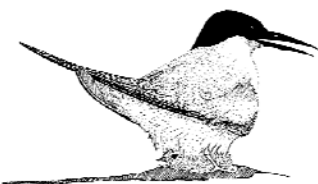


# KOINGNAAS WIND ENERGY FACILITY

## Avian Basic Assessment



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## EXECUTIVE SUMMARY

This study contains a review of recent literature on wind energy impacts on avifauna, and identifies potential impacts associated with the proposed Koingnaas Wind Energy Facility on the avifauna of this coastal area of the Northern Cape. The possible impacts are: (i) minimal habitat alteration by the facility itself (due to an already highly altered mining environment) and any associated power lines or substation/s, (ii) disturbance by construction and maintenance activities, (iii) possible displacement or disturbance of sensitive species, and (iv) direct collision with blades of the wind turbines or the associated power line network. Electrocutation of avifauna is a lesser problem for all but the largest species on the power line infrastructure.

The impact zone of the small (up to 24 turbine) wind energy facility proposed for the area south of Koingnaas within the Namaqualand vegetation zone is reviewed. The region is likely to support over 90 bird species, including 7 threatened (red-listed) species, 36 endemic species, of which 3 are red-listed endemics. The avian groups of greatest conservation significance likely to be impacted by the turbines include the flocking waterbirds such as cormorants and flamingos. While collision-prone bustards have been recorded their likelihood of occurrence is very low and thus impacts minimal. Resident raptors such as Black-chested Snake Eagles and Greater Kestrels may be at greater risk, particularly if the lattice (not smooth-sided) towers are used due to their attraction as perching and nesting sites for raptors. Impacts may occur in terms of both collision and disturbance from the facility itself. A brief survey revealed a rich vein of endemic passerines which could be affected by disturbance impacts.

To mitigate the possible issues raised above I recommend that: (i) the lattice towers are covered with netting to prevent birds nesting or perching on them; (ii) all power lines – present and future – are marked with bird flappers to reduce possible collisions with large migrating birds (iii) all turbine blades are marked with UV paint (UV paint is not visible to the human eye, so an underlying “bright white” that is visible is compatible with a UV covering overlaying this) that increases the probability that birds flying through the area will see and avoid them, and (iv) that where possible the turbine strings are orientated more north-west to south-east to reduce the possibility that birds will collide with the turbines. Possible impacts on the bustards in the area require that mitigation is necessary for the wind farm to proceed. With the proposed mitigations in place it is likely that the impacts on the sensitive species present (i.e. bustards, flamingos, ducks and raptors) can be reduced to allow the WEF to have minimal impact on the avian community.

Specifically which species are likely to move through the WEF can be investigated in more detail during the pre-construction assessment phase. However, during our brief site visit, no wetland species passed through the area but a snake eagle was present. The degree and significance of this impact will depend largely on the relative abundance and movements of collision-prone species, through the wind farm. The Environmental Management Programme should include a pre-construction monitoring phase covering three critical periods from November-April which will generate more detailed assessments of all impacts, and better inform recommended mitigation where necessary.

## **1. CONSULTANT'S DECLARATION OF INDEPENDENCE**

Dr Rob Simmons is an independent consultant to Savannah Environmental (Pty) Ltd. I have no business, financial, personal or other interest in the activity, application or appeal in respect of which I was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of this specialist performing such work.

## **2. BACKGROUND AND QUALIFICATIONS OF SPECIALIST CONSULTANT**

Dr Rob Simmons is a private consultant approached to undertake the specialist avifaunal assessment for the Wind Farm proposed at Koingnaas. I am an experienced ornithologists, with over 25 years' experience in avian research and impact assessment work. I have undertaken twenty avian impact assessments throughout Namibia and South Africa, and I undertake research on threatened species at the FitzPatrick Institute, UCT. In the Western and Northern Cape I specialize in raptors (particularly Black Harriers), shorebirds (particularly flamingos) and seabirds (particularly Damara Terns). I am a Research Associate of the University of Cape Town and of the Institute of Zoology London, and a member of the Birds and Wind Energy Specialist Group (BAWESG).

### **3. INTRODUCTION**

Savannah Environmental has been commissioned to determine the impacts of a Just Palm Tree Power 7MW wind energy facility near Koingnaas on the Northern Cape coast. They have appointed Dr Rob Simmons to conduct the specialist avifaunal assessment. This report is a Basic Assessment that reviews the bird species present from bird atlas records, reports on those species most at risk from collision, avoidance and electrocution of the various turbines, power lines and substations. A brief site visit allowed us to record those birds on site and assess habitats and flyways. I am also requested to assess the possible impacts and suggest ways to mitigate them wherever feasible. This allows us to re-evaluate turbine placement, and present additional mitigation measures to reduce impacts to the avian community to a minimum.

### **4. TERMS OF REFERENCE**

The terms of reference for the Basic Assessment were as follows :

- Describe the existing avifaunal environment at the appropriate scale (local and regional).
- Determine the importance and conservation value of the existing avian communities.
- Determine and assess the potential avian impacts associated with the proposed development.
- Rank the impacts in terms of the Nature, Extent, Duration, Magnitude, Probability of Occurrence, and Significance (where  $S = (E + D + M)P$ ).
- Suggest mitigation measures for the identified impacts and re-quantify the risks based on the above criteria.
- Suggest additional guidelines for an Environmental Management Plan post-Basic Assessment

## **5. STUDY METHODOLOGY**

### **5.1. Approach**

This Basic Assessment study included the following steps:

- A review of available published and unpublished literature pertaining to bird interactions with wind energy facilities that summarises the issues involved and the current level of knowledge in this field. Various data sources were examined including details of the avifauna of the area and previous studies of bird interactions with wind energy facilities and electrical infrastructures associated with them.
- An inclusive list of the avifauna likely to occur within the impact zone of the proposed wind energy facility was compiled using a combination of the existing distributional data from published atlases and some previous experience of the avifauna of the general area.
- A short-list of priority bird species (defined in terms of conservation status and endemism) which may be impacted by the proposed wind energy facility was extracted from the bird list. These species were considered as adequate surrogates for the local avifauna generally, and mitigation of impacts on these species was considered likely to accommodate any less important bird species that may be affected.
- A summary of more likely and significant impacts of the wind energy facility on the local avifauna was drawn up, and quantified using a simple points system.

### **5.2 Data sources used**

The following data sources and reports were used in the compilation of this report:

- Information on the biology (Hockey et al 2005), distribution (Harrison et al. 1997) and conservation status (Barnes 2000) of southern African birds was consulted. Up to date data were extracted from the Southern African Bird Atlas Projects (SABAP), which were obtained from the Animal Demography Unit website (<http://sabap2.adu.org.za/index.php>) for the relevant quarter-degree square (SABAP 1) and the "pentads" of 5' x 5' from (SABAP 2: 3010\_1715). From this square I compiled a list of the avifauna likely to occur within the broader impact zone of the proposed wind farm. I combined these data, with my own 2 day

visit to the area (with one assistant) in August 2011 and previous experience/knowledge of the local avifauna, undertaken on trips made through this area over the last 10 years.

- Conservation status and endemism of all species considered likely to occur in the area was determined from the national Red-list for birds (Barnes 2000), and the most recent and comprehensive summary of southern African bird life-histories (Hockey *et al.* 2005).
- EIA reports and subsequent monitoring reports on the potential impacts on birds of other wind energy facilities in South Africa were also assessed (van Rooyen 2001, Jenkins 2001, 2003, Küyler 2004, Jenkins 2008, 2009).

### **5.3 Limitations & assumptions**

Inaccuracies in the above sources of information could limit this study. The SABAP1 data for this area is almost 19 years old (Harrison *et al.* 1997), and this area is relatively remote and seldom visited. However, a small set of recent atlas cards (15) has been submitted to the SABAP2 system and this forms the basis for this study.

There are only two, small wind energy facilities functioning in South Africa (totaling 7 turbines), therefore data on the environmental effects of wind energy facilities here is limited. However numerous studies are emerging from such facilities internationally. While general principles can be gleaned from them, care is required when adapting international knowledge and experience to uniquely South African birds and conditions.

## **6. BACKGROUND**

### **6.1 Interactions between wind energy facilities and birds**

Recent literature reviews ([www.nrel.gov](http://www.nrel.gov), Kingsley & Whittam 2005, Drewitt & Langston 2006, Kuvlevsky *et al.* 2007, Stewart *et al.* 2007, Drewitt & Langston 2008) are essential summaries and sources of information in this field. The number of longer-term analyses of the effects of wind energy facilities on birds is increasing, but scientific research in this field is still in its infancy (Madders & Whitfield 2006, Stewart *et al.* 2007). Available information originates from short-term studies from the United States, and more recently longer-term ones from western Europe, where wind power generation is well established.

Concern about the impacts of wind facilities on birds first arose in the 1980s when numerous raptor mortalities were detected in California (Altamont Pass - USA) and at Tarifa (Spain). Mortalities at these sites focused attention on the impact of wind energy on birds, and subsequently much monitoring has been done at a wide variety of wind energy facility sites. More recently, there has been additional concern about the degree to which birds avoid or are excluded from the areas occupied by wind energy facilities – either because of the action of the turbine blades or because of the noise they generate - and hence suffer a loss of habitat (Larsen & Guillemette 2007, Stewart *et al.* 2007, Devereaux *et al.* 2008, Pearce-Higgins *et al.* 2009). With a few important exceptions, most studies suggest very low numbers of bird fatalities at wind energy facilities numbering tens to hundreds of birds per year (Kingsley & Whittam 2005). The observed mortality caused by wind energy facilities is also very low compared to other existing sources of anthropogenic avian mortality on a per structure basis (Crockford 1992, Colson & associates 1995, Gill *et al.* 1996, and Erickson *et al.* 2001). Problems arise when the few hundred birds are rare or highly threatened species.

#### **6.1.1. Collisions with turbines**

##### *Collision rates*

As more monitoring has been conducted, bird mortality rates at wind energy facilities have ultimately been compared in terms of a common unit: mortalities/turbine/year, or mortalities  $MW^{-1} \text{ year}^{-1}$  (Smallwood & Thelander 2008). Wherever possible, measured collision rates should allow for (i) the proportion of actual casualties which are detected by observers (searcher efficiency), and (ii) the rate at which carcasses are removed by scavengers (scavenger removal rate – important in an African landscape). Although collision rates may appear relatively low in many instances, cumulative effects over time, especially when applied to large, long lived, slow reproducing and/or threatened species (many of which are collision-prone), may be of considerable conservation significance.

The National Wind Co-ordinating Committee (2004) estimates that 2.3 birds are killed/turbine/year in the US outside California – correcting for searcher efficiency and scavenger rates. However, this index ranges from as low as 0.63 in Oregon to as high as 10 in Tennessee (NWCC 2004) illustrating the wide variance in mortality rates between sites. Curry & Kerlinger (2000) found that only 13% of the >5000 turbines at Altamont Pass, California were responsible for all Golden Eagle *Aquila chrysaetos* and Red-tailed Hawk *Buteo jamaicensis*

collisions. However, the most recent total casualty estimates for Altamont run to >1000 raptors, and nearly 3000 birds, killed in turbine collisions annually (Smallwood & Thelander 2008). This large figure includes >60 Golden Eagles, and at a mean rate of about 2-4 mortalities MW<sup>-1</sup> year<sup>-1</sup>.

At the Tarifa and Navarre wind energy facility sites on the Straits of Gibraltar, southern Spain, about 0.04-0.08 birds are killed/turbine/year (Janss 2000a, de Lucas *et al.* 2008), with relatively high collision rates for threatened raptors such as Griffon Vulture *Gyps fulvus*, of particular concern. At the same sites, collisions have also been found to be non-randomly distributed between turbines, with >50% of the vulture casualties recorded at Tarifa being killed by only 15% of the turbine array at the facility (Acha 1997). Collision rates from other European sites are equally variable, with certain locations sporadically problematic (Everaert 2003). Migration highways and other areas where birds funnel through a bottleneck are areas which should be avoided.

To date, only seven wind turbines have been constructed in South Africa at two pilot facilities at Klipheuwel and Darling in the Western Cape (van Rooyen 2001, Jenkins 2001, 2003). An avian mortality monitoring program was established at the Klipheuwel facility once the turbines were operational, involving regular site visits to monitor bird traffic through the area, and to detect bird mortalities (Küyler 2004). This study found that (i) 9-57% of birds observed within 500m of the turbines per survey period were flying at blade height, and (ii) 0-32% of birds sighted were flying either between the turbines or within the arc of the rotors of the outermost turbines. Five bird carcasses were found on the three-turbine site during the 8-month monitoring period, of which two, a Horus Swift *Apus horus* and a Large-billed Lark *Galerida magnirostris*, were thought to have been killed by collision with turbine blades, indicating a net collision rate for birds of about 1.00 mortality/turbine/year. Only short-term studies have been undertaken at the Darling site (Simmons *et al.* in press) despite recommendations to do long-term monitoring. Endemic species such as Black Harrier, and Jackal Buzzard and also Martial Eagles and Great White Pelican were observed and the rate of passage was 5-10 birds h<sup>-1</sup>.

#### *Causes of collision*

Multiple factors influence the number of birds killed at wind energy facilities. These can be classified into three broad groupings: avian variables, location variables, and facility-related variables. Although only one study has so far shown a direct relationship between the abundance of birds in an area and the number of collisions (Everaert 2003), it would seem logical to assume that the more birds there are flying through an array of turbines, the higher

the chances of a collision occurring. The identity of the species present in the area is also very important as some birds are more vulnerable to collision with turbines than others, and feature disproportionately frequently in collision surveys (Drewitt & Langston 2006, 2008, de Lucas *et al.* 2008). Species-specific variation in behaviour, such as foraging, commuting or courting, also affect susceptibility to collision (Barrios & Rodríguez 2004, Smallwood *et al.* 2009). There may also be seasonal and temporal differences in behaviour, for example breeding males displaying may be particularly at risk (Simmons 2011).

Landscape features often channel birds towards a certain area, and in the case of raptors, influence their flight and foraging behaviour. Ridges and steep slopes are important factors in determining the extent to which an area is used by gliding and soaring birds (Barrios & Rodríguez 2004). High densities of prey will attract raptors, increasing the time spent hunting, and as a result reducing the time spent being vigilant. Poor weather affects visibility. Birds fly lower during strong headwinds (Hanowski & Hawrot 2000, Richardson 2000), so when the turbines are functioning at their maximum speed, birds are likely to be flying at their lowest, exponentially increasing collision risk (Drewitt & Langston 2006, 2008).

Larger wind energy facilities, with more turbines, are almost by definition more likely to incur significant numbers of bird casualties (Kingsley & Whittam 2005), and turbine size may be proportional to collision risk, with taller turbines associated with higher mortality rates in some instances (e.g. de Lucas *et al.* 2009, although see Howell 1995, Erickson *et al.* 1999, Barclay *et al.* 2007). However, with newer technology, fewer, larger turbines are needed to generate the same amount of power, which may result in fewer collisions per Megawatt of power produced (Erickson *et al.* 1999). Certain turbine tower structures, and particularly the old-fashioned lattice designs, present many potential perches for birds, increasing the likelihood of collisions occurring as birds land at or leave these perch or roost sites. This problem has largely been solved with more modern, tubular tower designs (Drewitt & Langston 2006, 2008).

Illumination of turbines and other infrastructure often increases collision risk (Winkelman 1995, Erickson *et al.* 2001), either because birds moving long distances at night navigate using stars, and mistake lights for stars (Kemper 1964), or because lights attract insects, which in turn attract birds. Changing constant lighting to intermittent lighting has been shown to reduce nocturnal collision rates (Richardson 2000, APLIC 1994, Jaroslow 1979, Weir 1976) and changing flood-lighting from white to red (or green) can affect an 80% reduction in mortality rates (Weir 1976).

Spacing between turbines at a wind facility can also affect the number of collisions. Some authors have suggested that paths need to be left between turbines so that birds can move through these paths. Alternatively, where certain turbines are known to kill more birds they can be temporarily taken off service (e.g. during migration or breeding). For optimal wind generation, relatively large spaces are required between turbines in order to avoid wake and turbulence effects.

#### *Collision prone birds*

Collision prone birds are generally either (i) large species and/or species with high ratios of body weight to wing surface area, and low maneuverability (cranes, bustards, vultures, gamebirds, waterfowl, falcons), (ii) species which fly at high speeds (gamebirds, pigeons and sandgrouse, swifts, falcons), (iii) species which are distracted in flight - predators or species with aerial displays (many raptors, aerial insectivores, some open country passerines), (iv) species which habitually fly in low light conditions, and (v) species with narrow fields of forward binocular vision (Drewitt & Langston 2006, 2008, Jenkins *et al.* 2010). These traits confer high levels of *susceptibility*, which may be compounded by high levels of *exposure* to man-made obstacles such as overhead power lines and wind turbines area (Jenkins *et al.* 2010). Exposure is greatest in (i) highly aerial species, (ii) species that make regular and/or long distance movements (migrants, any species with widely separated resources food, water, roost and nest sites), (iii) species that fly in flocks (increasing the chances of incurring multiple fatalities in single collision incidents). Soaring species may be particularly prone to colliding with wind turbines or power lines where these are placed along ridges, the turbines to exploit the same updrafts favoured by such birds - vultures, storks, cranes, and most raptors (Erickson *et al.* 2001, Kerlinger & Dowdell 2003, Drewitt & Langston 2006, 2008, Jenkins *et al.* 2010).

#### *Mitigating collision risk*

One direct way to reduce the risk of birds colliding with turbine blades is to render the blades more conspicuous and hence easier to avoid. Blade conspicuity is compromised by a phenomenon known as 'motion smear' or retinal blur, in which rapidly moving objects become less visible the closer they are to the eye (McIsaac 2001, Hodos 2002). The retinal image can only be processed up to a certain speed, after which the image cannot be perceived. This effect is magnified in low light conditions, so that even slow blade rotation can be difficult for birds to see.

Laboratory-based studies of visual acuity in raptors have determined that (i) visual acuity in kestrels appears superior when objects are viewed at a distance, suggesting that the birds may view nearby objects with one visual field and objects further away with another, (ii) moderate motion of the visual stimulus significantly influences acuity, and kestrels may be unable to resolve all portions of an object such as a rotating turbine blade because of motion smear, especially under low contrast or dim lighting conditions, (iii) this deficiency can be addressed by patterning the blade surface in a way which maximizes the time between successive stimulations of the same retinal region, and (v) the easiest, cheapest and most visible blade pattern for this purpose, effective across the widest variety of backgrounds, is a single black blade in an array of white blades (McIsaac 2001, Hodos 2002). Given that this is not allowed under South African aviation regulations, a UV paint, highly visible to most birds (but not humans) may be better for South African environments. Hence blade marking may be an important means to reduce collision rates by making the rotating turbine blades as conspicuous as possible under the least favourable visual conditions, particularly at facilities where raptors are known or considered to be the most likely collision casualties.

Marking turbine rotors in this way, does not guarantee reduced collision frequency, especially during strong winds (when rotor speeds increase and birds tend to fly low and with less control) and when visibility is poor (at night or in thick mist). All other collision mitigation options operate indirectly, by reducing the frequency with which collision prone species are exposed to collision risk. This is achieved mainly by: (i) siting farms and individual turbines away from areas of high density or groupings and regular commuting or slope-soaring regions; (ii) using low risk turbine designs and configurations, which discourage birds from perching on turbine towers or blades, and allow sufficient space for commuting birds to fly safely through the turbine strings; and (iii) carefully monitoring collision incidence, and being prepared to shut-down problem turbines at particular times or under particular conditions (e.g. increased migration activity).

### ***6.1.2 Habitat loss – destruction, disturbance and displacement***

Although the final footprint of most wind energy facilities is likely to be relatively small, the construction phase of development inevitably incurs quite extensive temporary damage or permanent destruction of habitat, which may be of lasting significance in cases where wind energy facility sites coincide with critical areas for restricted range, endemic and/or threatened

species. Similarly, construction, and to a lesser extent ongoing maintenance activities, are likely to cause some disturbance of birds in the general surrounds, and especially of shy and/or ground-nesting species resident in the area. Mitigation of such effects requires that generic best-practice principles be rigorously applied - sites are selected to avoid the destruction of key habitats, and construction and final footprints, as well as sources of disturbance of key species, must be kept to an absolute minimum.

Some studies have shown significant decreases in the numbers of certain birds in areas where wind energy facilities are operational as a direct result of avoidance of the noise or movement of the turbines (e.g. Larsen & Guillemette 2007), while others have shown decreases which may be attributed to a combination of collision casualties and avoidance or exclusion from the impact zone of the facility in question (Stewart *et al.* 2007). Such displacement effects are probably more relevant in situations where wind energy facilities are built in natural habitat (Pearce-Higgins *et al.* 2009, Madders & Whitfield 2006) than in more modified environments such as farmland (Devereaux *et al.* 2008).

### ***6.1.3 Impacts of associated infrastructure***

Infrastructure commonly associated with wind energy facilities can be detrimental to birds. The construction and maintenance of substations, power lines, servitudes and roadways causes both temporary and permanent habitat destruction and disturbance. New overhead power lines also pose a collision and possibly an electrocution threat to certain species (Van Rooyen 2004a, Lehman *et al.* 2007, Jenkins *et al.* 2010).

#### *Habitat destruction during construction and maintenance of power lines and substations*

Some habitat destruction and alteration inevitably takes place during the construction of power lines, the on-site substation (switching yard) and associated roadways. Also, power line servitudes have to be cleared of excess vegetation at regular intervals in order to allow access to the line for maintenance, and to prevent vegetation from intruding into the legally prescribed clearance gaps between the ground and the conductors. These activities have an impact on birds breeding, foraging and roosting in or in close proximity to the servitude, and retention of cleared servitudes can have the effect of altering bird community structure along the length of any given power line (e.g. King & Byers 2002).

#### *Collision with power lines*

Power lines and wind turbines pose equal collision risks to birds, affecting the same suite of collision prone species (Bevanger 1994, 1995, 1998, Janss 2000b, Anderson 2001, van Rooyen 2004a, Drewitt & Langston 2008, Jenkins *et al.* 2010). Mitigation of this risk involves the careful selection of low impact alignments for new power lines relative to bird movements and avoidance of concentrations of high risk species. Where this cannot be avoided the use of static or dynamic marking devices to make the lines, (particular the earthwires), more conspicuous are needed. While various marking devices have been used globally, many remain untested in terms of reducing collisions, and those that have been are only partially effective (Drewitt & Langston 2008, Jenkins *et al.* 2010).

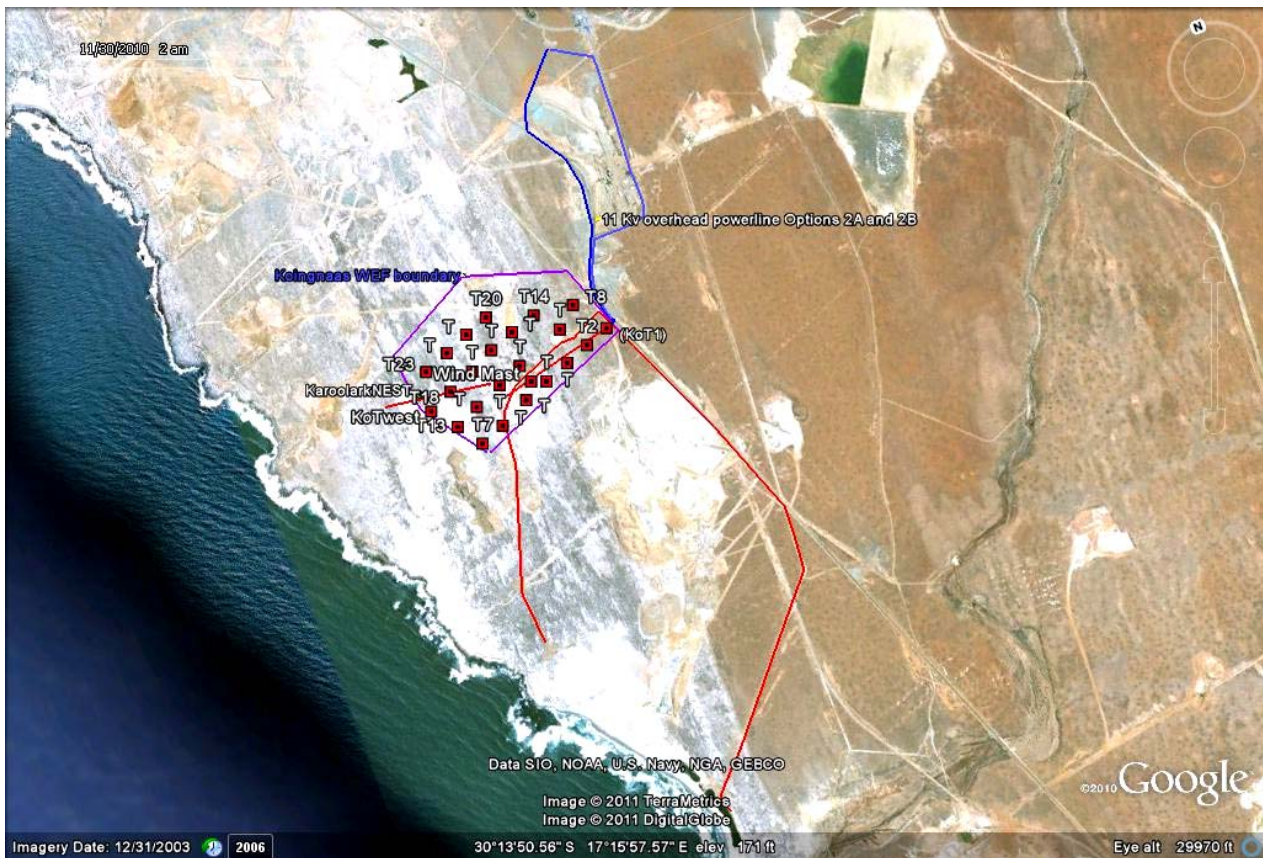
### *Electrocution on power lines*

Avian electrocutions occur when a bird perches or attempts to perch on an electrical structure and causes a short circuit by physically bridging the air gap between live components and/or live and earthed components (van Rooyen 2004b, Lehman *et al.* 2007). Electrocution risk is strongly influenced by the voltage and design of the power lines erected – increasing where air gaps are relatively small on low voltage lines. They mainly affect larger, perching species, such as vultures, eagles and storks, capable of spanning the spaces between “live” components. This can be mitigated by the use of bird-safe structures (with critical air gaps >2 m), the physical exclusion of birds from high risk areas of live infrastructure, and comprehensive insulation of such areas (van Rooyen 2004b, Lehman *et al.* 2007).

### **6.2. Description of the proposed wind energy facility**

The information available on the size and capacity of the wind energy facility proposed for Koingnaas is that 24 turbines will be sited on about 100 ha of land within the high security mining area comprising low dune vegetation. The towers supporting the turbines are of a metal lattice work nature, 35 m high (at hub height) each with three 16 m long blades. The facility will generate about 7 MW of power and link to the present grid system via the present Koingnaas substation via a switching yard of 50m x 40m. This will convert the current from 33 kV to 11kV.

The existing network of gravel tracks within the development site will need to be upgraded, and an additional system of minor service roadways will presumably connect the turbine array. In addition, one weather mast has been erected on site.



**Figure 1:** Proposed site of the Koingnaas Wind Energy Facility as proposed by Just Palm Tree Power. The red lines represent 1-km transects and road surveys for birds undertaken on 16 and 17 Aug 2011. The proposed and alternate 11 Kv powerline from the site is shown in blue.

## 7. DESCRIPTION OF THE AFFECTED ENVIRONMENT

### 7.1 Vegetation of the study area

The vegetation of this coastal region is described as part of the Namaqualand Coastal Duneveld – and is part of the Succulent Karoo Biome (Mucina and Rutherford 2006, p 265). This is a hyper-arid area with a mean annual rainfall of just 114 mm but relatively cool temperatures averaging just 17.3°C. Coastal fog is common adding substantially to high soil moisture levels. There is high plant species diversity but the habitat is heavily impacted by the mining operations of De Beers mining. None of the area is formerly conserved but recent additions and expansion to the Namaqua National Park around the Spoeg Rivier mouth recently changed that.

A very rare (but Least Threatened) vegetation type found within the area is the Namaqualand Salt Pan (vegetation unit AZi 2, Mucina and Rutherford 2006, p 643). Dreyer's Pan in Kleinsee is one example of this.

## **7.2 Avian microhabitats**

Bird habitats at Koingnaas comprise coastal marine rocky shore habitat backed by natural and man-made salt pans and gravel plains. The environment has been largely man-altered with large slimes dams and tailings dams part of the landscape. Rehabilitation of the tailings dams has been ongoing for 5 years now to re-introduce plants into these sensitive areas (P Carrick pers comm.). These are likely to be the least used of the habitats given the lack of seeds (for local passerines) or roost sites. Where large pits have been created by the mining operation the sheer walls occasionally allow kestrels roost and possible nest sites. Near the area proposed for the Koingnaas WEF one large pit was water-filled, allowing nesting areas for Red-knobbed Coot and foraging areas for martins. The remainder was short succulent karoo scrub on gravel giving way to more dune like habitat in the western section of the WEF boundary.

## **7.3 Bird Species and habitats found in the Koingnaas area**

The most up-to-date information available from the SABAP2 bird atlas scheme of the Avian Demography Unit downloaded from [http://sabap2.adu.org.za/map\\_interactive.php](http://sabap2.adu.org.za/map_interactive.php) was used. This allowed a recent bird species list based on 15 cards submitted from 2007 to 2011. This also allows a reporting rate to be generated to determine how likely the occurrence of any species is. It thus allows us to determine, for example, the likelihood of occurrence of red-listed species such as the flamingos, bustards and birds of prey.

There are three main microhabitats for birds in the area (i) coastal beaches, rocky shores and islands for marine and coastal bird species (ii) salt pans for terns and flamingos and (iii) succulent shrub habitat for larks and other endemic avifauna. The mine excavations allow for a fourth man-made habitat.

## **7.4 Species of Special Concern (SSC) likely to occur in the study area**

The total number of birds recorded in the study area is a healthy 92 species (Table 1). Among the species recorded are 7 threatened or red-listed in South Africa (Barnes 2000). Several of these are collision-prone species: five are highly collision prone (based on their low

manoeuvrability and their known collision rate) and 2 are moderately collision prone (Table 1). Among these are flamingos, cormorants, bustards and raptors. Several species occur at low frequency (below 10%) and will thus be at lower risk. However, the flamingo (33% probability of occurring) and bustard (20% probability) and Secretarybird (13%) are the most likely to suffer from inappropriately placed turbines, or unmarked power lines.

It must be noted that there are no data from South Africa on the susceptibility of particular bird species to turbine collisions per se, only to powerlines. The potential risk to turbine collisions has therefore been extrapolated from the power line vulnerability based on work by Martin and Shaw (2010). They indicated that species such as bustards and cranes have blind spots in their forward vision and simply do not see obstacles in front of them. The collision proneness (see Table 1) is also based on reports from various wind farms in California and Norway where species such as eagles and other large raptors are killed or displaced on a regular basis by turbines similar to the ones proposed.

Among these 7 red-listed species are three endemic or near-endemic species - the bustard, the Black Harrier and the cormorant (Table 1).

Among the 92 species, no less than 36 (39%) are endemic or near-endemic species. Of these endemics, four species are considered highly collision-prone (the bustard and Secretarybird mentioned above, and the South African Shelduck and the Korhaan).

Thus in sum, among the important species (threatened red-listed or endemic) the collision prone (high or moderate) species are the flamingo (1), cormorant (1), bustard (1), korhaan (1), raptors (6) and one duck; 11 species in total. These species will require special mitigation. There are other raptor species that are not red-listed (Appendix 1) including, Black-chested Snake Eagle and Southern Pale Chanting Goshawk, that are collision-prone.

**Table 1** Red-listed (**in red**) and endemic species (**in green**) likely to occur in the Koinaas area drawn from SABAP2 atlas cards for pentad 3010\_1715. These are based on 15 cards submitted to the SABAP2 project from 2007 to May 2011, and my own sampling.

Common name	Scientific name	Red-list status and Reporting Rate	Regional endemic?	Susceptibility to:		
				Collision	Electrocution	Disturbance
Ludwig's Bustard	<i>Neotis ludwigi</i>	Vulnerable 20%		High	-	Moderate
Martial Eagle	<i>Polemaetus bellicosus</i>	Vulnerable 7%	-	Moderate	High	Moderate
Black Harrier	<i>Circus maurus</i>	Vulnerable 7%	Endemic	Moderate	-	Moderate

Common name	Scientific name	Red-list status and Reporting Rate	Regional endemic?	Susceptibility to:		
				Collision	Electrocution	Disturbance
Lanner Falcon	<i>Falco biarmicus</i>	Near-threatened 7%	-	High	Moderate	-
Secretarybird	<i>Sagittarius serpentarius</i>	Near-Threatened 13%	-	High	Moderate	-
Black-chested Snake Eagle	<i>Circaetus pectoralis</i>	-	-	Moderate	Moderate	-
Lesser Flamingo	<i>Phoenicopterus minor</i>	Near-threatened 33%	-	High	-	-
Cape Cormorant	<i>Phalacrocorax capensis</i>	Vulnerable Recorded	Endemic	High	-	-
White-backed Mousebird	<i>Colius colius</i>	20%	Endemic	-	-	Moderate
South African Shelduck	<i>Tadorna cana</i>	60%	Endemic	High	-	-
Southern Black Korhaan	<i>Afrotis afra</i>	20%	Endemic	High	-	Moderate
Southern Pale Chanting Goshawk	<i>Melierax canorus</i>	73%	Near-endemic	Moderate	Moderate	Moderate
Jackal Buzzard	<i>Buteo rufofuscus</i>	20%	Endemic	Moderate	Moderate	Moderate
Bokmakierie	<i>Telophorus zeylonus</i>	73%	Near-endemic	-	-	Moderate
Cape Penduline-Tit	<i>Anthoscopus minutus</i>	7%	Near-endemic	-	-	Moderate
Grey Tit	<i>Parus afer</i>	27%	Endemic	-	-	Moderate
Cape Bulbul	<i>Pycnonotus capensis</i>	40%	Endemic	-	-	Moderate
Red-eyed Bulbul	<i>Pycnonotus nigricans</i>	7%	Near-endemic			
Grey-backed Cisticola	<i>Cisticola subruficapilla</i>	13%	Near-endemic	-	-	Moderate
Rufous-eared Warbler	<i>Malcorus pectoralis</i>	Occurs	Endemic	-	-	-
Karoo Prinia	<i>Prinia maculosa</i>	67%	Endemic	-	-	Moderate
Karoo Lark	<i>Calendulauda albescens</i>	33%	Endemic	-	-	Moderate
Cape Long-billed Lark	<i>Certhilauda curvirostris</i>	33%	Endemic			-
Karoo Thrush	<i>Turdus smithi</i>	33%	Endemic			-
Karoo Scrub-Robin	<i>Cercotrichas coryphoeus</i>	53%	Endemic	-	-	Moderate
Tractrac Chat	<i>Cercomela tractrac</i>	33%	Endemic			Moderate
Mountain Wheatear	<i>Oenanthe monticola</i>	27%	Near-endemic	-	-	Moderate
Ant-eating Chat	<i>Myrmecocichla formicovera</i>	47%	Near Endemic			-
Pied Starling	<i>Spreo bicolor</i>	100%	Endemic	-	-	Moderate
Southern Double-collared Sunbird	<i>Cinnyris chalybeus</i>	87%	Endemic	-	-	Moderate
Cape Weaver	<i>Ploceus capensis</i>	47%	Endemic	-	-	Moderate
Cape Sparrow	<i>Passer melanurus</i>	100%	Near-endemic	-	-	Moderate
Yellow Canary	<i>Crithagra flaviventris</i>	67%	Near-endemic	-	-	Moderate
White-throated Canary	<i>Crithagra albobularis</i>	47%	Near-endemic	-	-	Moderate
Lark-like Bunting	<i>Emberiza impetuani</i>	20%	Near-endemic	-	-	Moderate
Cape Bunting	<i>Emberiza capensis</i>	20%	Near-endemic	-	-	Moderate
Black-headed Canary	<i>Serinus alario</i>	Occurs	Endemic	-	-	-

### **7.5 Migration and/or preferential flight corridors for avifauna in general in the area and in particular for red-listed or endemic species of concern**

Flight corridors are likely to occur along the entire coast as wading birds (plovers, sandpipers, godwits etc) and the red-listed flamingo, use the beaches and areas parallel to the beaches as flyways. For more long-distance flights, these areas are also used by flamingos at night to commute to breeding areas or communal roosting feeding areas such as the Orange River mouth. Species such as the cormorants, and flamingos are generally found within 1 km of the coast and these will be high risk zones. However, flamingos may also both travel inland to dams and flooded pans and could well be found frequently farther than 1 km from the coast. The actual flight paths will require investigation in the pre-construction phase. It is further important to recognise that even if flamingos are not found in large numbers in the proposed wind farm area, they will pass through on their nocturnal migrations and are assumed to follow coastal corridors. Thus a turbine string orientated east-west near the coast has the potential to become problematic and should be avoided as far as possible. A north-west to south-east orientation of the turbine string may offer a solution that allows maximization of wind usage and reduction of impact to north-south flying birds.

Further up river are the breeding sites of Black Harriers (RES unpubl data) and this collision-prone red-listed species obviously forages down into the mining concession. It occurs with a probability of 7% in the SABAP data for Koingnaas. My own records show it nests only 20 km inland – well within its foraging range.

The least sensitive bird areas will be the mine dumps themselves where very few species are likely to occur given the lack of seeds and the lack of sheltered roosting sites.

#### **Quantifying the impacts**

**Nature of the effect** of the wind farm: Of the waterbirds, 7 raptors and 36 endemics (Table 1, Appendix 1), 11 main species are expected to be negatively affected by displacement, loss of habitat or direct mortality: Lesser Flamingo, Cape Cormorant, South African Shelduck, Black Harrier, Martial Eagle, Jackal Buzzard, Chanting Goshawk, Black-chested Snake Eagle, Secretarybird, Lanner Falcon, Ludwig's Bustard, Southern Black Korhaan. Of these, four occur with a probability below 10% (harrier, Martial, Lanner, cormorant), and populations are unlikely to be influenced negatively. Thus the following table quantifies the impacts for the flamingo, bustard, korhaan, shelduck, buzzard, snake eagle, chanting goshawk, and Secretarybird. If the

other species are subsequently found to occur at a higher frequency then they too should be included.

**The Extent (E)** of the impact will be local **(1)** reducing foraging habitat in the immediate wind farm area for the raptors and shelduck but higher for the bustard and korhaan **(3)** if the space created by the death of individuals brings in other birds to be killed.

**The Duration (D)** will be permanent **(5)** for the lifetime of the wind farm for all species.

**The Magnitude (M)** will cause a slight impact **(4)** for the raptors (unless the wind farm is expanded or others occur in the vicinity) and slightly higher for the bustard **(6)**, as mortality will decrease the local population and increase the likelihood of other birds being drawn in.

**The Probability of occurrence (P)** of the raptors avoiding the area is probable **(3)**, and for the bustard collision is ranked a highly probable given its propensity to hit overhead powerlines **(4)**.

**The Significance** [calculated as  $S = (E+D+M)P$  ], is as follows for the species identified as at risk:

Lesser Flamingo:	$S = (1 + 5 + 4)3 = 30$
South African Shelduck	$S = (1 + 5 + 4)3 = 30$
Jackal Buzzard/raptors	$S = (1 + 5 + 4)3 = 30$ (all other large raptors are likely to fall into this category too)
-	
Ludwig's Bustard	$S = (3 + 5 + 8)4 = 64$ (other large slow species such as korhaans will also fall into this category)
-	

From these ratings we can see that for 3 of the 4 groups of species, the significance weightings (30, 30 and 30) suggests that the presence of these species will be sufficient to have a direct influence on the decision to develop the area, and mitigation is required. Moreover, for the Ludwig's Bustard the rating at 64 has a direct influence on the decision to develop and must be mitigated.

**Table 2** A summary of the quantified impacts to the four main species likely to be impacted by the wind farm

<b>Nature:</b> Direct mortality or avoidance of area around the wind farm for the bird groups identified as at risk above, due to noise, or impacts with turbine blades (Flamingo = LF, Raptors = R, Shelduck = SD, and Ludwig's Bustard = LB)		
	<b>Without mitigation</b>	<b>With mitigation</b>

<b>Extent</b>	<b>1</b> (LF, R, SD) <b>3</b> (LB)	<b>1</b> (LF, R, SD) <b>2</b> (LB)
<b>Duration</b>	<b>5</b> (LF, R, SD)	<b>5</b> (LF, R, SD, LB)
<b>Magnitude</b>	<b>4</b> (LF, R, SD) <b>8</b> (LB)	<b>3</b> (LF, R, SD) <b>6</b> (LB)
<b>Probability</b>	<b>3</b> (LF, SD, R) <b>4</b> (LB)	<b>3</b> (LF, SD, R) <b>4</b> (LB)
<b>Significance (E+D+M)P</b>	<b>30</b> (LF, R, SD), <b>64</b> (LB)	<b>27</b> (LF, R, SD) <b>52</b> (LB)
<b>Status (+ve or -ve)</b>	Negative	Negative
<b>Reversibility</b>	Low	Low
<b>Irreplaceable loss of species?</b>	Yes	Reduced
<b>Can impacts be mitigated?</b>	Partially	
<p><b>Mitigation:</b> There are three classes of mitigation for birds around wind farms: (i) re-position the turbines to avoid intersecting the movements of the birds (ii) redesign the turbines to alter the present pattern/shape/size of the turbines so birds see them more readily and avoid contact or (iii) close down turbines when these birds approach. It is suggested that further research be undertaken as part of the pre-construction phase to determine where the flamingos fly on moving north and south and where the raptors and bustards forage. On present (limited) evidence, the WEF area is small and far enough from the coastal flyways that it will avoid impacting flamingo flyways. However, passage rates will need to be assessed through the pre-construction monitoring phase for the presence of bustards, korhaans and the raptors in the area.</p> <p>The following is also recommended: (i) re-orientating the turbine strings more north-west and south-east to reduce the "barrier" effect for north-south flying birds while maximizing wind energy production. This will also move the western-most turbine farther from the coast. (ii) painting one turbine blade with ultra-violet paint, (invisible to the human eye) readily seen by birds day and night; (iii) cover the towers so they are smooth-sided, and thus do not provide birds with perch, roost or nest sites.</p> <p><b>Power lines:</b> The proposed burying of the line between the turbines is positive for reducing bird impacts, but all above ground lines, even the small 11 kv lines require bird flappers to reduce impacts. There is little difference expected in the impacts to birds of the overhead lines Option 2A and Option 2B. They are similar length (2.7 vs 3.0 km) and follow boundaries near the tailings dam. Bird flappers are the only mitigation measure required.</p>		
<p><b>Cumulative impacts:</b></p> <p>If resident territorial birds are killed by turbines then other individuals will be pulled in to take up the vacant territory. Thus for bustards that may reside in the area, the impact may be greater than just around the immediate vicinity of the wind farm. A local population reduction may occur as a result. Furthermore, if the wind farm is enlarged, or mine scrapes fill with water that attract wetland birds, then bird movements can change. Lattice towers, if not covered to prevent birds perching, roosting or nesting on them, could increase cumulative impacts for raptors and crows that build nests there in this tree-less environment. The present study assumes that the land use here will remain stable and no further mine scrapes will be placed</p>		

near the wind farm.

Cumulative impacts of the overhead powerlines and the construction of a substation are expected to be minimal.

**Residual impacts:**

After mitigation, direct mortality or area avoidance by the species identified above may still occur and further mitigation will be needed.

To summarize, a suite of (4) raptors, two wetland birds and a bustard and korhaan were identified as at risk given their presence in the area and their vulnerability to collision. The probability that they will be affected by the wind farm is sufficient to warrant mitigation measures in all cases, particularly for the bustard. I suggest that: the turbine strings are orientated as north-west to south-east as possible to reduce impacts to north-south flying birds while concurrently maximizing wind-energy production. If this reduces the viability of the energy-gathering capacity of the turbines, then I suggest the developers compromise as much as they can, while taking into account the barrier effect that east-west turbines may create (this is a recommendation not a ruling); that all turbines should be painted with UV paint (invisible to the human eye) that is highly visible to birds. Above ground power lines are not expected to impact birds but all should be fitted with bird flappers to reduce all possible impacts. Further monitoring in the pre-construction phase will give better data on the use of different parts of the wind farm by these and other birds. The effects of power lines into the wind farm and the potential impact on the birds of the area cannot be gauged due to a lack of information on this aspect. Wherever possible all overhead lines should be marked with bird flappers or where possible buried underground.

## **8. PROVISIONAL ASSESSMENT OF IMPACTS**

Of the 7 red-listed species, all 7 have a medium to high probability of collision. Three species are perceived to have a moderate to high risk of electrocution on bird-unfriendly power infrastructure (Martial Eagle, Lanner Falcon and Secretarybird), and 3 may be displaced from the area (Ludwig's Bustard, Black Harrier and Martial Eagle). All these species may be disturbed in the longer term by operational activities around the facility (Table 1).

It is not possible at this stage to determine the relative significance of these various potential impacts, mainly because, too little information is available on the relative size of *local* populations of the priority species (Table 1). For example, a Black-chested Snake Eagle was present on both days of our visit within the wind farm boundary, yet not previously recorded in

the atlas cards. This can be investigated in more detail during the pre-construction phase. It is predicted however, that the species most likely to be displaced or killed without appropriate mitigation will be the night-flying flamingos and the bustards when they occur.

## **9. CONCLUSIONS AND PLAN OF STUDY FOR ENVIRONMENTAL MANAGEMENT PROGRAMME**

The Basic Assessment study has identified the following species that require further assessment of the local population: the Lesser flamingo (particularly its flight paths), the Cape cormorant, Ludwig's Bustard, and the 7 species of raptor (especially their occurrence in the area).

These issues and species will be investigated in more detail during pre-construction monitoring, which should form the main component of the Environmental Management Programme. This typically comprises a 12 month period covering all important seasons (winter, migration, breeding, dispersal) and assess passage rates of the larger collision-prone species and also the resident species that may be displaced by the footprint of the WEF. In particular, bird collisions in relation to the proposed sites of the turbines should be re-assessed to determine whether the risk warrants mitigation such as UV-patterning of turbine blades. This will be assessed mainly in terms of: (i) the actual abundance of priority bird species in the area; (ii) the distribution of relevant microhabitats and food resources; (iii) the movements and the altitude of priority birds through the impact zone.

Given the small size of the WEF, the small tower/turbine size and the low occurrence of priority species I suggest that this monitoring phase can be done in three visits covering the main (a) breeding season (October-November) (b) possible migration season of flamingos (December-February) and (c) autumn - when birds may return to this area from breeding grounds (March-April).

It must be pointed out that one site visit (for the Basic study) cannot hope to pick up all sensitive species passing through a proposed WEF. This is why BAWESG (Birds and Wind Energy Specialist Group of the EWT/Birdlife South Africa) have proposed a 12-month monitoring scheme. In this case, having seen the site and its small size, I think we can accommodate possible concerns raised by the developers reducing that period to three critical periods encompassing migratory movement, breeding and dispersal times. Unfortunately birds are *not* static entities that allow a one-off assessment.

Thus the EMPr (pre-construction monitoring phase will include:

- (i) Regular surveys of large terrestrial species, raptors and other collision-prone species within the study area to determine the relative importance of local populations of priority taxa,
- (ii) estimates of the magnitude and direction of movements of these species through the impact zone of the wind energy facility, in relation to nesting or roosting sites (e.g. cliff-lines, wetland pans, existing power lines) and foraging areas (high productivity coastlines and inland wetlands).
- (iii) identification of the numbers of resident species present and possibly breeding in the area using line-transect methods
- (iv) these protocols should be followed in a paired control area, with similar habitat, distance from the coast and land-use, to compare with the bird data from the WEF.

This is employed in the post-construction monitoring to determine if any changes in bird numbers or distribution is due to the wind farm or is a natural change outside the influence of the wind farm.

This phase should be followed up with a similar post-construction monitoring of 12 months following the protocol above. Both should be undertaken by trained observers and professional ornithologists. To reduce observer bias, the same observers should be used for both phases.

<b>Objective:</b> Determine the effect of the wind farm on the avifauna of the area through pre-construction (and post-construction) monitoring of the WEF and a suitable control area of similar habitat and land-use.	
<b>Project component</b>	Monitoring should take place to determine the effect on birds of the construction of the turbines themselves and the power lines linking them to the substation.
<b>Potential Impact</b>	Without pre- and post-construction monitoring, exact passage rates and the effectiveness of the mitigation measures proposed cannot be assessed. The long-term effect will be to learn nothing of the effect of wind farms on coastal and other collision-prone birds in South Africa, thereby compromising

	their long-term conservation.
<b>Activity/risk source</b>	<ol style="list-style-type: none"> <li>1. Determine the abundance and species richness of all birds resident within the WEF boundary through line transect methods in all critical seasons over the period November-April (3 visits).</li> <li>2. Determine the passage rate of all collision-prone species passing through the wind farm in all critical seasons.</li> <li>3. Compare both with identical assessments in a paired control site, matched for similar habitat and land use and altitude and proximity to the sea.</li> <li>4. Repeat all the above for 12 months post-construction to determine effects of WEF and infra-structure versus control areas.</li> </ol>
<b>Mitigation: Target/Objective</b>	<p>The objective is to determine in the first phase which species exist in the WEF and may be at risk, and the second phase which of the identified at-risk species are being affected. If the mitigation measures such as painting turbine blades with UV paint are applied to individual turbines, then mortality rates of turbines with UV paint can be compared to those without. The avoidance of the constructed WEF can be gauged by comparison between before and after data in the WEF. To determine if this a natural decrease in species richness we can compare the two control sites.</p> <p>The pre-construction monitoring should cover all critical months over the period November-April. While a 12-month period is recommended in the BAWESG guidelines (i.e. 5-6 periods of 2-5 days each depending on the size of the WEF), the small size and low numbers of sensitive birds can reduce this period. Post-construction monitoring should be identical in all respects after construction.</p> <p>The application of bird flappers to the 11 Kv powerlines should be carried out on construction of the line. Both the line and the turbine area should be regularly patrolled for bird mortalities</p>

<b>Mitigation: Action and control</b>	<b>Responsibility</b>	<b>Time Frame</b>
Covering the lattice towers with netting or other material to prevent larger species from roosting, perching and nesting on them.	Wind farm developers	At the start of construction of each lattice tower. Post-construction monitoring to assess the effectiveness of the covering
Painting of the white blades with UV stripes (invisible to the human eye) to make them more visible to birds, both day and night.	Wind farm developers	Prior to construction. Post-construction monitoring to assess the effectiveness of the UV painting.
Bird flappers to be put on all 11 Kv lines newly erected around the WEF	Wind farm developers	At the time of line erection. Post-construction monitoring to assess the effectiveness of the bird flappers.

The results will allow a more detailed assessment of all impacts, and the efficacy of the recommended mitigation where necessary (particularly with reference to the micro-siting and patterning of turbines). Ultimately it will improve our understanding of the long-term effects of wind energy developments on birds in South Africa.

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**Appendix 1.** List of bird species recorded within the Koingnaas pentad 3010\_1715 in the period 2007 to 2011, SABAP2 atlas period. Data extracted from the Animal Demography Unit, University of Cape Town and based on 15 atlas cards. My own records from 16-17 August 2011 are added. Endemic species are shown in green and red-listed species in red.

	English Name	Scientific Name	Full protocol	
			Sightings	Reporting rate
1	Pied Starling	<i>Spreo bicolor</i>	15	100.0%
2	Cape Sparrow	<i>Passer melanurus</i>	15	100.0%
3	Rock Kestrel	<i>Falco rupicolus</i>	14	93.3%
4	Red-knobbed Coot	<i>Fulica cristata</i>	14	93.3%
5	Pied Crow	<i>Corvus albus</i>	14	93.3%
6	Common Ostrich	<i>Struthio camelus</i>	14	93.3%
7	Cape Wagtail	<i>Motacilla capensis</i>	14	93.3%
8	Blacksmith Lapwing	<i>Vanellus armatus</i>	14	93.3%
9	African Stonechat	<i>Saxicola torquatus</i>	14	93.3%
10	Speckled Pigeon	<i>Columba guinea</i>	13	86.7%
11	Southern Double-collared Sunbird	<i>Cinnyris chalybeus</i>	13	86.7%
12	Southern Pale Chanting Goshawk	<i>Melierax canorus</i>	11	73.3%
13	Southern Masked-Weaver	<i>Ploceus velatus</i>	11	73.3%
14	Little Swift	<i>Apus affinis</i>	11	73.3%
15	Laughing Dove	<i>Streptopelia senegalensis</i>	11	73.3%
16	Common Starling	<i>Sturnus vulgaris</i>	11	73.3%
17	Common Fiscal	<i>Lanius collaris</i>	11	73.3%
18	Cape Crow	<i>Corvus capensis</i>	11	73.3%
19	Bokmakierie	<i>Telophorus zeylonus</i>	11	73.3%
20	Yellow Canary	<i>Crithagra flaviventris</i>	10	66.7%
21	Rock Martin	<i>Hirundo fuligula</i>	10	66.7%
22	Three-banded Plover	<i>Charadrius tricollaris</i>	9	60.0%
23	South African Shelduck	<i>Tadorna cana</i>	9	60.0%
24	Karoo Prinia	<i>Prinia maculosa</i>	9	60.0%
25	Southern Red Bishop	<i>Euplectes orix</i>	8	53.3%
26	Karoo Scrub-Robin	<i>Cercotrichas coryphoeus</i>	8	53.3%

27	Egyptian Goose	<i>Alopochen aegyptiacus</i>	8	53.3%
28	Brown-throated Martin	<i>Riparia paludicola</i>	8	53.3%
29	Barn Swallow	<i>Hirundo rustica</i>	8	53.3%
30	White-throated Canary	<i>Crithagra albogularis</i>	7	46.7%
31	Pied Avocet	<i>Recurvirostra avosetta</i>	7	46.7%
32	Cape Weaver	<i>Ploceus capensis</i>	7	46.7%
33	Cape Teal	<i>Anas capensis</i>	7	46.7%
34	Ant-eating Chat	<i>Myrmecocichla formicivora</i>	7	46.7%
35	Familiar Chat	<i>Cercomela familiaris</i>	6	40.0%
36	European Bee-eater	<i>Merops apiaster</i>	6	40.0%
37	Cape Bulbul	<i>Pycnonotus capensis</i>	6	40.0%
38	Tractrac Chat	<i>Cercomela tractrac</i>	5	33.3%
39	Namaqua Dove	<i>Oena capensis</i>	5	33.3%
40	Little Stint	<i>Calidris minuta</i>	5	33.3%
41	Karoo Thrush	<i>Turdus smithi</i>	5	33.3%
42	Karoo Lark	<i>Calendulauda albescens</i>	5	33.3%
43	Cape Turtle-Dove	<i>Streptopelia capicola</i>	5	33.3%
44	Cape Long-billed Lark	<i>Certhilauda curvirostris</i>	5	33.3%
45	Black-winged Stilt	<i>Himantopus himantopus</i>	5	33.3%
46	Black-headed Heron	<i>Ardea melanocephala</i>	5	33.3%
47	Wood Sandpiper	<i>Tringa glareola</i>	4	26.7%
48	Mountain Wheatear	<i>Oenanthe monticola</i>	4	26.7%
49	Malachite Sunbird	<i>Nectarinia famosa</i>	4	26.7%
50	House Sparrow	<i>Passer domesticus</i>	4	26.7%
51	Grey Tit	<i>Parus afer</i>	4	26.7%
52	Common Waxbill	<i>Estrilda astrild</i>	4	26.7%
53	White-throated Swallow	<i>Hirundo albigularis</i>	3	20.0%
54	White-backed Mousebird	<i>Colius colius</i>	3	20.0%
55	Southern Black Korhaan	<i>Afrotis afra</i>	3	20.0%
56	Ruff Ruff	<i>Philomachus pugnax</i>	3	20.0%
57	Red-faced Mousebird	<i>Urocolius indicus</i>	3	20.0%
58	Red-eyed Dove	<i>Streptopelia semitorquata</i>	3	20.0%

59	Ludwig's Bustard	<i>Neotis ludwigii</i>	3	20.0%
60	Lark-like Bunting	<i>Emberiza impetuani</i>	3	20.0%
61	Jackal Buzzard	<i>Buteo rufufuscus</i>	3	20.0%
62	Hadedda Ibis	<i>Bostrychia hagedash</i>	3	20.0%
63	Cape Bunting	<i>Emberiza capensis</i>	3	20.0%
64	Spotted Thick-knee	<i>Burhinus capensis</i>	2	13.3%
65	Secretarybird	<i>Sagittarius serpentarius</i>	2	13.3%
66	Long-billed Crombec	<i>Sylvietta rufescens</i>	2	13.3%
67	Grey-backed Cisticola	<i>Cisticola subruficapilla</i>	2	13.3%
68	Greater Kestrel	<i>Falco rupicoloides</i>	2	13.3%
69	Chat Flycatcher	<i>Bradornis infuscatus</i>	2	13.3%
70	Yellow-billed Kite	<i>Milvus aegyptius</i>	1	6.7%
71	Spotted Eagle-Owl	<i>Bubo africanus</i>	1	6.7%
72	Southern Grey-headed Sparrow	<i>Passer diffusus</i>	1	6.7%
73	Pearl-breasted Swallow	<i>Hirundo dimidiata</i>	1	6.7%
74	Martial Eagle	<i>Polemaetus bellicosus</i>	1	6.7%
75	Little Grebe	<i>Tachybaptus ruficollis</i>	1	6.7%
76	Lesser Flamingo	<i>Phoenicopterus minor</i>	1	6.7%
77	Large-billed Lark	<i>Galerida magnirostris</i>	1	6.7%
78	Lanner Falcon	<i>Falco biarmicus</i>	1	6.7%
79	Hartlaub's Gull	<i>Larus hartlaubii</i>	1	6.7%
80	Common Sandpiper	<i>Actitis hypoleucos</i>	1	6.7%
81	Cape Penduline-Tit	<i>Anthoscopus minutus</i>	1	6.7%
82	Black-shouldered Kite	<i>Elanus caeruleus</i>	1	6.7%
83	Black Harrier	<i>Circus maurus</i>	1	6.7%
84	African Red-eyed Bulbul	<i>Pycnonotus nigricans</i>	1	6.7%
85	African Hoopoe	<i>Upupa africana</i>	1	6.7%
86	Rufous-eared Warbler	<i>Malcorus pectoralis</i>	occurs	
87	Karoo Chat	<i>Cercomela schlegelii</i>	occurs	
88	Capped Wheatear	<i>Oenanthe pileata</i>	occurs	
89	Black-headed Canary	<i>Serinus alario</i>	occurs	

90	Black-chested Snake Eagle	<i>Circaetus pectoralis</i>	Recorded by us	
91	Dusky sunbird	<i>Cinnyris fuscus</i>	Recorded by us	
92	Cape Cormorant	<i>Phalacrocorax capensis</i>	Recorded by us	
<b>92 species recorded in 15 atlas cards in the Koingnaas region : 36 Endemic species and 7 red-listed species</b>				