GAROB WIND ENERGY FACILITY

COPPERTON - NORTHERN CAPE

JUWI RENEWABLE ENERGIES (PTY) LTD

AVIFAUNAL IMPACT ASSESSMENT (EIA PHASE)

NOVEMBER 2012

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EXECUTIVE SUMMARY

This study assesses the potential interactions between birds and the proposed Garob Wind Energy Facility (WEF), located near the village of Copperton in the Northern Cape. The proposed facility comprises of 58 wind turbines with a combined output of 140MW, and associated infrastructure such as roads, power lines, and electrical substations. The facility is situated on the farm Nelspoortjie – an area of approximately 5 520 hectares.

Care must be taken in an arid area such as this one – since bird presence and abundance in an areas is usually determined by rainfall, which is erratic and rare. For example, Ludwig's Bustard are known to move around the Karoo according to rainfall. This means that certain species could have been missed or under or over recorded by the atlas counts. This also means that pre-construction bird monitoring may not easily adequately represent the situation on site. If significant rain falls on site at some point there could be a temporary local influx of a species such as Ludwig's Bustard onto the site. This may fall between monitoring site visits and hence go undetected. Once the facility is operational this will also be a factor to consider. If such an influx occurs this may result in a temporary high collision risk, which may not be repeated for several years. Related closely to this bird movement is the presence of locust outbreaks, since many of these bird species feed on locusts. A local outbreak may attract higher densities of certain bird species to the area thereby placing them at greater risk of collision.

The site is relatively flat, and consists of short vegetation predominantly. This open arid vegetation favours large terrestrial species such as bustards and korhaans, raptors, and small terrestrials such as larks. Up to approximately 150 bird species could occur on site (according to Harrison *et al*, 1997). This is a relatively low diversity of species, reflecting the aridity and uniformity of the study area, as well as possibly the low number of counts or cards submitted (the more counts the more chance of detecting additional species). In total, according to Harrison *et al* (1997), 9 Red Listed species could occur here, comprising 3 Vulnerable (V) and 6 Near-threatened (NT) species. In addition, the White Stork *Ciconia ciconia* was considered as threatened as it is afforded protection internationally under the Bonn Convention on Migratory Species. Almost all of these Red Listed species are important with respect to wind energy facilities. A list of 'target species' has been developed based on various data sources. Target species are those species requiring special conservation attention with respect to the proposed wind energy facility. These species are as follows: Lesser Kestrel *Falco naumanni*; Kori Bustard *Ardeotis kori*; Ludwig's Bustard *Neotis ludwigii*; Secretarybird *Sagittarius serpentarius*; Lanner Falcon *Falco biarmicus*; Cape Long-billed Lark *Certhilauda brevirostris*; White Stork *Ciconia ciconia*; Jackal Buzzard *Buteo rufofuscus*; Black-shouldered Kite *Elanus caeruleus*; Rock Kestrel *Falco rupicolus*; Greater Kestrel *Falco rupicoloides*; Southern Pale Chanting Goshawk *Melierax canorus*; Karoo Korhaan *Eupodotis vigorsii*; Northern Black Korhaan *Afrotis afraoides*; and Namaqua Sandgrouse *Pterocles namaqua*. The large terrestrial species such as the bustards, storks, flamingos and Secretarybird are all believed to be likely to collide with wind turbines, mainly based on their proven vulnerability to collision with overhead power lines. The smaller species such as the larks could most likely be impacted on through disturbance and habitat destruction. The raptors, such as Lesser Kestrel, are also believed to be at high risk of collision. It must be stressed that at this stage this list is preliminary and would need to be refined as more pre-construction bird monitoring work is done on site.

The potential interactions between these birds and the proposed facility are: disturbance of birds during construction and maintenance; habitat destruction during construction and maintenance of the facility and associated

infrastructure; displacement of birds from the site, or from flying over the site; collision of birds with turbine blades during operation; and collision and electrocution of birds on associated electrical infrastructure.

With respect to the assessment of these potential impacts for the Garob project, the following are key findings: Disturbance of birds, habitat destruction, and displacement of bird are all anticipated to be of relatively low significance. This is primarily due to the vast amount of similar habitat available in this part of the Northern Cape. In other words the proposed site does not offer any unique habitat in our view. Collision and electrocution of birds on any necessary new overhead power line is likely to be of medium significance, but is relatively straight forward to mitigate for and can be reduced to low significance. Collision of birds with turbine blades could also be of medium significance, although it is uncertain whether target species move over the site frequently enough to present a high risk of collisions occurring. A pre-construction bird monitoring programme has been initiated on site, in accordance with the best practice guidelines currently available (Jenkins *et al*, 2011). Two site visits (winter and spring) have so far been completed and the early indications are that bird flight activity on site is very low. Although this is expected to increase in the warmer seasons it is an indication that the significance of collision could be reduced to low. The species that have been recorded flying across the site are also predominantly non Red Listed species to date, such as Northern Black and Karoo Korhaan and Southern Pale Chanting Goshawk. At this stage then this impact is rated as low significance. It is recommended that if final submission of this report is delayed further it should include findings from the third (summer) pre-construction bird monitoring site visit if at all possible as more data will strengthen the report. Use of this monitoring data will allow us greater confidence in this assessment.

Micro-siting of turbines and other infrastructure within the proposed site remains the foremost means of mitigating the above discussed impacts on birds. This study has identified preliminary high avifaunal sensitivity areas on the site based on micro habitats, consisting of surface water and likely flight paths. Construction of infrastructure should not take place within these areas or their buffers. Ideally sensitivity mapping and consequent turbine micro siting would also incorporate actual data on target bird species flight paths, collected through pre construction bird monitoring. Based on the first monitoring data there do not appear to be any flight paths evident at this stage.

The following mitigation measures are recommended:

- The pre-construction bird monitoring programme should continue and as much as possible of the findings emanating from this programme should be incorporated into the final version of this report.
- A site specific avifaunal EMP/walk through must be conducted as the project nears construction. This will provide a final check of all layout details and identify high risk sections of the overhead power line that will require collision mitigation measures. This should also provide an opportunity for findings from the above mentioned monitoring programme to influence the final layout where necessary.
- All overhead power line should be constructed with an Eskom approved bird friendly pole structure and any additional add on mitigation measures needed to ensure that the poles/pylons pose no electrocution risk to perching birds in the area.
- Anti bird-collision line marking devices will need to be installed on the overhead power line on the sections identified by the above avifaunal walk through.

- If significant impacts are identified once the facility is operational, suitable mitigation measures will need to be implemented by the facility operator. These could include curtailment or shutdown of certain problematic turbines.

Overall the chosen site would appear to be of relatively low sensitivity for avifauna based on work done to date. There are no particularly unique or sensitive habitats on site, and no attractants which would concentrate high numbers of birds on or near the site. If the above mitigation measures are implemented this project should have an acceptable level of impact on avifauna.

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 12 years. During this time he has completed impact assessments for at least 70 projects, at least ten of which involved wind energy generation. He is a founding member of the Birds and Wind Energy Specialist Group. A full *Curriculum Vitae* can be supplied on request.

Declaration of Independence

The specialist investigator 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.
- » Should we consider ourselves to be in conflict with any of the above declarations, we shall formally submit a Notice of Withdrawal to all relevant parties and formally register as an Interested and Affected Party.

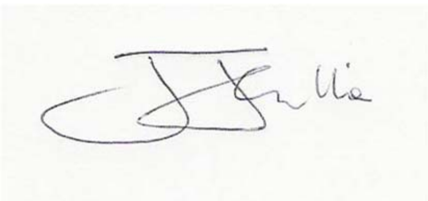
Terms and Liabilities

- » This report is based on a short term investigation using the 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 12 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 SA's environment and birds in the longer term. This does not mean 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 on 5th November 2012 by Jon Smallie in his capacity as specialist investigator.



1. INTRODUCTION

juwi Renewable Energies (Pty) Ltd (hereafter juwi) plans to construct a wind energy facility (hereafter referred to as Garob Wind Energy Facility) in the Northern Cape just east of the village of Copperton. Savannah Environmental (Pty) Ltd (hereafter Savannah) was appointed to conduct the Environmental Impact Assessment study, and subsequently appointed Jon Smallie (WildSkies Ecological Services) to conduct the specialist avifaunal assessment.

This study investigates the potential impacts of the proposed facility on the birds of the area. 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 site, or from flying over the site; collision of birds with turbine blades during operation; and collision and electrocution of birds on associated electrical infrastructure. The likelihood and significance of each of these impacts will be investigated further in this study.

2. STUDY METHODOLOGY

2.1. Terms of reference

The avifaunal specialist has conducted this assessment according to the following terms of reference, supplied by Savannah:

Scoping phase:

- A description of the environment that may be affected by the activity and the manner in which the environment may be affected by the proposed project.
- A description and evaluation of environmental issues and potential impacts (including direct, indirect and cumulative impacts) that have been identified.
- Direct, indirect and cumulative impacts of the identified issues must be evaluated in the scoping report in terms of the following criteria:
    - the nature, which shall include a description of what causes the effect, what will be affected, and how it will be affected
    - The extent, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of the development) or regional, national, or international.
- A statement regarding the potential significance of the identified issues based on the evaluation of the issues or impacts
- A comparative evaluation of any identified feasible alternatives (and if relevant the nomination of a preferred alternative for consideration in the EIA Phase)
- Identification of potentially significant impacts to be assessed with the EIA Phase

- Details of the methodology to be adopted in assessing potentially significant impacts in the EIA Phase. This should be detailed enough to include within the Plan of Study for EIA and must include a description of the proposed method of assessing the potential environmental impacts associated with the project.

EIA Phase:

- an indication of the methodology used in determining the significance of potential environmental impacts
- a description of all environmental issues that were identified during the environmental impact assessment process
- an assessment of the significance of direct, indirect and cumulative impacts in terms of the following criteria:
    - the nature of the impact, which shall include a description of what causes the effect, what will be affected and how it will be affected
    - the extent of the impact, indicating whether the impact will be local (limited to the immediate area or site of development), regional, national or international
    - the duration of the impact, indicating whether the lifetime of the impact will be of a short-term duration (0–5 years), medium-term (5–15 years), long-term (> 15 years, where the impact will cease after the operational life of the activity) or permanent
    - the probability of the impact, describing the likelihood of the impact actually occurring, indicated as improbable (low likelihood), probable (distinct possibility), highly probable (most likely), or definite (impact will occur regardless of any preventative measures)
    - the severity/beneficial scale, indicating whether the impact will be very severe/beneficial (a permanent change which cannot be mitigated/permanent and significant benefit, with no real alternative to achieving this benefit), severe/beneficial (long-term impact that could be mitigated/long-term benefit), moderately severe/beneficial (medium- to long-term impact that could be mitigated/ medium- to long-term benefit), slight or have no effect
    - the significance, which shall be determined through a synthesis of the characteristics described above and can be assessed as low, medium or high
    - the status, which will be described as either positive, negative or neutral
    - the degree to which the impact can be reversed
    - the degree to which the impact may cause irreplaceable loss of resources
    - the degree to which the impact can be mitigated
- a description and comparative assessment of all alternatives identified during the environmental impact assessment process
- recommendations regarding practical mitigation measures for potentially significant impacts, for inclusion in the Environmental Management Plan (EMP)
- an indication of the extent to which the issue could be addressed by the adoption of mitigation measures
- a description of any assumptions, uncertainties and gaps in knowledge
- an environmental impact statement which contains:
    - a summary of the key findings of the environmental impact assessment;
    - an assessment of the positive and negative implications of the proposed activity (one alternative only in EIA phase);
    - a comparative assessment of the positive and negative implications of identified alternatives

2.2. Approach

This study followed the following steps:

- » 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 on or near the site.
- » The site was visited for four days in August, in order to assess first-hand the conditions on site, the likelihood of key species occurring there, and the importance of the site for these species.
- » The potential impacts of the proposed facility on these species were described and evaluated.
- » 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, and confirmed by field work.
- » Recommendations were made for the management and mitigation of impacts.
- » Pre-construction bird monitoring has begun on site and is half complete (two of the four site visits being complete) and the findings from this work has been incorporated into this report.

2.3. Data sources used

The following data sources and reports were used in varying levels of detail for this study:

- » The Southern African Bird Atlas Project data (SABAP1 - Harrison *et al*, 1997) for the four quarter degree squares considered relevant (2922CC, 2922CD, 2922DC, 3022AB). The Southern African Bird Atlas Project 2 (SABAP2) data was also consulted at http://sabap2.adu.org.za/v1/index.php. The number of cards submitted for the four relevant pentads is as follows: 2950_2220 0 cards, 2950_2225 1 card, 2955_2220 1 card, 2955_2225 2 cards. Unfortunately this level of coverage does not allow formal use of this SABAP2 data for this project.
- » The data collected during the first site visit for the pre-construction bird monitoring programme.
- » 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.
- » The Co-ordinated Avifaunal Roadcount project (CAR – Young *et al*, 2003) data was consulted to obtain relevant data on large terrestrial bird report rates in the area where possible.
- » The conservation status of all relevant bird species was determined using Barnes (2000)
- » The latest vegetation classification of South Africa (Mucina & Rutherford, 2006) was consulted in order to determine which vegetation types occur on site.
- » Aerial photography for the area, obtained from the Surveyor General.
- » The 'Avian Wind Farm Sensitivity Map: Criteria and procedures used. (Retief *et al,* 2011).

» The Endangered Wildlife Trust and BirdLife South Africa “Best Practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa” were used extensively in the design of this programme (Jenkins, van Rooyen, Smallie, Anderson & Smit, 2012).

2.4. Limitations & assumptions

Any inaccuracies in the above sources of information could limit this study. In particular, the SABAP1 data is now fairly old (Harrison *et al*, 1997), but no reliable more recent data on bird species presence and abundance in the study area exists, since SABAP2 coverage is not yet adequate for formal use for this study. This study relies mostly upon secondary data sources with regards to bird abundances such as the SABAP1 (Harrison *et al*, 1997). However, primary information on bird presence and habitat was collected during the EIA phase site visit and the first two pre-construction bird monitoring site visits and is used directly in determining which species are likely to occur on site.

3. BACKGROUND TO THE STUDY

3.1 Background to interactions between wind energy facilities and birds

The South African experience of wind energy generation has been extremely limited to date. By necessity, much of what we know about birds and wind energy is based on international literature, primarily from the United States, United Kingdom, European Union, Australia and Canada. Most of the principles that have been learnt internationally can, to a certain extent, be applied locally, with care to adapt existing international knowledge to local bird species and conditions. An additional challenge is that much of the international literature is so called grey literature, i.e. published in proceedings, consultant reports and unpublished reports – not peer reviewed journals. Most literature focuses on the impact of collision of birds with turbines, giving less attention to the impacts of habitat destruction and disturbance or displacement of birds.

A relatively recent summary of the available literature entitled “Wind Turbines and Birds, a background review for environmental assessment” by Kingsley & Whittam (2005) and the Avian Literature Database of the National Renewable Energy Laboratory (www.nrel.gov) have been used extensively in the discussion below.

Concern for the avian impacts of wind energy facilities first arose in the 1980’s when raptor mortalities were detected in California (Altamont Pass - US) and at Tarifa (Spain). The Altamont Pass and Tarifa sites were the site of some extremely high levels of bird mortalities. These mortalities focused attention on the impact of wind energy on birds, and subsequently a large amount of monitoring at various sites has been undertaken. Naturally, as more monitoring was conducted at different sites, a need arose for a standard means of expressing the levels of bird mortalities – in this case, number of mortalities per turbine per year. The resulting collision rates have varied significantly across different countries and sites, from as little as zero to as many as 10 birds per turbine per year. It is also important to note that searcher efficiency (and independence) and scavenger removal rates need to be accounted for. Searcher efficiency refers to the percentage of bird mortalities that are detected by searchers, searcher independence refers to whether the person monitoring has certain objectives of their own which may influence the results of monitoring.

In South Africa to date, only eight wind turbines have been constructed, 3 at a demonstration facility at Klipheuwel in the Western Cape, in 2002 and 2003, 4 at a site near Darling (although access to these for the purpose of monitoring bird impacts has been restricted), and 1 at Coega near Port Elizabeth. A monitoring program, conducted by Jacques Kuyler (2004), was put in place once the 3 Klipheuwel turbines were operational, and found two bird collisions with blades, a Horus Swift *Apus Horus* and a Thick-billed Lark *Rhamphocoris clotbey*, equating to one bird mortality per turbine per year.

3.1.1. Factors influencing bird collisions with turbines

A number of factors influence the number of birds killed at wind farms. These can be classified into three broad groupings: bird related information; site related information and facility related information.

Bird related information

Although only one study has so far shown a direct relationship between numbers of birds present in an area and number of collisions (Everaert, 2003, Belgium) it stands to reason that the more birds flying through the area of the turbines, the more chance of collisions occurring. The particular bird species present in the area is also very important as some species are more vulnerable to collision with turbines than others. Bird behaviour and activity differs between species – with certain hunting behaviours rendering certain species more vulnerable. For example a falcon stooping after prey is (possibly) too focused on its prey to notice the presence of infrastructure. There may also be seasonal and temporal differences in behaviour, for example breeding males displaying may be particularly at risk. These factors can all influence the birds' vulnerability. Birds are believed to be capable of learning to avoid obstacles with sufficient time living in an area.

Whilst all birds face some inherent risk of impact by wind turbines, there are definitely certain groups that are more at risk due to their flight behavior or habitat preferences (Jordan & Smallie, 2010). These authors summarized knowledge from the European Union, United Kingdom, United States, Canada and Australia to identify the following taxonomic groups as being affected most by wind energy facilities: Podicipediformes, Pelicaniformes, Ciconiiformes, Anseriformes, Falconiformes, Charadriformes, Strigiformes, Caprimulgiformes, Gruiformes, Galliformes, Psittaciformes, Passeriformes. In determining which species are likely to be at risk at wind energy facilities in South Africa, the above groups form a useful starting point.

Site information

Landscape features can potentially channel or funnel birds towards a certain area, and in the case of raptors, influence their flight and foraging behaviour. Elevation, ridges and slopes are all important factors in determining the extent to which an area is used by birds in flight. High levels of prey will attract raptors, increasing the time spent hunting, and as a result reducing the time spent being observant. Certain sites are also vulnerable to poor weather such as mist, which may influence the bird collision risk.

Facility information

According to Kingsley & Whittam (2005), “More turbines will result in more collisions”. Although only two mortalities have been recorded at Klipheuwel, the difference between the 3 turbines at Klipheuwel and the proposed project at Garob is significant and largely renders comparisons and extrapolations meaningless. Larger facilities also have greater potential for disturbance and habitat destruction, and displacement of birds from the area. With newer technology and larger turbines, fewer turbines are needed for the same quantity of power generation, possibly resulting in fewer mortalities per MW of power produced (Erickson *et al*, 1999).

Lighting of turbines and other infrastructure has the potential to attract birds, thereby increasing the risk of collisions with turbines. Erickson *et al* (2001) suggest that lighting is the single most critical attractant leading to collisions with tall structures. Changing constant lighting to intermittent lighting has been shown to reduce attraction (Richardson 2000) and mortality (APLIC, 1994; Jaroslow, 1979; Weir, 1976) and changing white flood light to red flood light resulted in an 80% reduction in mortality (Weir, 1976).

Spacing between turbines at a wind facility can have an effect on the number of collisions. Some authors have suggested that paths need to be left between turbines so that birds can move along these paths, whilst others have argued that these gaps result in more collisions.

Infrastructure associated with the facility often also impacts on birds. Overhead power lines pose a collision and possibly an electrocution threat to certain bird species. 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 Data species vulnerable to power line collisions are generally long living, slow reproducing species under natural conditions. The collision risk of the proposed power lines has been assessed by this study.

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. The electrocution risk of the proposed 132kV and smaller lines has been assessed below subject.

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

3.1.2. Potential explanations for collisions of birds with turbines:

The three main hypotheses proposed for birds not seeing turbine blades are as follows (Hodos, 2002):

» An inability to divide attention between prey and obstacles. This seems an unlikely explanation as birds have been found to maintain good acuity in the peripheral vision, have different foveal region in the eye for frontal and ground vision and they have various other optical methods for keeping objects at different distances simultaneously in focus.
» The phenomenons of motion smear or retinal blur.
» The angle of approach. If a bird approaches from side on to the turbine, the blades present a very small profile and are even more difficult to detect.

Mitigation measures should therefore focus on solving the problem of motion smear both from front and side angles.

3.1.3. Mitigation measures

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.

3.2. Description of the proposed wind energy facility

The proposed activity is the establishment of a wind energy facility (WEF) and associated infrastructure on a site 5km east of Copperton in the Northern Cape. An area of approximately 5 520 hectares is being considered on the Farm 103, portion 5 (Nelspoortjie Farm). The proposed facility would include:

» Approximately 58 wind turbines of 2 -3 megawatts in installed capacity with a total output of 140MW.
» Concrete foundations to support the turbine towers;
» Cabling between turbines, to be lain underground and along access roads where practical;
» An on-site substation to facilitate the connection to the grid
» Overhead power lines feeding into the existing Eskom grid
» Internal access roads to each wind turbine.
» Workshop area for maintenance and storage if required.

At this time there is no alternative site for consideration for the overall wind energy facility. Alternatives exist for the proposed 132kV power line positioning. Figure 1 below shows the location of the proposed site for the Garob Wind Energy Facility.

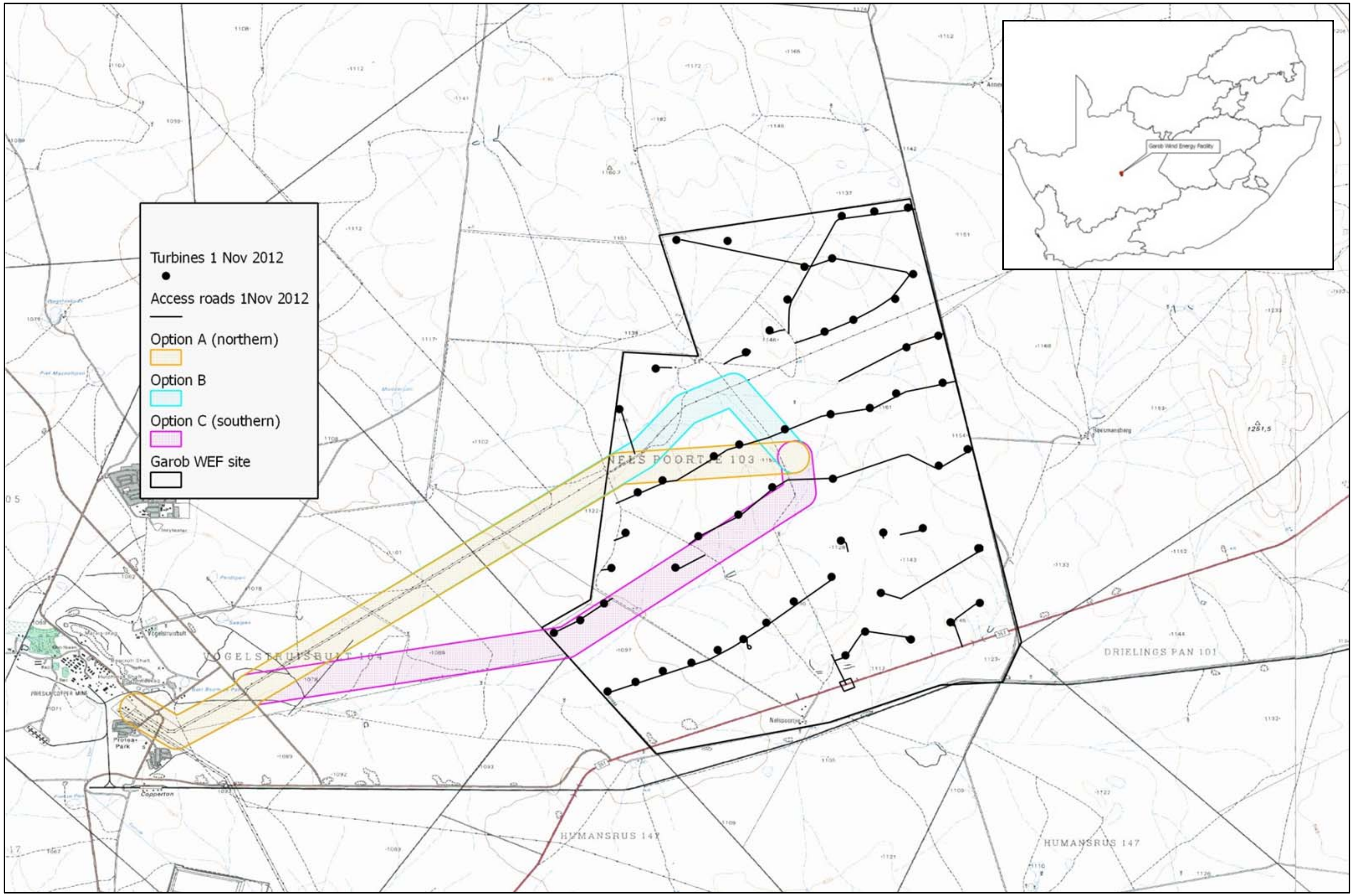


Figure 1. The location of the proposed Garob Wind Energy Facility – immediately east of Copperton.

4. DESCRIPTION OF AFFECTED ENVIRONMENT

This site is situated immediately east of Copperton in the Northern Cape. The broader area is exceptionally flat, with higher ground situated only to the east of the site towards Prieska. This area is known for extensive livestock farming only, as the aridity prevents any crop cultivation or other development. In this type of area we would expect large terrestrial species such as bustards and korhaans and raptors to be the most important species.

4.1. Vegetation 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 since it is widely accepted within ornithological circles that vegetation structure is more important in determining which bird species will occur there. The classification of vegetation types is from Mucina & Rutherford (2006).

The site itself falls entirely within "Bushmanland Arid Grassland". To the south west of the site is some "Bushmanland Basin Shrubland", and to the north east is "Lower Gariep Broken Veld". The main relevance of this information to avifauna is that the site is composed of short karoo type veld, with some grassy components. This affects the species likely to occur on site, and is reflected in the data in Table 1 below, which shows that most of the Red Listed bird species recorded by the Southern African Bird Atlas Project (Harrison *et al*, 1997) in the area favour short open vegetation types. Several small drainage lines are present on site. These contain more woody species such as *Acacia spp,* which provides a slightly different vegetation type as discussed in more detail in 4.2.

4.2. Bird micro habitats

The above vegetation description partially describes the habitat available and hence the 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 small 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 will be critically important in mapping the site in terms of avifaunal sensitivity and ultimately siting the proposed turbines within the affected farms. The micro habitats that the Red Listed species are most likely to use are shown in Table 2. The micro habitats on site include: karoo type shrubland, minor drainage lines and slight ridges. Examples of all of these are shown in Figure 2. Although several slightly different micro habitats (based on appearance to us) exist on site, these are essentially all karoo type habitats. Several small dams exist on or near site, as well as several windmills with reservoirs. These areas provide more moisture than the surrounds and hence have slightly different vegetation and avifauna.

Figure 2. Examples of the micro habitats available to birds on the Garob Wind Energy Facility site.

4.3. Bird presence in the study area

The most reliable, and hence preferred, data source for a study of this nature is the Southern African Bird Atlas Project (SABAP1 - Harrison *et al*, 1997). This project recorded data on birds over at least a ten year period, and as such represents bird distribution over significantly varying conditions. This data is therefore far more representative than any other data available at present. The Southern African Bird Atlas Project 2 (SABAP2) is striving to provide a more recent data source, but as mentioned elsewhere in this study, it has not yet covered this study area adequately.

Appendix 2 lists all the bird species recorded by the SABAP1 (Harrison *et al*, 1997) in the four quarter degree squares considered relevant to the study area, i.e. 2922CC, 2922CD, 2922DC, and 3022AB. Although the proposed site falls entirely within the square 2922CD, since the broader area is so uniform, and many of the relevant species far ranging, it is considered worthwhile to consider the neighbouring squares too. The total number of all species recorded and the number of cards (counts) submitted per square is also shown. An approximate total of 150 species could occur in the area, based on what has been recorded by Harrison *et al* (1997). This is a relatively low diversity of species, reflecting the aridity and uniformity of the study area, as well as possibly the low number of counts or cards submitted (the more counts the more chance of detecting additional species). The number of cards can be used as an indicator of our confidence in that particular report rate. If lots of cards have been submitted our confidence in the data is higher, and vice versa. In this study, all four squares have been poorly counted, with cards ranging from 3 to 11. This means that we need to use this data with caution. Report rates are essentially percentages of the number of times a species was recorded in the square, divided by the number of times that square was counted. It is important to note that this data provides an indication of which species *could* occur on the proposed site. The species in Table 1 were recorded in the entire quarter degree square in each case, and may not actually have been recorded on the proposed site for this study.

Table 1 shows only the Red Listed bird species recorded across the four squares. In total 9 Red Listed species were recorded, comprising 3 Vulnerable (V) and 6 Near-threatened (NT) species. In addition, the White Stork *Ciconia ciconia* was included here as it is afforded protection internationally under the Bonn Convention on Migratory Species. Almost all of these Red Listed species are important with respect to wind energy facilities. The large terrestrial species such as the bustards, storks, flamingos and Secretarybird are all believed to be likely to collide with wind turbines, mainly based on their proven vulnerability to collision with overhead power lines. The smaller species such as the larks could most likely be impacted on through disturbance and habitat destruction. The raptors, such as Lesser Kestrel, are also believed to be at high risk of collision.

In addition to the species' preferred micro habitats, the likelihood of each species actually occurring on or close to the proposed site has also been specified in Table 1, based on ornithological experience and assessment of the available habitat on site (albeit on a desktop basis at this stage). Most of these species have at least a possibility of occurring on the site, but for most of them the site is not very important for national populations of the species, i.e. this is not their core area.

Care must be taken in an arid area such as this one – since bird presence and abundance in an areas is usually determined by rainfall, which is erratic and rare. For example, Ludwig's Bustard are known to move around the Karoo according to rainfall. This means that certain species could have been missed or under or over recorded by the atlas counts. This also means that pre-construction bird monitoring may not perfectly represent the situation on site. If significant rain falls on site at some point there could be a temporary local influx of a species such as Ludwig's Bustard onto the site. This may fall between monitoring site visits and hence go undetected. Once the facility is operational this will also be a factor to consider. If such an influx occurs this may result in a temporary high collision risk, which may not be repeated for several years. Related closely to this bird movement is the presence of locust outbreaks, since many of these bird species feed on locusts. A local outbreak may attract higher densities of certain bird species to the area thereby placing them at greater risk of collision.

Importantly, the species in Table 1 represent many of the broad groupings of bird species i.e. large terrestrial birds (Bustards and Secretarybird), raptors (Lesser Kestrel), water associated species (storks and flamingos), small grassland/shrubland species (the larks). Assessing the impacts on the species in Table 1 therefore potentially covers impacts on other species from these groupings that were not recorded but may occur on the site. This study concentrates on assessing the impacts on the Red Listed species as these are the species of most conservation concern, and are often the species most sensitive to any artificial impacts. However, impacts on non-Red Listed species that are believed to be relevant to this study are also considered. In particular, non-Red Listed species groups such as raptors, owls, lapwings, waterfowl, and thick-knees. Swallows, swifts and martins will also be relevant to this study due to the amount of time they spend in the air, which increases the chances of collisions. One could argue that if non-Red Listed species are not considered adequately in impact assessment they could make their way onto the Red List with time. Whilst this is valid, it is believed that species already on the Red List should always be given priority, and that if too many species are considered this may dilute the attention given to any the most important species.

Table 1. Red Listed species recorded in the four quarter degree squares considered relevant (2922CD, 2922CC, 2922DC, & 3022AB) during the Southern African Bird Atlas Project (Harrison *et al,* 1997). All species recorded by this project can be viewed in Appendix 3.

Roberts #	**Common Name**	***Scientific Name***	**Cons status**	**2922CC Report rate (3 cards)**	**2922CD Report rate (8 cards)**	**2922DC Report rate (11 cards)**	**3022AB Report rate (8 cards)**	**Preferred micro habitat**	**Likelihood of occurring on site**	**Relative importance of site for national population of species**	**Likely interactions with proposed facility**
183	Lesser Kestrel	*Falco naumanni*	V	0.33 (33%)	0.00	0.00	0.00	Karoo shrubland, grassland	Probable	Low	Collision, disturbance, habitat destruction
230	Kori Bustard	*Ardeotis kori*	V	0.67 (67%)	0.00	0.00	0.00	Karoo shrubland, grassland, woodland	Confirmed	Low	Collision, disturbance, habitat destruction
232	Ludwig's Bustard	*Neotis ludwigii*	V	0.33	0.25	0.00	0.25	Karoo shrubland, grassland	Confirmed	Low	Collision, disturbance, habitat destruction
84	Black Stork	*Ciconia nigra*	NT	0.00	0.00	0.09	0.00	Riverine, cliff	Unlikely	Low	Collision
96	Greater Flamingo	*Phoenicopterus ruber*	NT	0.00	0.00	0.00	0.13	Dam, pan, floodplain	Unlikely – could overfly	Low	Collision
118	Secretarybird	*Sagittarius serpentarius*	NT	0.00	0.00	0.18	0.00	Karoo shrubland, grassland, woodland	Possible	Low – unless breeding on site	Collision, disturbance, habitat destruction
172	Lanner Falcon	*Falco biarmicus*	NT	0.33	0.00	0.09	0.00	Karoo shrubland, grassland	Possible	Low – unless breeding on site	Collision, disturbance, habitat destruction
500	Cape Long-billed Lark	*Certhilauda curvirostris*	NT	0.00	0.38	0.18	0.13	Karoo shrubland, grassland	Possible	Low	Disturbance, habitat destruction
510	Sclater's Lark	*Spizocorys sclateri*	NT	0.00	0.13	0.00	0.13	Karoo shrubland, grassland	Possible	Low	Disturbance, habitat destruction
83	White Stork	*Ciconia ciconia*	BONN	0.00	0.00	0.09	0.00	Grassland, arable land, wetland, dam, karoo shrubland	Possible	Low	Collision, electrocution

V = Vulnerable; NT = Near-threatened; Bonn = Protected under the Bonn Convention on migratory species.

The more recent Southern African Bird Atlas 2 data was also consulted to shed light on more recently recorded bird abundance in the area. Unfortunately the coverage by counters in this area has not been good to date. The number of cards submitted for the four relevant pentads is as follows: 2950_2220 0 cards, 2950_2225 1 card, 2955_2220 1 card, 2955_2225 2 cards. The majority of species recorded by SABAP2 had been recorded previously by SABAP1.

According to the landowner, Mr Pieter Fourie, vultures have been very occasionally sighted in the area in the last few years in small groups. This would presumably be White-backed Vulture *Gyps africanus*. This species would certainly be a target species for this study if it turns out to occur frequently enough in the area.

Sightings of target and relevant species by this author during the EIA phase site visit are shown in Figure 3 (all recorded species shown in Appendix 2). The most commonly sighted species were korhaans, both Northern Black *Afrotis afraoides* and Karoo Korhaan *Eupodotis vigorsii*. Only one sighting of a single Ludwig's Bustard was made, and a pair of Kori Bustard was also seen. The only raptors seen were Greater Kestrel *Falco rupicoloides* and Southern Pale Chanting Goshawk *Melierax canorus*.

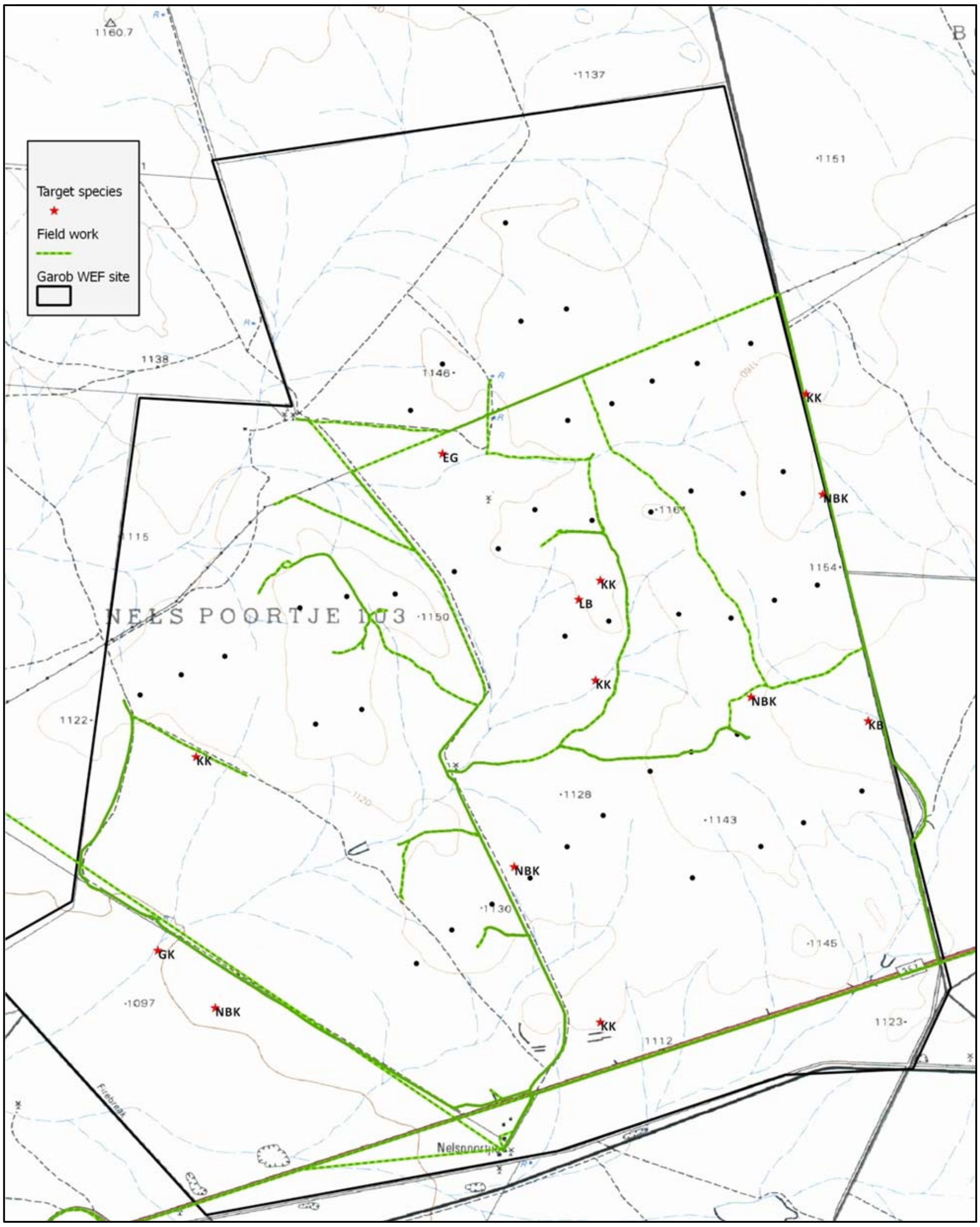


Figure 3. Target species sightings during field work (shown by green tracks, excluding walking). KK = Karoo Korhaan; NBK = Northern Black Korhaan; LB = Ludwig's Bustard; KB = Kori Bustard; GK = Greater Kestrel; EG = Egyptian Goose.

Target species for this study

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 occur 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 (Barnes 2000) 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 although the study was not intended to identify species for consideration in EIA's, it does serve as a useful resource, and in particular includes assessment of non-Red Listed bird species. The current Garob study has therefore used the various information sources above to develop a target species list for the project.

The resultant list of 'target species' for this study is as follows: Lesser Kestrel *Falco naumanni*; Kori Bustard *Ardeotis kori*; Ludwig's Bustard *Neotis ludwigii*; Secretarybird *Sagittarius serpentarius*; Lanner Falcon *Falco biarmicus*; Cape Long-billed Lark *Certhilauda brevirostris*; White Stork *Ciconia ciconia*; Jackal Buzzard *Buteo rufofuscus*; Black-shouldered Kite *Elanus caeruleus*; Rock Kestrel *Falco rupicolus*; Greater Kestrel *Falco rupicoloides*; Southern Pale Chanting Goshawk; Karoo Korhaan *Eupodotis vigorsii*; Northern Black Korhaan *Afrotis afraoides*; and Namaqua Sandgrouse *Pterocles namaqua*. It must be stressed that at this stage this list is preliminary and would need to be confirmed as more work is done during the pre-construction bird monitoring on site.

As discussed elsewhere in this report, the impact of most concern for these species is that of collision with turbines. Since the broader area is so uniform, and generally undeveloped, habitat destruction and disturbance of birds is likely to be of lower significance. The proportion of flight time spent at turbine height (and hence at risk of collision) is not known for any of these key bird species. This means that the exact risk of collisions of any of these species with the turbine blades once operational is very difficult to assess. In judging the potential significance of this impact it is essential to understand the flight characteristics of the species, i.e. how often and how high the target species fly. This data is only obtained through observation of the relevant area and species. Fortunately a pre-construction bird monitoring programme has been initiated and is half complete.

Pre-construction bird monitoring preliminary findings

The following is the relevant portion of the executive summary from the latest progress report for the monitoring programme, based on two of the scheduled four site visits to date:

Pre-construction bird monitoring at the Garob WEF aims to establish the bird baseline on site before construction. This will entail obtaining indices of the abundance of relevant bird species on site; and characterising relevant species flight activity on site. This information will allow for before-after comparisons to be made post construction, and if patterns in bird flight activity emerge, for input into final turbine siting. It will also provide us with a better general understanding of bird movement on site, which will increase the confidence of our assessment of likely impacts in the above mentioned EIA phase.

The first and second site visits (winter and spring) have been conducted at the Garob site. Monitoring activities comprise data collection at five Vantage Points, fifteen Walked Transects, three Vehicle Based counts, and numerous incidental observations. Activities at the control site include one Vantage Point, one Vehicle Based count, three Walked Transects and Incidental Observations.

The following are key findings to date:

- It must be stressed that at this stage sufficient data does not exist to enable comprehensive statistical analysis. The findings of this report should therefore be viewed as preliminary and qualitative. Bird flight data is particularly low on this site, which points towards a possible low risk of collision of birds with turbine blades.
- It is likely that the winter site visit would naturally record low bird activity and abundance relative to the other seasons. Spring is also likely to record low bird abundance if the rains have not yet come. It is likely that bird presence on site may be at a maximum after rainfall, particularly in summer. The summer site visit is therefore anticipated to capture higher usage of the site by various bird species.
- A short list of 26 target species (those species which warrant special attention) has been identified for the Garob site. These are species which are believed to be vulnerable to interactions with the facility, and are of conservation concern either due to their formal Red List classification (Barnes, 2000) or other factors.
- Thirty-three bird species have been recorded on Walked Transects in winter, and 26 in spring. In each case six of these species are target species. Species recorded most frequently include Lark-like Bunting, Sabota Lark, Spike-heeled Lark, Sociable Weaver and Grey-backed Sparrowlark, none of which are target species for this study. The target species recorded most frequently on Walked Transects (as on other data capture methods) is the Northern Black Korhaan.
- Vehicle based counts have recorded a total of 4 target species across both seasons, all of which are target species. These are (in order of abundance) Northern Black Korhaan; Kori Bustard; Karoo Korhaan and Southern Pale Chanting Goshawk.
- Incidental observations in both seasons are predominantly of Northern Black Korhaan.
- In total seven target bird species have been recorded flying across the five Vantage Points on site. The species recorded flying for the longest combined duration is the Northern Black Korhaan, followed by Karoo Korhaan and Greater Kestrel. To date the flight activity on site is very low. During winter, 8 of the 20 Vantage Point sessions recorded no bird flight at all, and in spring 10 of the 20 session recorded no flights. Although this low level of data poses challenges in terms of identifying patterns in flight movement, it is actually good news for bird collisions with the proposed turbines. If birds seldom fly on site, there could be a lower risk of collision than if the same species were flying more frequently.
- At this stage it would appear that most of the flights take place at 30 metres and lower above ground level.

- Spatial information from flight paths has been presented in this report for record purposes. As more data becomes available, more detailed analysis will be possible. No strong flight path patterns are evident at this early stage.
- In total 77 bird species have been recorded on site (71 species in winter and an additional 6 in spring), 12 of which are target species. This list will be added to as data collection continues.
- On the control site very similar low levels of bird activity have been recorded.
- Based on data collection to date there are no 'red flags' for this project.

Although it is not possible at this stage to make statistical findings using the data collected, early indications are that bird flight activity on site in particular is low – pointing towards a possible low risk of bird collision. In addition, no sensitive avifaunal features such as breeding Red Listed species or roosts have been identified on site or in the vicinity to date. There have been no species recorded on site which are particularly threatened, or have particularly restricted ranges.

It is important to note at this point that the aridity of this site and surrounds means that the distribution and abundance of several species key to this project is closely linked to rainfall. An excellent example is the Ludwig's Bustard *Neotis ludwigii*, whose distribution correlates with rainfall in the previous three months (Allan 1994). This means that short term influxes of this species (and others) onto the site could occur following significant rainfall. Sampling rainfall variation (and hence utilisation of this site by such species) adequately would require decades. We need to recognise then that in spite of the formal data findings of this programme, species such as the bustards do remain a cause for some concern on site in the long term. During the operational lifespan of the wind energy facility (approximately 25 years) there is a strong chance that at some point high numbers of these species could occur in the area and hence be at risk of collision with turbines. Given that the occurrence of such an event is temporary, and extremely unpredictable, this factor cannot be assigned a high significance in assessing the potential impacts of the facility on avifauna. However, once operational the facility will need to monitor these factors and respond accordingly.

The next site visit will take place in early January 2013.

5. ASSESSMENT OF IMPACTS OF PROPOSED FACILITY

The potential impacts of the proposed Garob WEF and associated infrastructure are as follows. These impacts have been formally assessed and rated according to the criteria (supplied by Savannah Environmental Pty (Ltd) shown in Appendix 1.

5.1. Wind energy facility

Destruction of bird habitat:

Since the site is situated in an extremely uniform area and does not appear to possess any unique habitat, this impact is not anticipated to of high significance for most of the site. The exception to this will be some of the areas identified in the sensitivity mapping exercise, in particular any surface water sources or significant drainage lines.

Table 2. Assessment of the impact of habitat destruction during construction of the wind energy facility.

Nature: Habitat destruction during construction of wind energy facility		
	Without mitigation	**With mitigation**
Extent	1	1
Duration	4	4
Magnitude	2	2
Probability	4	4
Significance	**28 (low)**	**28 (low)**
Status (positive or negative)	Negative	Negative
Reversibility	Moderate, if the facility were removed vegetation would probably recover to some extent	
Irreplaceable loss of resources?	No	Yes
Can impacts be mitigated?	Not substantially, a certain amount of habitat has to be altered	
Mitigation: Micro siting of turbines to avoid sensitive areas. Strict control of machinery, staff and equipment to ensure no unnecessary damage to vegetation		
Cumulative impacts: Could be quite substantial if more projects are built in the same area. At this stage I am aware of two other wind projects, and some solar facilities planned. Collectively these facilities could remove quite a lot of habitat from the area. However on a landscape level this is still not believed to be significant in this area.		
Residual Impacts: minimal, vegetation would probably recover to a large extent		

Disturbance of birds:

This is unlikely to be of high significance for the target species, unless breeding on site – which has not been recorded to date.

Table 3. Assessment of the impact of disturbance during construction of the wind energy facility.

Nature: Disturbance of birds during construction and maintenance of wind energy facility		
	Without mitigation	**With mitigation**
Extent	2	2
Duration	1	1
Magnitude	4	4
Probability	4	4
Significance	**28 (Low)**	**28 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	High, if disturbance ceased birds would recover	Low
Irreplaceable loss of resources?	No – unless through failed breeding, but no key species found breeding on site to date	Yes
Can impacts be mitigated?	Partially	

Mitigation: Avoid sensitive areas of site as identified in Section 6 of this report. Maintain strict control of vehicles, staff and machinery at all times.
Cumulative impacts: Could be quite substantial if more projects are built in the same area. At this stage I am aware of two other wind projects, and some solar facilities planned. Collectively these facilities could disturb birds over quite a wide area. However on a landscape level this is still not believed to be significant in this area.
Residual Impacts: None

Displacement of birds from the site and barrier effects:

The likelihood of this impact being significant is related to how much birds actually use and depend on the site. At this stage it is not anticipated to be a significant impact.

Table 4. Assessment of the impact of displacement of birds from the site during operation of the wind energy facility.

Nature: Displacementof birds during operation of wind energy facility		
	Without mitigation	**With mitigation**
Extent	2	2
Duration	4	4
Magnitude	2	2
Probability	3	3
Significance	**24 (low)**	**24 (low)**
Status (positive or negative)	Negative	Negative
Reversibility	High – removal of facility would cause birds to revert to their original behavior	
Irreplaceable loss of resources?	No not necessarily	
Can impacts be mitigated?	No	
Mitigation: the only way to mitigate this impact would be to curtail or shut down certain or all turbines. This is considered extremely unlikely to be necessary at this site.		
Cumulative impacts: Could be quite substantial if more projects are built in the same area. At this stage I am aware of two other wind projects, and some solar facilities planned. Collectively these facilities could disturb birds over quite a wide area. However on a landscape level this is still not believed to be significant in this area.		
Residual Impacts: Birds displaced from the site may not return to re inhabit their old territories.		

Collision of birds with turbine blades

This impact is likely to affect species such as korhaans, bustards, storks and raptors if they fly frequently enough on and across the site. The pre-construction bird monitoring programme has been initiated in order to gather data on frequency of flights on site. The data from the first two site visits points towards very low flight activity on site. It is strongly recommended that this report be updated with as much information as possible from the monitoring programme, as late in the process of finalising this EIA as possible. This will result in a higher confidence assessment.

Table 5. Assessment of the impact of collision of birds with turbine blades during operation of the wind energy facility.

Nature: Collision of birds with turbine blades during operation of wind energy facility		
	Without mitigation	**With mitigation**
Extent	1	1
Duration	4	4

Magnitude	6	6
Probability	2	2
Significance	**22 (low)**	**22 (low)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes – birds are killed	Yes
Can impacts be mitigated?	Not very effectively	
Mitigation: the best mitigation measure prior to construction is to ensure that the turbines are sited in a way that poses the least possible collision risk to birds. This has partially been done based on sensitive habitats (dams and drainage lines) in Section 6. However the avifaunal input into turbine siting will be far stronger based on pre-construction bird monitoring data. It is essential that this report be updated at the latest possible stage to include the most possible monitoring data. If collisions are frequent post construction the operator will need to consider mitigation measure such as curtailment or even shut down of particular turbines.		
Cumulative impacts: Since there are at least 2 other wind farm projects proposed in the Copperton area there is a risk that the cumulative impact of all sites on particular species could be great. However it is not considered likely that this will be a major factor in this area given the uniformity of the habitat, and the relative lack of sensitive features on site which could attract high numbers of birds.		
Residual Impacts: if the facility were decommissioned the impact would cease, but birds already killed could not be recovered.		

5.2. Roads

Destruction of habitat for construction of roads, substations, and other infrastructure:

As with the main wind energy facility described above, these impacts are anticipated to be of mdium significance.

Table 6. Assessment of the impact of habitat destruction during construction of roads.

Nature: Habitat destruction during construction of roads		
	Without mitigation	**With mitigation**
Extent	1	1
Duration	4	4
Magnitude	2	2
Probability	5	5
Significance	**35 (Medium)**	**35 (medium)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes – partially	
Mitigation: Micro siting of turbines to avoid sensitive areas. Strict control of machinery, staff and equipment to ensure no unnecessary damage to vegetation		
Cumulative impacts: Could be quite substantial if more projects are built in the same area. At this stage I am aware of two other wind projects, and some solar facilities planned. Collectively these facilities could remove quite a lot of habitat from the area. However on a landscape level this is still not believed to be significant in this area.		
Residual Impacts: vegetation could probably recover to a large extent		

5.3. Power lines

Collision and electrocution on overhead power lines:

These two impacts are likely to be of medium significance if not correctly mitigated. In this arid area, overhead power lines stand out vertically and therefore present large obstacles to birds in flight (thereby increasing the likelihood of collision) and present suitable perching substrate where large trees are virtually absent (thereby increasing the risk of electrocution). Fortunately this impact is relatively easily mitigated, particularly in the case of electrocution.

Table 7. Assessment of the impact of collision and electrocution of birds on overhead power lines.

Nature: Collision and electrocution of birds on overhead power lines		
	Without mitigation	**With mitigation**
Extent	1	1
Duration	5	5
Magnitude	6	6
Probability	4	2
Significance	**48 (Medium)**	**24 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	Low – birds are killed	Low – birds are killed
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: For collision: high risk sections of the 132kV power line connecting to the grid must be installed with an effective Eskom approved line marking device. The best device available at the time of construction must be used. These devices should be installed on the earth wires at a spacing of no more than 5m, alternating a dark and a light colour. The high risk sections of power line should be identified during a final avifaunal walk through for the site once all final positions of infrastructure have been finalized. All power line on site connecting turbines should be buried. For electrocution: Only an Eskom approved bird friendly pylon structure must be used for the connection to the grid. It is recommended that the steel monopole, with Bird Perch be used. All power line linking turbines on site should be buried.		
Cumulative impacts: The cumulative impacts of overhead power lines on certain bird species in the arid parts of South Africa are substantial. Bustards and cranes (collision) and large raptors (electrocution) have been heavily impacted upon by power lines in these areas. As a result some of these species are unlikely to be able to sustain too much more additional mortality. Every effort should therefore be made to ensure that this proposed facility does not impact unduly upon these birds. This can be achieved through implementing the above mitigation measures.		
Residual Impacts: once the power lines are decommissioned the impact would cease. However the birds that may have been killed by the power lines can be considered a residual impact since they cannot be recovered.		

6. SENSITIVITY MAPPING FOR THE PROPOSED SITE

Avoiding areas of high bird use or sensitivity is the most important means of mitigating the effects of wind turbines (and associated infrastructure) on birds. This section of this study focused on identifying those areas that should be avoided based on the micro habitats present. The strongest basis for the identification of these areas is on the basis of actual flight data for target species, collected through pre construction bird monitoring. The surface water sources and major drainage lines evident at a desktop level (and confirmed during field work) have been mapped and buffered. Field work confirmed that the drainage lines are indeed the most sensitive areas on this site, since they will be used as flight paths by relevant species such as korhaans, bustards and water fowl. Surrounding many of the drainage lines are flats low lying areas or 'vlaktes' which will also attract these species for foraging. The higher ground would typically be sensitive for raptors as they would forage along the edges using favourable air currents. However the relatively low density of raptors in the area coupled with the relative insignificance of the ridges or higher ground on site means that these areas are not considered significant in this study. Ideally infrastructure should not be constructed within these areas. The consolidated sensitivity map is shown in Figure 4.

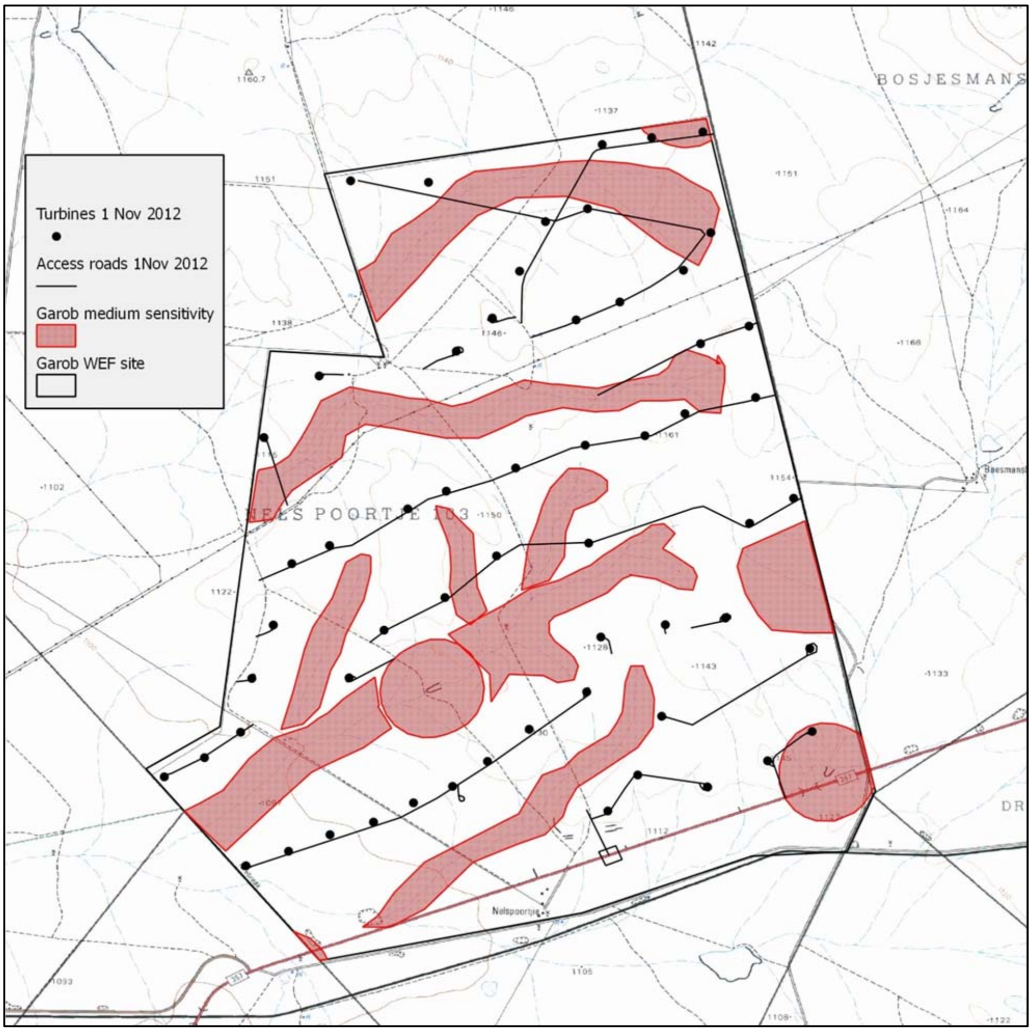
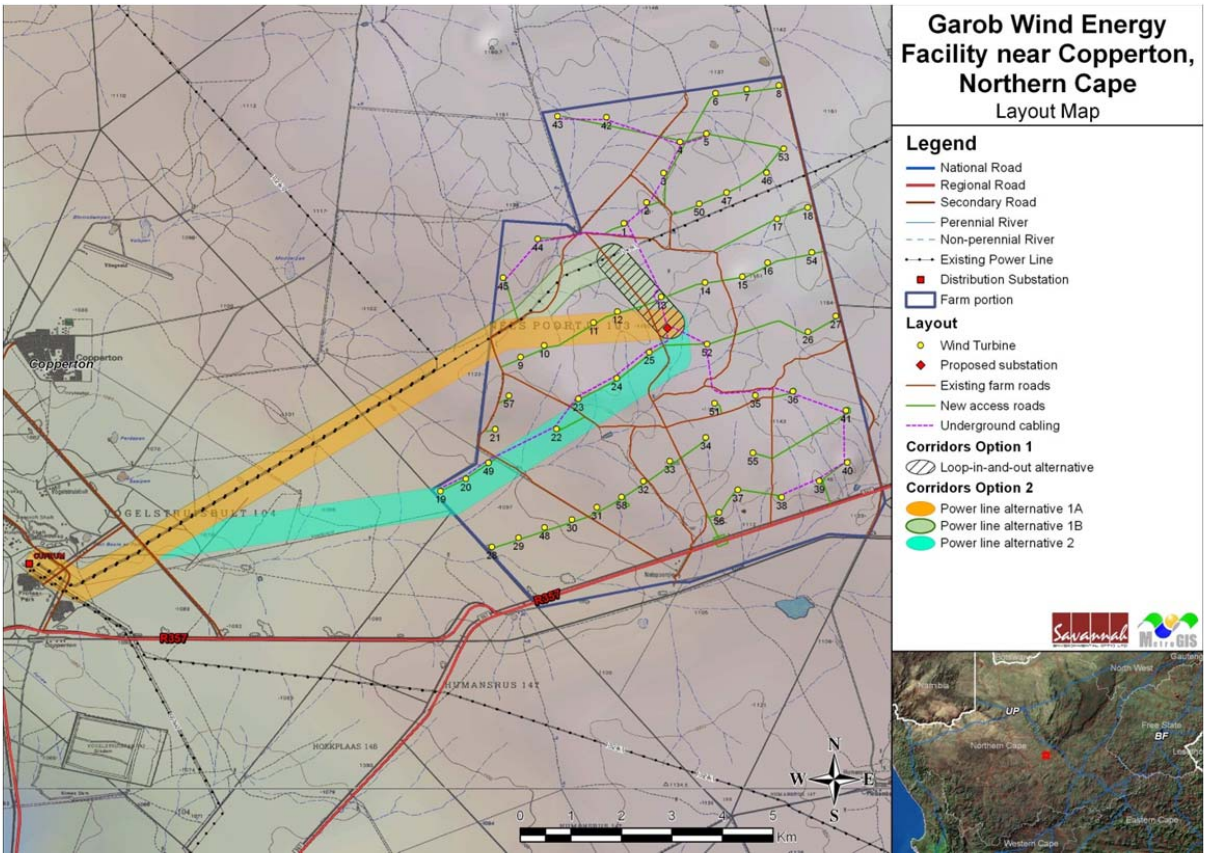


Figure 4. Sensitivity map for the Garob WEF study area. Red areas indicate medium sensitivity, dams and drainage lines.

7. COMPARISON OF ALTERNATIVES

Two options are being considered for the necessary grid connection, as follows:

* Option 1: Loop in and out of the existing BURCHELL/CUPRUM 132 kV line
* Option 2: would be to connect directly to the existing Eskom Cuprum substation via a 132 kV power line. Two alternatives are being considered for this option:
  - **Alternative 1** would be to connect directly to the existing Eskom Cuprum substation via the ***northern corridor*** parallel to the BURCHELL/CUPRUM 132 kV line. Two sub alternatives are being considered within this corridor; a) sub alternative A is the shortest route with a section crossing the wind farm site in a westerly direction; b) sub alternative B is the longer route (approximately 2.5 km longer than sub-alternative A)
  - **Alternative 2** will be to connect directly to the existing Eskom Cuprum substation via a ***southern corridor*** which follows a route to avoid traversing the adjacent property (Farm 103/7) which forms part of another proposed renewable energy project.



From an avifaunal perspective it makes good sense to group infrastructure in one part of the landscape rather than scattering them around. In addition it is believed that multiple power lines are more visible to birds in flight than single lines (APLIC 1994), thereby partially mitigating for the impact of collision.

The Option 1 is therefore the most preferred route from an avifaunal perspective as it requires the least new power line.

From Option 2, Alternative 1B is preferred as it joins the existing power line for most of its route, and it avoids the low lying sensitive areas that are traversed by Alternative 2 (Figure 3). The second most preferred would be sub alternative A. Alternative 2 is not preferred as it runs close to the largest drainage line on site and does not take advantage of following the existing power line route.

None of the routes are fatally flawed from an avifaunal perspective. No particularly sensitive areas exist along the routes from the site to Cuprum.

8. INPUT INTO ENVIRONMENTAL MANAGEMENT PLAN

OBJECTIVE: Reduce the facilities' impact on avifauna to within acceptable levels	
Project component/s	Wind turbines, roads, power lines
Potential Impact	Collision of Red Listed bird species with turbine blades, habitat destruction and disturbance of birds, collision and electrocution of birds on power lines
Activity/risk source	Operation of wind energy facility and associated power lines
Mitigation: Target/Objective	Incorporate data from pre-construction bird monitoring into final micro siting – by submission of site specific EMP. Due date will be on finalization of site specific EMP. Target is to reduce impact on birds, but cannot be elaborated on more at this stage until pre-construction monitoring data becomes available.

Mitigation: Action/control	Responsibility	Timeframe
Conduct pre construction bird monitoring on site Incorporate findings into site specific EMP and final layout	WildSkies Ecological Services (Pty) Ltd – under contract from juwi	Pre-construction monitoring will be complete by approximately May/June 2013
Conduct avifaunal walk down on final 132kv power line route to identify high risk sections of power line for collision mitigation	WildSkies Ecological Services (Pty) Ltd	In time for inclusion in overall site specific EMP
Install above identified collision mitigation	Juwi/Eskom – subject to Eskom standards	By the time of cable stringing
Ensure that pylon structure used for 132kv power line is bird friendly	Juwi/Eskom – subject to Eskom standards	By the time of construction

Performance Indicator	The overall indicator will be the effect of the facility on birds through collision, habitat destruction and disturbance. The simplest of these to monitor is collision. Post construction monitoring will aim to detect any collision victims under turbines and assess the significance of any such mortalities. Habitat destruction and disturbance effects will be assessed less formally during post construction monitoring. It is likely that only the disturbance of breeding Red Listed species would amount to a significant effect.

Monitoring	Post construction bird monitoring will need to be conducted for a certain period after the facility is commissioned. This monitoring will capture information on the above identified issues and evaluate the effectiveness of the proposed mitigation measures.

8. IMPACT STATEMENT & CONCLUSION

The proposed development is likely to pose potential impacts on birds predominantly through collision with turbines, and collision and electrocution on associated power lines. Fortunately data is currently being collected through a pre-construction bird monitoring programme. This data will enable an informed decision on the potential risk of collision of the target species. The mitigation measures for the impacts of collision and electrocution on power lines are reasonably straight forward, and will reduce these impacts to acceptable levels. Impact management for collision with turbines is however a lot more challenging, as explained elsewhere in this report. One of the primary means of mitigating collision with turbines is the correct placement of turbines, outside of known flight paths of target species. Data emanating from the pre-construction monitoring programme should be used for this turbine micro siting. **It is essential that this report be updated to include as much as possible of the data emanating from the monitoring programme.**

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APPENDIX 1- Environmental Impact Assessment Report: Assessment of Impacts

Direct, indirect and cumulative impacts of the issues identified through the scoping study, as well as all other issues identified in the EIA phase must be assessed in terms of the following criteria:

» The **nature**, which shall include a description of what causes the effect, what will be affected and how it will be affected.
» The **extent**, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 will be assigned as appropriate (with 1 being low and 5 being high):
» The **duration**, wherein it will be indicated whether:
  * the lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1;
  * the lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2;
  * medium-term (5–15 years) – assigned a score of 3;
  * long term (> 15 years) - assigned a score of 4; or
  * permanent - assigned a score of 5;

» The **magnitude**, quantified on a scale from 0-10, where 0 is small and will have no effect on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high (processes are altered to the extent that they temporarily cease), and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.
» The **probability** *of occurrence*, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale of 1–5, where 1 is very improbable (probably will not happen), 2 is improbable (some possibility, but low likelihood), 3 is probable (distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures).
» the **significance**, which shall be determined through a synthesis of the characteristics described above and can be assessed as low, medium or high; and
» the **status**, which will be described as either positive, negative or neutral.
» the degree to which the impact can be reversed.
» the degree to which the impact may cause irreplaceable loss of resources.
» the *degree* to which the impact can be *mitigated.*

The **significance** is calculated by combining the criteria in the following formula:

S=(E+D+M)P

S = Significance weighting
E = Extent
D = Duration
M = Magnitude
P = Probability

The **significance weightings** for each potential impact are as follows:

- < 30 points: Low (i.e. where this impact would not have a direct influence on the decision to develop in the area),
- 30-60 points: Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated),
- > 60 points: High (i.e. where the impact must have an influence on the decision process to develop in the area).

APPENDIX 2. Bird data for the site - from the Southern African Bird Atlas Project 1 (Harrison *et al*, 1997)

Roberts #	Common Name	*Scientific Name*	Cons status	2922CC (3 cards)	2922CD (8 cards)	2922DC (11 cards)	3022AB (8 cards)	Field record
1	Common Ostrich	*Struthio camelus*		0.00	0.25	0.18	0.00	1
8	Little Grebe	*Tachybaptus ruficollis*		0.00	0.50	0.00	0.00	
58	Reed Cormorant	*Phalacrocorax africanus*		0.33	0.00	0.00	0.00	
62	Grey Heron	*Ardea cinerea*		0.33	0.00	0.00	0.00	
63	Black-headed Heron	*Ardea melanocephala*		0.00	0.13	0.09	0.00	1
67	Little Egret	*Egretta garzetta*		0.33	0.00	0.00	0.00	
71	Cattle Egret	*Bubulcus ibis*		0.33	0.13	0.00	0.13	
83	White Stork	*Ciconia ciconia*	BONN	0.00	0.00	0.09	0.00	
84	Black Stork	*Ciconia nigra*	NT	0.00	0.00	0.09	0.00	
91	African Sacred Ibis	*Threskiornis aethiopicus*		0.00	0.13	0.00	0.00	1
94	Hadeda Ibis	*Bostrychia hagedash*		0.00	0.13	0.00	0.00	1
96	Greater Flamingo	*Phoenicopterus ruber*	NT	0.00	0.00	0.00	0.13	
102	Egyptian Goose	*Alopochen aegyptiaca*		0.00	0.13	0.27	0.25	1
103	South African Shelduck	*Tadorna cana*		0.00	0.38	0.36	0.25	1
104	Yellow-billed Duck	*Anas undulata*		0.00	0.25	0.00	0.00	
106	Cape Teal	*Anas capensis*		0.00	0.38	0.00	0.00	
118	Secretarybird	*Sagittarius serpentarius*	NT	0.00	0.00	0.18	0.00	
127	Black-shouldered Kite	*Elanus caeruleus*		0.00	0.00	0.09	0.00	1
131	Verreaux's Eagle	*Aquila verreauxii*		0.00	0.00	0.18	0.00	
152	Jackal Buzzard	*Buteo rufofuscus*		0.00	0.00	0.09	0.00	
162	Southern Pale Chanting Goshawk	*Melierax canorus*		0.33	0.63	0.81	0.88	1
172	Lanner Falcon	*Falco biarmicus*	NT	0.33	0.00	0.09	0.00	
181	Rock Kestrel	*Falco rupicolus*		0.00	0.38	0.27	0.38	1
182	Greater Kestrel	*Falco rupicoloides*		0.33	0.50	0.18	0.25	1
183	Lesser Kestrel	*Falco naumanni*	V	0.33	0.00	0.00	0.00	
186	Pygmy Falcon	*Polihierax semitorquatus*		0.00	0.00	0.18	0.00	
203	Helmeted Guineafowl	*Numida meleagris*		0.00	0.13	0.00	0.00	1
226	Moorhen	*Gallinula chloropus*		0.00	0.13	0.00	0.00	
228	Red-knobbed Coot	*Fulica cristata*		0.00	0.38	0.00	0.00	
230	Kori Bustard	*Ardeotis kori*	V	0.67	0.000	0.00	0.00	1
232	Ludwig's Bustard	*Neotis ludwigii*	V	0.3333	0.25	0.00	0.25	1
235	Karoo Korhaan	*Eupodotis vigorsii*		0.6667	0.50	0.27	0.50	1
239	Southern Black Korhaan	*Afrotis afra*		1.0000	0.88	0.27	0.63	1
248	Kittlitz's Plover	*Charadrius pecuarius*		0.0000	0.00	0.00	0.13	
249	Three-banded Plover	*Charadrius tricollaris*		0.000	0.25	0.00	0.38	

				0				
255	Crowned Lapwing	*Vanellus coronatus*		0.333 3	0.63	0.00	0.13	
258	Blacksmith Lapwing	*Vanellus armatus*		0.00	0.50	0.54	0.75	
264	Common Sandpiper	*Actitis hypoleucos*		0.00	0.13	0.00	0.00	
266	Wood Sandpiper	*Tringa glareola*		0.00	0.13	0.00	0.00	
270	Common Greenshank	*Tringa nebularia*		0.00	0.00	0.09	0.13	
284	Ruff	*Philomachus pugnax*		0.00	0.13	0.00	0.00	
290	Common Whimbrel	*Numenius phaeopus*		0.00	0.13	0.00	0.00	
295	Black-winged Stilt	*Himantopus himantopus*		0.00	0.25	0.00	0.25	
297	Spotted Thick-knee	*Burhinus capensis*		0.33	0.13	0.00	0.13	
300	Temminck's Courser	*Cursorius temminckii*		0.00	0.00	0.09	0.00	
301	Double-banded Courser	*Rhinoptilus africanus*		0.33	0.50	0.09	0.00	1
344	Namaqua Sandgrouse	*Pterocles namaqua*		0.67	0.50	0.27	0.38	1
348	Rock Dove	*Columba livia*		0.00	0.13	0.00	0.13	
349	Speckled Pigeon	*Columba guinea*		0.67	0.63	0.18	0.63	
352	Red-eyed Dove	*Streptopelia semitorquata*		0.33	0.00	0.09	0.00	
354	Cape Turtle-Dove	*Streptopelia capicola*		0.67	0.38	0.27	0.13	1
355	Laughing Dove	*Streptopelia senegalensis*		0.67	0.75	0.81	0.38	1
356	Namaqua Dove	*Oena capensis*		1.00	0.63	0.45	0.25	1
382	Jacobin Cuckoo	*Clamator jacobinus*		0.00	0.00	0.09	0.00	
401	Spotted Eagle Owl	*Bubo africanus*		0.67	0.00	0.27	0.25	
406	Rufouscheeked Nightjar	*Caprimulgus rufigena*		0.00	0.00	0.09	0.00	
411	Common Swift	*Apus apus*		0.00	0.00	0.09	0.00	
415	White-rumped Swift	*Apus caffer*		0.00	0.25	0.18	0.13	
417	Little Swift	*Apus affinis*		0.00	0.00	0.36	0.13	
425	White-backed Mousebird	*Colius colius*		0.33	0.38	0.18	0.13	1
426	Red-faced Mousebird	*Urocolius indicus*		0.00	0.38	0.18	0.00	1
438	European Bee-eater	*Merops apiaster*		0.00	0.0	0.09	0.00	
445	Swallow-tailed Bee-eater	*Merops hirundineus*		0.00	0.00	0.09	0.00	
451	African Hoopoe	*Upupa africana*		0.00	0.13	0.00	0.00	
465	Acacia Pied Barbet	*Tricholaema leucomelas*		0.00	0.25	0.36	0.25	
495	Cape Clapper Lark	*Mirafra apiata*		0.33	0.13	0.18	0.00	1
497	Fawn-coloured Lark	*Calendulauda africanoides*		0.33	0.00	0.27	0.25	1
498	Sabota Lark	*Calendulauda sabota*		0.67	0.75	0.55	0.75	1
500	Cape Long-billed Lark	*Certhilauda curvirostris*	NT	0.00	0.38	0.18	0.13	
506	Spike-heeled Lark	*Chersomanes albofasciata*		0.33	0.50	0.36	0.75	1
507	Red-capped Lark	*Calandrella cinerea*		0.33	0.00	0.18	0.50	
508	Pink-billed Lark	*Spizocorys conirostris*		0.00	0.00	0.00	0.13	1
510	Sclater's Lark	*Spizocorys sclateri*	NT	0.00	0.13	0.00	0.13	
511	Stark's Lark	*Spizocorys starki*		0.00	0.13	0.18	0.00	

512	Large-billed Lark	*Galerida magnirostris*		0.67	0.00	0.00	0.25	
516	Grey-backed Sparrowlark	*Eremopterix verticalis*		1.00	0.63	0.27	0.50	
517	Black-eared Sparrowlark	*Eremopterix australis*		0.67	0.13	0.00	0.50	1
518	Barn Swallow	*Hirundo rustica*		0.33	0.38	0.45	0.13	
520	White-throated Swallow	*Hirundo albigularis*		0.00	0.25	0.000	0.00	
526	Greater Striped Swallow	*Hirundo cucullata*		0.00	0.13	0.36	0.00	
529	Rock Martin	*Hirundo fuligula*		0.67	0.13	0.45	0.13	
533	Brown-throated Martin	*Riparia paludicola*		0.00	0.00	0.09	0.00	
548	Pied Crow	*Corvus albus*		1.00	0.38	0.00	0.25	1
552	Ashy Tit	*Parus cinerascens*		0.00	0.00	0.09	0.00	
557	Cape Penduline-Tit	*Anthoscopus minutus*		0.33	0.00	0.00	0.13	
567	African Red-eyed Bulbul	*Pycnonotus nigricans*		0.00	0.50	0.36	0.00	1
577	Olive Thrush	*Turdus olivaceus*		0.00	0.63	0.09	0.00	
583	Short-toed Rock-Thrush	*Monticola brevipes*		0.00	0.00	0.09	0.00	
586	Mountain Wheatear	*Oenanthe monticola*		0.00	0.13	0.73	0.63	
587	Capped Wheatear	*Oenanthe pileata*		0.00	0.13	0.09	0.13	
589	Familiar Chat	*Cercomela familiaris*		0.67	0.63	0.36	0.25	
590	Tractrac Chat	*Cercomela tractrac*		0.00	0.13	0.09	0.38	
591	Sickle-winged Chat	*Cercomela sinuata*		0.00	0.00	0.09	0.13	
592	Karoo Chat	*Cercomela schlegelii*		0.00	0.25	0.18	0.25	
595	Ant-eating Chat	*Myrmecocichla formicivora*		0.67	0.50	0.73	0.75	1
596	African Stonechat	*Saxicola torquatus*		0.00	0.25	0.00	0.00	
601	Cape Robin-Chat	*Cossypha caffra*		0.00	0.13	0.27	0.00	
614	Karoo Scrub-Robin	*Cercotrichas coryphoeus*		0.00	0.63	0.45	0.75	
615	Kalahari Scrub-Robin	*Cercotrichas paena*		0.00	0.13	0.09	0.13	
619	Garden Warbler	*Sylvia borin*		0.00	0.13	0.00	0.00	
621	Chestnut-vented Tit-Babbler	*Parisoma subcaeruleum*		0.00	0.00	0.36	0.13	
622	Layard's Tit-Babbler	*Parisoma layardi*		0.00	0.00	0.00	0.13	
631	African Reed-Warbler	*Acrocephalus baeticatus*		0.00	0.13	0.00	0.00	
635	Lesser Swamp-Warbler	*Acrocephalus gracilirostris*		0.00	0.25	0.00	0.00	
651	Long-billed Crombec	*Sylvietta rufescens*		0.00	0.00	0.09	0.00	
653	Yellow-bellied Eremomela	*Eremomela icteropygialis*		0.00	0.25	0.09	0.25	
664	Zitting Cisticola	*Cisticola juncidis*		0.00	0.00	0.09	0.00	
665	Desert Cisticola	*Cisticola aridulus*		0.00	0.25	0.27	0.00	
669	Grey-backed Cisticola	*Cisticola cinnamomeus*		0.33	0.00	0.18	0.25	
677	Levaillant's Cisticola	*Cisticola tinniens*		0.00	0.13	0.00	0.00	
685	Black-chested Prinia	*Prinia flavicans*		0.00	0.50	0.73	0.38	
688	Rufous-eared Warbler	*Malcorus pectoralis*		0.33	0.75	0.45	0.88	
697	Chat Flycatcher	*Bradornis infuscatus*		0.33	0.75	0.64	0.63	1
698	Fiscal Flycatcher	*Sigelus silens*		0.33	0.25	0.09	0.13	
706	Fairy Flycatcher	*Stenostira scita*		0.00	0.00	0.18	0.13	

713	Cape Wagtail	*Motacilla capensis*		0.67	0.75	0.27	0.25	
716	African Pipit	*Anthus cinnamomeus*		0.67	0.25	0.09	0.13	
717	Long-billed Pipit	*Anthus similis*		0.00	0.00	0.09	0.00	
719	Buffy Pipit	*Anthus vaalensis*		0.00	0.00	0.00	0.13	
732	Common Fiscal	*Lanius collaris*		0.33	0.38	0.64	0.38	1
733	Red-backed Shrike	*Lanius collurio*		0.00	0.00	0.09	0.00	
741	Brubru	*Nilaus afer*		0.00	0.25	0.09	0.00	
746	Bokmakierie	*Telophorus zeylonus*		0.00	0.50	0.18	0.25	
759	Pied Starling	*Spreo bicolor*		0.00	0.00	0.09	0.50	1
760	Wattled Starling	*Creatophora cinerea*		0.33	0.25	0.00	0.00	
764	Cape Glossy Starling	*Lamprotornis nitens*		0.00	0.00	0.09	0.00	
770	Pale-winged Starling	*Onychognathus nabouroup*		0.33	0.00	0.36	0.00	
788	Dusky Sunbird	*Cinnyris fuscus*		0.00	0.13	0.45	0.25	
796	Cape White-Eye	*Zosterops virens*		0.00	0.13	0.18	0.00	
799	White-browed Sparrowweaver	*Plocepasser mahali*		1.00	0.25	0.90	0.00	
800	Sociable Weaver	*Philetairus socius*		0.00	0.25	0.36	0.00	1
801	House Sparrow	*Passer domesticus*		0.67	0.50	0.27	0.50	
803	Cape Sparrow	*Passer melanurus*		1.00	0.88	0.63	0.75	
804	Southern Grey-headed Sparrow	*Passer diffusus*		0.00	0.00	0.09	0.00	
806	Scaly-feathered Finch	*Sporopipes squamifrons*		0.00	0.13	0.09	0.00	1
814	Southern Masked Weaver	*Ploceus velatus*		0.67	0.63	0.81	0.63	
821	Red-billed Quelea	*Quelea quelea*		0.00	0.13	0.00	0.13	
824	Southern Red Bishop	*Euplectes orix*		0.00	0.25	0.00	0.38	
846	Common Waxbill	*Estrilda astrild*		0.00	0.13	0.00	0.00	
847	Black-faced Waxbill	*Estrilda erythronotos*		0.00	0.00	0.18	0.00	
852	African Quailfinch	*Ortygospiza atricollis*		0.00	0.00	0.09	0.00	
856	Red-headed Finch	*Amadina erythrocephala*		0.67	0.13	0.18	0.13	
870	Black-throated Canary	*Crithagra atrogularis*		0.00	0.25	0.27	0.00	
876	Black-headed Canary	*Serinus alario*		0.00	0.00	0.09	0.13	
878	Yellow Canary	*Crithagra flaviventris*		0.67	0.63	0.36	0.25	
879	White-throated Canary	*Crithagra albogularis*		0.00	0.13	0.36	0.25	
885	Cape Bunting	*Emberiza capensis*		0.00	0.00	0.27	0.00	
887	Lark-like Bunting	*Emberiza impetuani*		0.33	0.50	0.72	0.63	
888	Yellow-billed Kite	*Milvus migrans*		0.00	0.00	0.09	0.00	
889	Black Kite	*Milvus migrans*		0.00	0.00	0.09	0.00	