance (132kV and above), pp217-245. Eskom Technology, Services International, Johannesburg 2004.

Young, D.J., Harrison, J.A., Navarro, R.A., Anderson, M.D., & Colahan, B.D. (eds) 2003. Big Birds on Farms: Mazda CAR Report 1993-2001. Avian Demography Unit. Cape Town.

Websites:

www.abcbirds.org American Bird Conservancy Accessed 2012

www.sibleyguides.com Sibley Guides Accessed 2012

www.nssf.org National Shooting Sports Foundation Accessed 2012

www.sabap2.adu.org.za. The Second Southern African Bird Atlas Project. In progress. Accessed February 2013

www.project-gpwind.eu The Good Practice Wind project Accessed 2012

www.birdlife.org Birdlife International Accessed October 2013

www.birdlife.org.za BirdLife South Africa Accessed October 2013

www.iucnredlist.org. Accessed October 2013

www.mybirdpatch.adu.org.za

APPENDIX 1. BIRD SPECIES RECORDED ON THE GRAHAMSTOWN PLAN8 WIND ENERGY FACILITY SITE DURING WALKED TRANSECTS

	Full year			Autumn			Winter			Spring			Summer		
Total species	**102**			**46**			**51**			**64**			**57**		
	# birds	**# records**	**# birds/km**	**# birds**	**# records**	**# birds/km**	**# birds**	**# records**	**# birds/km**	**# birds**	**# records**	**# birds/km**	**# birds**	**# records**	**# birds/km**
Barn Swallow	121	13	5.46	4	3	0.72							117	10	21.12
Dark-capped Bulbul	106	60	4.78	19	13	3.43	59	24	10.65	14	10	2.53	14	13	2.53
Neddicky	89	82	4.02	15	15	2.71	21	19	3.79	33	29	5.96	20	19	3.61
Cape Glossy Starling	76	25	3.43	42	10	7.58	23	12	4.15	6	2	1.08	5	1	0.90
Speckled Mousebird	69	20	3.11	33	7	5.96	9	4	1.62	25	7	4.51	2	2	0.36
Bokmakierie	68	37	3.07	18	9	3.25	22	13	3.97	11	6	1.99	17	9	3.07
Sombre Greenbul	66	52	2.98	16	13	2.89	20	14	3.61	21	16	3.79	9	9	1.62
Rufous-naped Lark	63	57	2.84	1	1	0.18	29	26	5.23	21	18	3.79	12	12	2.17
Malachite Sunbird	56	43	2.53	6	5	1.08	21	14	3.79	16	14	2.89	13	10	2.35
Cape Turtle-Dove	53	39	2.39	23	15	4.15	19	15	3.43	1	1	0.18	10	8	1.81
Wailing Cisticola	50	42	2.26	2	1	0.36	8	6	1.44	28	24	5.05	12	11	2.17
Cape Longclaw	47	30	2.12	10	8	1.81	12	7	2.17	16	8	2.89	9	7	1.62
Cape Canary	34	10	1.53	17	4	3.07				17	6	3.07			
Common Fiscal	34	26	1.53	11	7	1.99	14	11	2.53	4	4	0.72	5	4	0.90
Yellow Canary	34	12	1.53				19	6	3.43	15	6	2.71			
Greater Double-collared Sunbird	33	15	1.49	3	2	0.54	22	7	3.97	8	6	1.44			
Southern Boubou	31	20	1.40	7	5	1.26	5	3	0.90	10	6	1.81	9	6	1.62
Cape White-eye	29	13	1.31	19	8	3.43	2	2	0.36	5	1	0.90	3	2	0.54
Red-winged Starling	28	8	1.26	17	2	3.07	9	4	1.62				2	2	0.36
Southern Double-collared Sunbird	25	14	1.13	7	4	1.26	14	7	2.53	2	2	0.36	2	1	0.36
Cape Weaver	22	6	0.99	4	3	0.72	16	2	2.89				2	1	0.36
Cape Robin-Chat	21	20	0.95	5	5	0.90	11	11	1.99	4	3	0.72	1	1	0.18
Fork-tailed Drongo	21	14	0.95	12	7	2.17	1	1	0.18	7	5	1.26	1	1	0.18

Bar-throated Apalis	20	15	0.90	6	4	1.08	8	6	1.44				6	5	1.08
Cape Sparrow	20	1	0.90	20	1	3.61									
Knysna Turaco	20	11	0.90	6	3	1.08	2	2	0.36	10	5	1.81	2	1	0.36
Black-headed Oriole	19	16	0.86	11	8	1.99	3	3	0.54	2	2	0.36	3	3	0.54
Red-faced Mousebird	19	3	0.86				4	1	0.72	15	2	2.71			
African Stonechat	17	12	0.77	1	1	0.18	8	5	1.44	4	3	0.72	4	3	0.72
Grey-backed Cisticola	16	14	0.72				12	10	2.17				4	4	0.72
Rock Martin	16	2	0.72				15	1	2.71				1	1	0.18
African Pipit	14	11	0.63	6	5	1.08	2	1	0.36				6	5	1.08
Cape Grassbird	14	13	0.63				7	6	1.26	1	1	0.18	6	6	1.08
Lesser-striped Swallow	14	6	0.63							2	1	0.36	12	5	2.17
Amethyst Sunbird	12	10	0.54				3	2	0.54	7	6	1.26	2	2	0.36
Fiscal Flycatcher	12	9	0.54	5	2	0.90	5	5	0.90	2	2	0.36			
Red-fronted Tinkerbird	12	12	0.54				4	4	0.72	3	3	0.54	5	5	0.90
Crowned Hornbill	10	5	0.45	3	1	0.54				7	4	1.26			
Helmeted Guineafowl	10	3	0.45				3	1	0.54	2	1	0.36	5	1	0.90
Karoo Prinia	10	7	0.45	1	1	0.18	3	2	0.54	1	1	0.18	5	3	0.90
African Hoopoe	9	7	0.41				5	3	0.90	4	4	0.72			
Cape Batis	9	7	0.41	4	4	0.72	4	2	0.72	1	1	0.18			
Cape Bulbul	9	7	0.41							9	7	1.62			
Levaillant's Cisticola	9	2	0.41										9	2	1.62
Common Waxbill	8	2	0.36										8	2	1.44
Pearl-breasted Swallow	8	3	0.36										8	3	1.44
Golden-breasted Bunting	7	7	0.32	7	7	1.26									
Southern Black Tit	7	4	0.32	3	1	0.54	3	2	0.54	1	1	0.18			
White-browed Scrub-Robin	7	5	0.32	2	2	0.36				1	1	0.18	4	2	0.72
Emerald-spotted Wood-Dove	6	4	0.27				1	1	0.18	3	2	0.54	2	1	0.36
Red-eyed Dove	6	6	0.27	2	2	0.36							4	4	0.72
Acacia Pied Barbet	5	5	0.23				2	2	0.36	3	3	0.54			
Black-bellied Starling	5	3	0.23										5	3	0.90
Cape Wagtail	5	2	0.23	1	1	0.18							4	1	0.72
Green-backed Cameroptera	5	4	0.23							5	4	0.90			

Brimstone Canary	4	2	0.18							2	1	0.36	2	1	0.36
Chinspot Batis	4	4	0.18				4	4	0.72						
Common House Martin	4	1	0.18										4	1	0.72
Crowned Lapwing	4	2	0.18				2	1	0.36	2	1	0.36			
Grey Sunbird	4	4	0.18							1	1	0.18	3	3	0.54
Sentinel Rock-Thrush	4	4	0.18				1	1	0.18	1	1	0.18	2	2	0.36
Southern Tchagra	4	4	0.18	1	1	0.18							3	3	0.54
Swee Waxbill	4	1	0.18							4	1	0.72			
White-throated Canary	4	4	0.18							4	4	0.72			
Black-collared Barbet	3	2	0.14							2	1	0.36	1	1	0.18
Familiar Chat	3	2	0.14	1	1	0.18							2	1	0.36
Grey-headed Bush Shrike	3	3	0.14							3	3	0.54			
Mocking Cliff-chat	3	3	0.14				3	3	0.54						
Olive Bushshrike	3	3	0.14	1	1	0.18				1	1	0.18	1	1	0.18
Olive Thrush	3	3	0.14	1	1	0.18	2	2	0.36						
Plain-backed Pipit	3	2	0.14	1	1	0.18	2	1	0.36						
Red-throated Wryneck	3	3	0.14	3	3	0.54									
African Dusky Flycatcher	2	2	0.09										2	2	0.36
African Paradise Flycatcher	2	2	0.09										2	2	0.36
Black Cuckooshrike	2	2	0.09				2	2	0.36						
Black Cuckoo	2	2	0.09							2	2	0.36			
Burchell's Coucal	2	2	0.09							2	2	0.36			
Cape Crow	2	1	0.09										2	1	0.36
Chestnut-vented Tit-babbler	2	2	0.09	2	2	0.36									
Dark-backed Weaver	2	1	0.09							2	1	0.36			
Dusky Flycatcher	2	1	0.09							2	1	0.36			
Greater Honeyguide	2	2	0.09				1	1	0.18	1	1	0.18			
Lazy Cisticola	2	1	0.09										2	1	0.36
Sabota Lark	2	2	0.09				2	2	0.36						
Streaky-headed Seedeater	2	2	0.09	2	2	0.36									
Black-backed Puffback	1	1	0.05										1	1	0.18
Black Sparrowhawk	1	1	0.05							1	1	0.18			

Cape Bunting	1	1	0.05							1	1	0.18			
Cape Clapper Lark	1	1	0.05							1	1	0.18			
Cape Penduline-Tit	1	1	0.05										1	1	0.18
Cape Sugarbird	1	1	0.05				1	1	0.18						
Diderick Cuckoo	1	1	0.05										1	1	0.18
Green Wood-Hoopoe	1	1	0.05	1	1	0.18									
Grey-winged Francolin	1	1	0.05							1	1	0.18			
Lesser Honeyguide	1	1	0.05							1	1	0.18			
Long-billed Pipit	1	1	0.05							1	1	0.18			
Narina Trogon	1	1	0.05							1	1	0.18			
Spotted Thick-knee	1	1	0.05				1	1	0.18						
Tambourine Dove	1	1	0.05							1	1	0.18			
White-throated Robin	1	1	0.05										1	1	0.18
Yellow Bishop	1	1	0.05							1	1	0.18			
Yellow-fronted Canary	1	1	0.05							1	1	0.18			

APPENDIX 2. SEASONAL BIRD SPECIES LISTS FOR THE GRAHAMSTOWN PLAN8 WIND ENERGY FACILITY SITE

	Target species	Endemic/Near endemic to s Africa	Autumn	Winter	Spring	Summer
Acacia Pied Barbet		✓		✓	✓	✓
African Black Swift					✓	
African Crowned Eagle	✓				✓	✓
African Dusky Flycatcher					✓	✓
African Emerald Cuckoo					✓	
African Firefinch					✓	
African Fish-Eagle	✓		✓	✓		✓
African Goshawk	✓					✓
African Harrier-Hawk	✓		✓		✓	✓
African Hoopoe				✓	✓	✓
African Paradise-Flycatcher					✓	✓
African Pipit			✓	✓	✓	✓
African Rock Pipit						✓
African Sacred Ibis				✓	✓	
African Spoonbill					✓	
African Stonechat			✓	✓	✓	✓
Alpine Swift					✓	
Amethyst Sunbird				✓	✓	✓
Amur Falcon	✓					✓
Barn Swallow			✓		✓	✓
Bar-throated Apalis			✓	✓	✓	✓
Black Cuckoo					✓	
Black Cuckooshrike				✓	✓	
Black Harrier	✓	✓	✓		✓	
Black Saw-wing					✓	✓
Black Sparrowhawk					✓	
Black-backed Puffback			✓		✓	✓
Black-bellied Starling				✓	✓	✓
Black-collared Barbet				✓	✓	✓
Black-headed Heron				✓	✓	
Black-headed Oriole			✓	✓	✓	✓
Black-shouldered Kite	✓			✓	✓	
Blacksmith Lapwing					✓	
Black-winged Stilt				✓		
Bokmakierie		✓	✓	✓	✓	✓
Booted Eagle	✓		✓	✓	✓	
Brimstone Canary				✓	✓	✓
Brown-hooded Kingfisher						✓
Brown-throated Martin					✓	
Burchell's Coucal		✓	✓		✓	
Cape Batis		✓	✓	✓	✓	
Cape Bunting					✓	
Cape Canary			✓	✓	✓	

	Target species	Endemic/Near endemic to s Africa	Autumn	Winter	Spring	Summer
Cape Clapper Lark		✓			✓	
Cape Crow			✓	✓	✓	✓
Cape Glossy Starling		✓	✓	✓	✓	✓
Cape Grassbird		✓		✓	✓	✓
Cape Longclaw		✓	✓	✓	✓	✓
Cape Penduline-Tit		✓				✓
Cape Robin-Chat			✓	✓	✓	✓
Cape Rock-Thrush			✓			
Cape Sparrow		✓	✓		✓	
Cape Spurfowl					✓	✓
Cape Sugarbird			✓	✓		✓
Cape Turtle-Dove			✓	✓	✓	✓
Cape Wagtail			✓	✓	✓	✓
Cape Weaver		✓	✓	✓	✓	✓
Cape White-eye			✓	✓	✓	✓
Cattle Egret				✓	✓	✓
Chestnut-vented Tit-Babbler		✓	✓		✓	
Chinspot Batis				✓		
Cloud Cisticola				✓		
Collared Sunbird					✓	✓
Common Fiscal			✓	✓	✓	✓
Common House-Martin						✓
Common Quail					✓	
Common Starling				✓	✓	✓
Common Waxbill						✓
Crowned Hornbill			✓	✓	✓	✓
Crowned Lapwing			✓	✓	✓	
Dark-capped Bulbul			✓	✓	✓	✓
Dark-backed Weaver					✓	
Diderick Cuckoo						✓
Dusky Flycatcher					✓	
Egyptian Goose			✓	✓	✓	✓
Emerald-spotted Wood-Dove				✓	✓	✓
Familiar Chat			✓			✓
Fiscal Flycatcher		✓	✓	✓	✓	
Forest Canary					✓	
Fork-tailed Drongo			✓	✓	✓	✓
Golden-breasted Bunting			✓			
Greater Double-collared Sunbird		✓	✓	✓	✓	✓
Greater Honeyguide			✓	✓	✓	
Greater Striped Swallow		✓	✓			
Green Wood-Hoopoe			✓	✓	✓	✓
Green-backed Cameroptera			✓		✓	✓
Grey Heron				✓	✓	
Grey Sunbird					✓	✓
Grey-backed Cameroptera						✓

	Target species	Endemic/Near endemic to s Africa	Autumn	Winter	Spring	Summer
Grey-backed Cisticola		✓		✓	✓	✓
Grey-headed Bush-Shrike					✓	
Grey-winged Francolin		✓			✓	
Hadeda Ibis			✓	✓	✓	✓
Hamerkop				✓		
Helmeted Guineafowl			✓	✓	✓	✓
Horus Swift						✓
Jackal Buzzard	✓	✓	✓	✓	✓	✓
Jacobin Cuckoo					✓	✓
Karoo Prinia		✓	✓	✓	✓	✓
Klaas's Cuckoo					✓	
Knysna Turaco		✓	✓	✓	✓	✓
Lanner Falcon	✓			✓	✓	
Large-billed Lark					✓	
Lazy Cisticola			✓			✓
Lesser Honeyguide					✓	
Lesser Striped Swallow					✓	✓
Levaillant's Cisticola					✓	✓
Little Swift					✓	
Long-billed Pipit					✓	
Long-crested Eagle			✓		✓	
Malachite Kingfisher			✓			
Malachite Sunbird			✓	✓	✓	✓
Martial Eagle	✓				✓	
Mocking Cliff-Chat				✓	✓	✓
Mountain Wagtail					✓	
Narina Trogon					✓	✓
Neddicky			✓	✓	✓	✓
Olive Bush-Shrike		✓	✓	✓	✓	✓
Olive Thrush			✓	✓	✓	
Olive Woodpecker			✓			
Pearl-breasted Swallow					✓	✓
Peregrine Falcon	✓		✓		✓	✓
Pied Crow			✓		✓	✓
Plain-backed Pipit			✓	✓		
Red-chested Cuckoo					✓	
Red-eyed Dove			✓	✓	✓	✓
Red-faced Mousebird				✓	✓	✓
Red-fronted Tinkerbird				✓	✓	✓
Red-throated Wryneck			✓			
Red-winged Starling			✓	✓	✓	✓
Reed Cormorant				✓		
Rock Dove					✓	✓
Rock Kestrel	✓		✓	✓	✓	✓
Rock Martin			✓	✓	✓	✓
Rufous-naped Lark			✓	✓	✓	✓

	Target species	Endemic/Near endemic to s Africa	Autumn	Winter	Spring	Summer
Sabota Lark				✓		
Sentinel Rock-Thrush		✓		✓	✓	✓
Sombre Greenbul			✓	✓	✓	✓
Southern Black Tit		✓	✓	✓	✓	✓
Southern Boubou		✓	✓	✓	✓	✓
Southern Double-collared Sunbird		✓	✓	✓	✓	✓
Southern Grey-headed Sparrow					✓	
Southern Red Bishop					✓	
Southern Tchagra		✓	✓	✓	✓	✓
Speckled Mousebird			✓	✓	✓	✓
Speckled Pigeon				✓	✓	
Spectacled Weaver						✓
Spike-heeled Lark					✓	
Spotted Thick-knee					✓	
Spur-winged Goose				✓		✓
Steppe Buzzard	✓				✓	✓
Streaky-headed Seedeater			✓			
Swee Waxbill		✓	✓		✓	
Tambourine Dove					✓	
Trumpeter Hornbill					✓	
Wailing Cisticola			✓	✓	✓	✓
White-bellied Korhaan	✓			✓	✓	✓
White-breasted Cormorant				✓	✓	
White-browed Scrub-Robin			✓		✓	✓
White-crowned Lapwing			✓			
White-necked Raven			✓	✓	✓	✓
White-throated Canary					✓	
White-throated Robin		✓				✓
Yellow Bishop					✓	
Yellow Canary		✓	✓	✓	✓	
Yellow-billed Duck				✓		
Black (Yellow-billed) Kite	✓				✓	
Yellow-breasted Apalis					✓	
Yellow-fronted Canary					✓	
Total			75	84	137	95