Impofu East Wind Farm

Red Cap Impofu East (Pty) Ltd

Avifaunal impact assessment study (EIA Phase)

March 2019

Wild Skies ecological services

REPORT REVIEW & TRACKING

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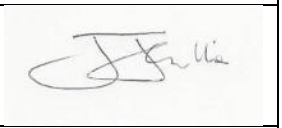
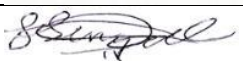
Lead author	Jon Smallie – SACNASP 400020/06	
Internal review	Luke Strugnell – SACNASP 400181/09	

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EXECUTIVE SUMMARY

Red Cap Energy (Pty) Ltd successfully developed the 80 MW Kouga Wind Farm and the 111 MW Gibson Bay Wind Farm in the Kouga Local Municipality, Eastern Cape, South Africa. This area lies on a section of coastal plain in close proximity to the ocean on either side which results in excellent wind conditions and low levels of turbulence, making it ideal for wind farm development. Red Cap has now signed option agreements on approximately 11 838 ha of new undeveloped private farmland, known as the "Impofu Wind Farms" Project. The 3 wind farms will ultimately consist of up to a maximum total of 95 turbines and associated infrastructure and will connect to the grid close to Port Elizabeth. The Impofu East Wind Farm, the subject of this report, consists of up to 33 turbines.

We have conducted an initial assessment of the site, a screening assessment and a full (four seasons) pre-construction bird monitoring programme on site. The most important of our findings are as follows:

We make the following conclusions regarding the avifaunal community and potential impacts of the Impofu East Wind Farm:

- We classified nine species as top most priority for this assessment: Denham's Bustard, White-bellied Korhaan, Blue Crane, Black Harrier, African Marsh-Harrier, Martial Eagle, African Fish-Eagle, Jackal Buzzard and White Stork.
- Eighty-four small bird species were recorded on the overall Impofu Wind Farms site through walked transects. None of these species are regionally Red Listed and 9 are regionally endemic or near-endemic (a relatively low level of endemism in our view). Endemic species included: Cape Weaver; Cape White-eye; Karoo Prinia; Cape Grassbird; Cape Bulbul; Fiscal Flycatcher; Greater Double-collared Sunbird; Sentinel Rock Thrush and Knysna Turaco. Overall species richness showed little seasonal variation.
- Fifteen large terrestrial or raptor species were recorded on the overall Impofu Wind Farms site through driven transects. The most abundant was White Stork, followed by Denham's Bustard, Jackal Buzzard and Blue Crane. Three of these species are regionally Red Listed: Denham's Bustard (Vulnerable); Blue Crane (Near-threatened); and Secretarybird (Vulnerable). Two species are endemic or near-endemic: Blue Crane and Jackal Buzzard. Whilst Blue Crane and Denham's Bustard abundance was high, it appears to be relatively lower than elsewhere in this Kouga region. White-bellied Korhaan and Martial Eagle were not recorded on either the overall Impofu Wind Farms site or the Impofu East by this method.
- A Martial Eagle nest was found to the north of Impofu Dam (well off the Impofu East Wind Farm site), with a recently fledged chick (in October 2017) in attendance at the nest.

- No Blue Crane roost sites were confirmed on Impofu East or the overall Impofu Wind Farms site to date, the only known sites being approximately 13-20km to the east of Impofu East (closest turbine – T30) at Grasmere and Soutvlei.
- Two separate displaying Denham's Bustard males were recorded on the Impofu East site during September-October 2017. These were single birds and in our view, whilst an important factor, did not constitute a lek site for the species. The Kouga Denham's Bustard lek site was monitored although it is approximately 3.2km north-east of the Impofu East Wind Farm closest turbine (T30).
- Twenty target species were recorded as Incidental Observations on site during the monitoring programme. Most abundant of these was White Stork, followed by Denham's Bustard.
- Twenty-one relevant bird species were recorded flying on the overall Impofu Wind Farms site. Six of these are regionally Red Listed: Martial Eagle, Black Harrier and African Marsh-Harrier (Endangered); Denham's Bustard and Lanner Falcon (Vulnerable); and Blue Crane (Near-threatened). The most frequently recorded flying species were: White Stork (summer only); Blue Crane; Denham's Bustard; Jackal Buzzard; and African Marsh-Harrier. Martial Eagle and Black Harrier were however not recorded flying on the Impofu East wind farm site. White-bellied Korhaan and Secretarybird were not recorded flying at all on the overall Impofu Wind Farms site. African Fish-Eagle was recorded on the overall site but not specifically on the Impofu East Wind Farm. Based on the spatial location of bird flight records we have identified Turbines 21, 23, 25, 28 and 29 at Impofu East as particularly high risk. Since the risk at these turbine locations is predominantly based on Jackal Buzzard (a non Red Listed species) and African Marsh-Harrier (for which no turbine collision fatalities have been reported at operational wind farms to date) we do not recommend that these turbines be moved or not built. We rather recommend that these turbines be searched weekly at a minimum and according to the full best practice protocol once post construction bird fatality searches start (i.e. it should not be one of the turbines subject to less frequent or thorough searching).
- Crude turbine collision fatality rates were calculated for each species in order to estimate how many birds the proposed Impofu East Wind Farm could kill. This calculation is considered to be a worst case scenario and is fraught with assumptions. It is estimated that approximately 7.6 fatalities could be recorded at Impofu East Wind Farm per year across the 21 target bird species recorded flying on site. This includes the following priority species fatalities: 1.1 White Storks; 1.6 Blue Cranes; 1.3 Denham's Bustards; 1 Jackal Buzzard; and 0.7 African Marsh-Harrier. Importantly the fatality rates for several species, including: Martial Eagle (0.05 fatalities/year); Black Harrier (0.02 birds fatalities/year); Lanner Falcon (0.17 fatalities/year); and Grey Crowned Crane (0.12 fatalities/year), are very low. It is noted that the above calculated fatality rates have decreased by approximately 40% in the EIA Phase due to the reduced number of planned turbines assessed in the Scoping Phase.

Human caused fatalities of Red listed or otherwise threatened bird species are always cause for concern and should be avoided as far as possible. There are currently no established thresholds for acceptable impacts on bird species in South Africa. To establish these thresholds would require complex modelling incorporating accurate information on many factors for each species (including population size, age specific fatality rates, breeding productivity etc). Such modelling and information is not available in South Africa at present. In the absence of this information we are forced to make a subjective finding as to the acceptability of the above estimated estimates (see Section 4.2 and Table 14 for our assessment). In our view the above fatality rates are of moderate significance for these species. Regional populations of these bird species are not likely to be driven towards extinction by these fatalities in our view. It is however essential that all mitigation measures recommended in this report be accepted to ensure that these fatality rates are reduced where possible. It is also essential that an adaptive management approach be adopted, ensuring that the wind farm is prepared to respond timeously and effectively if unsustainable impacts are detected.

Based on this assessed risk, we assessed the potential impacts on birds according to the methods provided by Aurecon, and made the following findings:

- Destruction of bird habitat during construction will be of Low to Moderate negative significance.
- Disturbance of birds during construction will be of Negligible negative significance.
- Disturbance of birds during operations will be of Minor negative significance.
- The displacement of birds from the site during operations will be of Negligible negative significance.
- Bird fatalities through collision with turbine blades will be of Moderate negative significance.
- Bird fatalities through collision and electrocution on any sections of overhead power line on site are of Minor negative significance pre mitigation. This can be mitigated successfully to Negligible negative significance.
- The 'during' and post-construction bird monitoring programme outlined in Appendix 4 must be implemented and adhere to any updated versions of the best practice guidelines for this work (Jenkins *et al,* 2015) available by the time of implementation.
- Considering all available information we are of the opinion that wind farms will cumulatively have a Moderate impact on avifauna in this study area. Under the No-Go alternative impacts on birds will not occur and hence be of Low significance

Although extensive avoidance of impacts has already been applied on this project, we have identified the following mitigation measures which are required to further reduce the significance of impacts on birds:

- An avifaunal walk down should be conducted to confirm final layout and identify any sensitivities that may arise between the EIA and construction.
- All construction activities should be strictly managed according to generally accepted environmental best practice standards, so as to avoid any unnecessary impact on the receiving environment.
- Monitoring of breeding status of Martial Eagles should be conducted in all breeding seasons post acceptance of the project as preferred bidder (to establish baseline) and including during and post construction.
- Given that the impact of bird collision with turbines could occur once the wind farm is operational and require mitigation, we recommend strongly that an appropriate mitigation budget be provided for by the developer. At this stage it is not possible to determine what mitigation may be appropriate, and in the time between writing this report and the mitigation need arising (likely several years) new mitigation methods may be developed. However if such a need arises and suitable mitigation is identified it cannot be argued by the wind farm operator that mitigation was not budgeted for. Mitigation could cost the operator either in the form of additional costs or lost productivity as a result of changes to turbine operations. We have suggested a budget for this aspect later in this report in Section 4.2.
- If Blue Crane turbine or power line collision fatalities occur as a result of livestock feeding points once the facility is operational this will need to be mitigated, probably by restricting farmers from feeding too close (we estimate within 200 -300m) to turbines and power lines or by covering/ obstructing the feeding points in some way that prevents the birds from easily feeding from them (as was done successfully with fence wires in the Overberg area at feeding points for sheep). Landowners should be made aware of this possibility at the outset of the project.
- The overhead conductors or earth wires of any overhead power lines should be fitted with an Eskom approved anti bird collision line marking device to make cables more visible to birds in flight and reduce the likelihood of collisions.
- Pylons or poles of any overhead power line must be designed according to Eskom approved bird friendly designs to ensure that perching large birds cannot be electrocuted.
- The during construction and post construction monitoring programme outlined in Appendix 4 should be implemented according to the latest available version of the best practice guidelines at the time.
- Cumulative impacts warrant a cumulative approach to mitigation in order to achieve maximum effectiveness. In the Kouga area a unique situation exists where an entity already exists for the purpose of strategically managing such issues, the Greater Kromme Stewardship Association. We recommend that the Impofu Wind Farms should become a

fully paid up member during construction and operation of this Association for the purpose of further research and mitigation into the impacts of wind farms on priority species in the Kouga area.

We have no objections should the the Impofu East Wind Farm proceed.

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/ or 12/9/11/L
NEAS Reference Number:	DEA/EIA
Date Received:	

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

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

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

PROJECT TITLE

IMPOFU EAST WIND FARM

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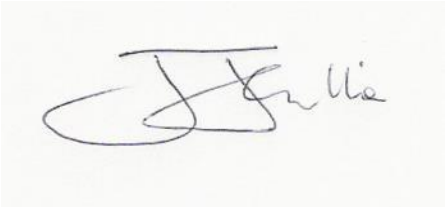
4.2 The specialist appointed in terms of the Regulations_

I, J SMALLIE declare that -- General declaration:

I act as the independent specialist in this application;
I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
I declare that there are no circumstances that may compromise my objectivity in performing such work;
I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
I will comply with the Act, Regulations and all other applicable legislation;
I have no, and will not engage in, conflicting interests in the undertaking of the activity;
I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
all the particulars furnished by me in this form are true and correct; and
I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.



Signature of the specialist:

WILDSKIES ECOLOGICAL SERVICES PTY LTD

Name of company (if applicable):

MARCH 2019

Date:

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1. INTRODUCTION

Red Cap Energy (Pty) Ltd (Red Cap) successfully developed the 80 MW Kouga Wind Farm and the 111 MW Gibson Bay Wind Farm in the Kouga Local Municipality, Eastern Cape, South Africa. Red Cap has now signed option agreements on approximately 11 838 ha of new undeveloped private farmland, known as the “Impofu Wind Farms” Project. The proposal is to develop three adjoining wind farms known as Impofu North, Impofu West and Impofu East Wind Farm respectively. The proposed site is centred on 34° 5'14.81"S latitude and 24°34'35.47"E longitude, lying directly to the west and north-west of the small coastal village of Oyster Bay between an elevation of 8 m and 210 m above sea level. This area lies on a section of coastal plain in close proximity to the ocean on either side which results in excellent wind conditions and low levels of turbulence, making it ideal for wind farm development.

The three wind farms will ultimately consist of up to a maximum total of 95 turbines and associated infrastructure. The three wind farms will connect to the grid close to Port Elizabeth. The grid connection falls under a separate application and will not be discussed further in this report. Figures 1 and 2 show the area under assessment.

Aurecon South Africa (Pty) Ltd, (hereafter referred to as Aurecon) has been appointed by Red Cap to undertake the Environmental Impact Assessment (EIA) process for the Impofu Wind Farms. These services are to ensure compliance with the relevant environmental legislation, and are to include applications to various Competent Authorities for environmental authorisations, licenses and permits. WildSkies Ecological Services (Pty) Ltd (hereafter WildSkies) has been appointed by Red Cap to conduct the necessary avifaunal studies (including pre-construction monitoring) for this process.

The three wind farms will each be reported on separately. This report assesses the Impofu East Wind Farm (for which the applicant is Red Cap Impofu East Pty Ltd), which is shown in Figure 2 and Figure 3.

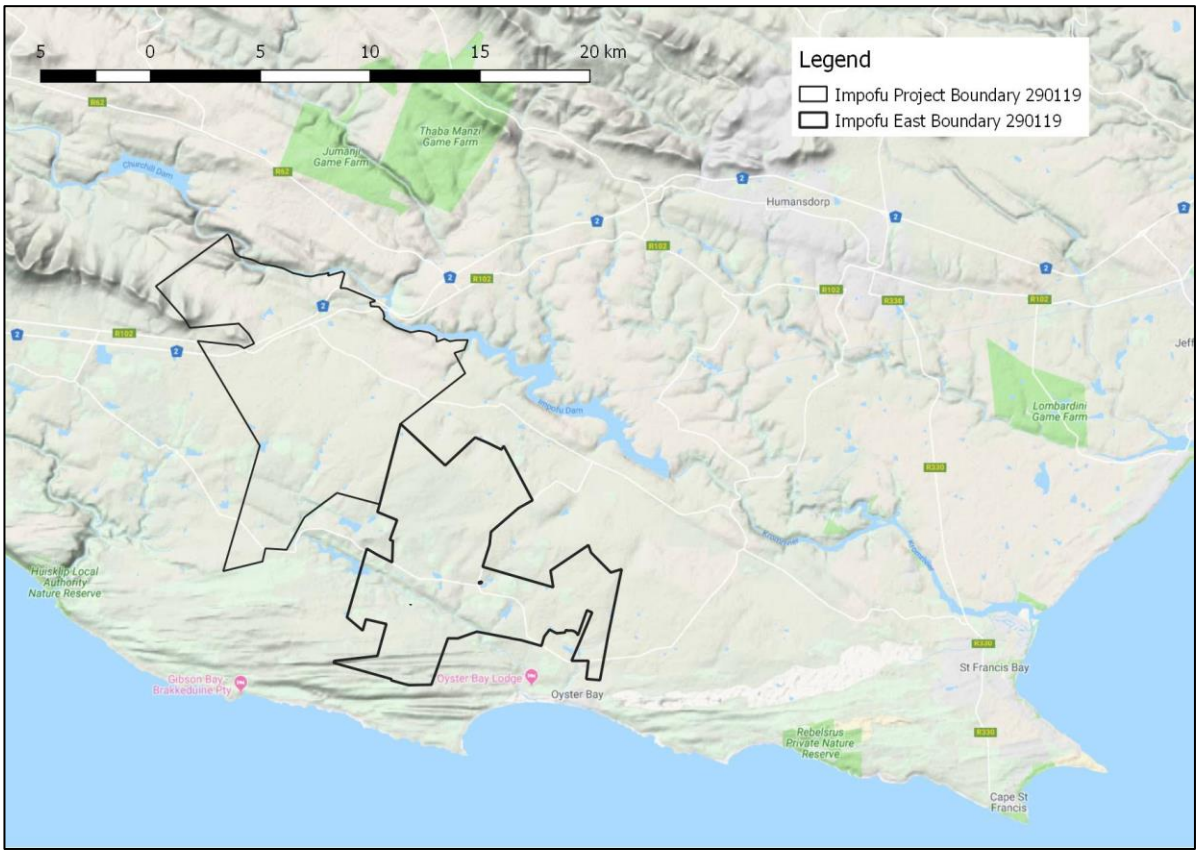

Figure 1. The position of the proposed Impofu Wind Farms relative to the nearest town - Humansdorp.

Figure 2. The position and layout of the proposed Impofu East Wind Farm.

Figure 3. The Impofu East Wind Farm detailed layout.

1.1 Project description

At present 95 turbine locations make up the basis of the application for Environmental Authorisations for the three wind farms combined. At this point in time the megawatt (MW) size of the turbine to be used has not been finalised, but it is assumed it would be from about 3-6 MW. What is known is that the total number of turbines to be constructed on the site would not be more than 95 across the three wind farms. The 95 turbine locations are made up of: Impofu North - 33; West – 29; and East – 33).

Each turbine would have a circular foundation of approximately 20-25 m diameter, a temporary disturbed area including the foundation, the hardstand and construction area of approximately 100 x 50 m (or 0.5 hectares) for use as a laydown area and to accommodate a crane pad during installation, with a permanent hardstand footprint of approximately 50 x 30 m remaining for maintenance purposes. Since the turbine technology is continually improving it is not possible at this early stage in the development process to know the exact turbine model and specification. Assumptions have thus been made for assessment purposes regarding the potential "worst-case" extent of the area to be impacted by the turbine blades (the rotor swept area envelope), based on a range of turbine sizes that could be used for the wind farm development. It is a "worst-case" scenario that is thus assessed as it takes account of the total rotor swept area from multiple turbine sizes at once which is actually greater

than the actual turbine rotor swept area could be. This given that it assumes each turbine has the largest blade it can from the lowest hub height and extends this all the way up to the highest hub height whereas an actual turbine would only have one hub height and the related rotor swept area from its blades from that hub height. The "worst case" scenario is derived from the following constraints and represented graphically in Figure 4.

Rotor swept area envelope:

- Rotor diameter: maximum of 150 m (75 m blade / radius)
- Hub height: range from 90 to 120 m (lowest and highest possible hub heights)
- Tip height: maximum based on 120 m hub + 75 m blade = 195 m
- Tip height: minimum of 30 m (and not lower)
- Resulting in an envelope between 30 m up to 195 m; being 150 m wide, with a hub height within this between 90-120 m high

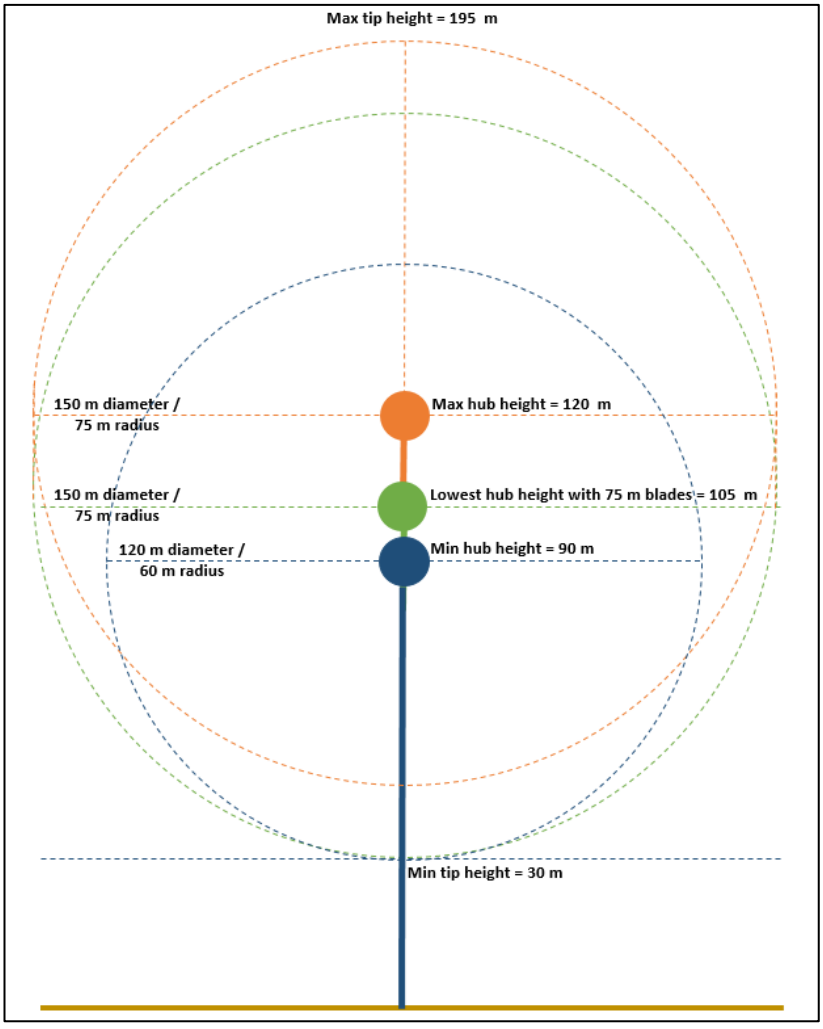

Figure 4. Graphic illustration of the rotor swept area envelope.

The supporting infrastructure within the site includes roads, underground and overhead medium voltage (MV) power lines (33 kV or lower) and substations (including control, operation, workshop, storage buildings / areas) and temporary construction camp / lay down areas (totalling 1.5 ha).

The internal gravel roads will be approximately 6 m wide with potential side drains along the side and of a specification to accommodate the abnormal trucks that will deliver the turbine components. Where possible existing roads will be used and upgraded to avoid additional clearance of natural or agricultural land cover. In exceptional circumstances short sections of the roads may be surfaced with bitumen or concrete if they are excessively steep. The wind farm application/s will include the 33 or lower kV MV lines that would transfer the power generated from the turbines to the three respective on-site substations (each with a transformer). These lines would predominantly be in the form of underground cables, but in cases where they have to cross complex terrain such as drainage lines or steep kloofs, they would be short sections of overhead power lines. Impofu East specifically has potentially a maximum of nine sections (1 400 m in total) of overhead power lines.

The three substations are named the Impofu North, Impofu West and Impofu East substations and would have associated switching stations. The switching stations form part of the Grid Connection application. Since the switching station component will be owned by Eskom, there will be a physical barrier between the two components in the form of a fence.

The total footprint of each substation is approximately 150 x 75 m (11,250 m^2) and the adjoining Eskom switching stations would be of a similar size. The substation area will include the standard substation electrical equipment such as transformers and bus bars, and the area will also house the control, operation, workshop, storage buildings / areas.

1.2 Background to wind energy facilities & birds

The interaction between birds and wind farms first documented was that of birds killed through collisions with turbines, dating back to the 1970's. Certain sites in particular, such as Altamont Pass – California, and Tarifa – Spain, killed a lot of birds and focused attention on the issue. However it appears that sites such as these are the exception rather than the rule, with most facilities causing much lower fatality rates (Kingsley & Whittam, 2005; Rydell *et al* 2012; Ralston-Paton *et al* 2017). With time it became apparent that there are actually four ways in which birds can be affected by wind farms: 1) collisions – which is a direct mortality factor; 2) habitat alteration or destruction (less direct); 3) disturbance – particularly whilst breeding; and 4) displacement/barrier effects (various authors including Rydell *et al* 2012). Whilst the impacts of habitat alteration and disturbance are probably fairly similar to that associated with other forms of development, collision and displacement/barrier effects are unique to wind energy.

Associated infrastructure such as overhead power lines also have the potential to impact on birds. For example they pose a collision and possibly electrocution threat to certain bird species.

1.2.1 Collision of birds with turbine blades

Without doubt the impact of bird collision with turbines has received the most attention to date amongst researchers, operators, conservationists, and the public.

The two most common measures for collision fatality used to date are number of birds killed per turbine per year, and number of birds killed per megawatt installed per year. Rydell *et al* (2012) reviewed studies from 31 wind farms in Europe and 28 in North America and found a range between 0 and 60 birds killed per turbine per year, with a median of 2.3. European average bird fatality rates were much higher at 6.5 birds per turbine per year compared to the 1.6 for North America. These figures include adjustment for detection (the efficiency with which monitors detect carcasses in different conditions) and scavenger bias (the rate at which birds are removed by scavengers between searches). These are important biases which must be accounted for in any study of mortality.

In South Africa, Ralston-Paton, Smallie, Pearson & Ramalho (2017) reviewed the results of operational phase bird monitoring at 8 wind farms ranging in size from 9 to 66 turbines and totalling 294 turbines (or 625MW). Hub height ranged from 80 to 115m (mean of 87.8m) and rotor diameter from 88 to 113m (mean of 102.4m). The estimated fatality rate at the wind farms (accounting for detection rates and scavenger removal) ranged from 2.06 to 8.95 birds per turbine per year. The mean fatality rate was 4.1 birds per turbine per year. This places South Africa within the range of fatality rates that have been reported for North America and Europe.

The composition of the South African bird fatalities by family group was as follows: Unknown 5%; Waterfowl 3%; Water birds other 2%; Cormorants & Darters 1%; Shorebirds, Lapwings and gulls 2%; Large terrestrial birds 2%; Gamebirds 4%; Flufftails & coots 2%; **Songbirds 26%; Swifts, swallows & martins 12%;** Pigeons & doves 2%; Barbets, mousebirds & cuckoo's 1%; Ravens & crows 1%; Owls 1%; and **Diurnal raptors 36%.**

Threatened species killed included Verreaux's Eagle *Aquila verreauxii* (5 - Vulnerable), Martial Eagle *Polemaetus bellicosus* (2 - Endangered), Black Harrier *Circus maurus* (5 - Endangered), and Blue Crane *Anthropoides paradiseus* (3 – Near-threatened). Although not Red Listed, a large number of Jackal Buzzard *Buteo rufofuscus* fatalities (24) were also reported.

Ralston-Paton *et al's* review included the first year of operational monitoring at the first 8 facilities. At least one more year has elapsed at each of these facilities and additional facilities have come on line.

Where we are aware of this additional monitoring data and it is relevant to the Impofu study we have cited it in the text.

1.2.2 Loss or alteration of habitat during construction

The area of land directly affected by a wind farm and associated infrastructure is relatively small. As a result, in most cases habitat destruction or alteration in its simplest form (removal of natural vegetation) is unlikely to be of great significance. However, fragmentation of habitat can be an important factor for some smaller bird species. Construction and operation of a wind farm results in an influx of human activity to areas often previously relatively uninhabited (Kuvlesky *et al* 2007) although this is not the case at Impofu. This disturbance could cause certain birds to avoid the entire site, thereby losing a significant amount of habitat (Langston & Pullan, 2003). In addition to this, birds are aerial species, spending much of their time above the ground. It is therefore simplistic to view the amount of habitat destroyed as the terrestrial land area only.

Ralston *et al* (2017) did not review habitat destruction or alteration. From our own work to date, we have recorded a range of habitat destruction on 6 wind farms from 0.6 to 4% (mean of 2.4%) of the total site area (defined by a polygon drawn around the outermost turbines and other infrastructure) and 6.9 to 48.1ha (mean of 27.8ha) of aerial space.

1.2.3. Disturbance of birds

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

Ralston-Paton *et al* (2017) found no conclusive evidence of disturbance of birds at the sites reviewed. It may be premature to draw this conclusion after only one year as effects are likely to vary with time (Stewart *et al*, 2007) and statistical analysis was not as in depth as desired. At this stage in the industry a simplistic view of disturbance has been applied whereby the presence or absence of active breeding at breeding sites of key species is used as the basis for findings.

1.2.4. Displacement & barrier effects

A barrier effect or displacement occurs when a wind energy facility acts as a barrier for birds in flight, which then avoid the obstacle and fly around it. This can reduce the collision risk, but will also increase

the distance that the bird must fly. This has consequences for the birds' energy balance. Obviously the scale of this effect can vary hugely and depends on the scale of the facility, the species territory and movement patterns and the species reaction.

Ralston-Paton *et al* (2017) reported that little conclusive evidence for displacement of any species was reported for the 8 wind farms in South Africa, although once again this is an early and possibly simplistic conclusion.

1.2.5. Associated infrastructure

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

Ralston-Paton *et al* (2017) did not review power line impacts at the 8 sites. Our own experience has been of relatively few power line impacts at most sites, although monitoring of power lines has been much less frequent (quarterly) than at turbines (weekly).

1.2.6. Mitigation

Realistic possible mitigation measures for bird turbine collision include: increasing turbine visibility (for example through painting turbine blades; restriction of turbines during high risk periods; automated turbine shutdown on demand; human based turbine shutdown on demand; bird deterrents – both audible and visual; habitat management; and offsets. Most of these suggested mitigation measures are largely untested and/or impractical. For any mitigation to be undertaken during operation, budget will need to be available. This report strongly recommends that the wind farm operator make provision for

a mitigation contingency budget so that if issues are encountered during operation, the best-suited and proven mitigation at that point in time can be implemented. This is discussed further in Section 4.

Mitigation for habitat destruction consists typically of avoiding sensitive habitats during layout planning. A certain amount of habitat destruction is unavoidable.

For disturbance, mitigation takes the form of allowing sufficient spatial and temporal protection for breeding sites of sensitive species.

Mitigation of power line impacts is relatively well understood and effective, and is described in more detail later in this report.

The primary means of mitigating bird impacts therefore remains correct siting, both of the entire facility, and of the individual turbines themselves. This has already been done in detail with the Impofu Wind Farms during the screening phase in which detailed no go areas for avifuana were used in developing the layout being assessed. Whichever mitigation measures are identified as necessary, this should be informed by a thorough pre and post construction bird monitoring programme.

1.2.7. Contextualising wind energy impacts on birds

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

1.3 Relevant legislation

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

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

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

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

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

- The National Environmental Management – Biodiversity Act - Threatened or Protected Species list (TOPS). Those TOPS species relevant to this study and occurring on site are shown in Table 5.

- The Provincial Nature Conservation Ordinance (Nature Conservation Ordinance 19 of 1974) identifies very few bird species as endangered, none of which are relevant to this study.

Protected status is accorded to all wild bird species, except for a list of approximately 12 small passerine species, all corvids (crows and ravens) and all Mousebirds.

- The Civil Aviation Authority has certain requirements regarding the visibility of wind turbines to aircraft. It is our understanding that these may preclude certain mitigation measures for bird collisions, such as the painting of turbine blades in different colours.

2. METHODOLOGY

2.1 Terms of reference

The scope of the impact assessment for the wind farms includes the following:

- The three on-site substations associated with Impofu North, Impofu West and Impofu East Wind Farms;
- Internal roads, hardstands and turbines (roads total approximately 38 km for Impofu North, 24 km for Impofu West and 38 km for Impofu East);
- Underground and aboveground cables (in terms of overhead powerlines, Impofu North has a potential maximum of 800 m in three locations; Impofu West has a maximum of 950 m in four locations and Impofu East has a maximum of 1,400 m in nine locations- the exact distances will only be finalised when final construction starts as wherever possible underground cables will be used and these overhead areas identified now are worst case senarios);
- The upgrade to the short section of existing public road called Brakkeduine Road (Minor Road 50092) which crosses the Klipdrifrivier – relevant to Impofu East only;
- The upgrading of the river crossing on the existing public road DR01774 just below the operational Tsitsikamma Community Wind Farm – relevant for Impofu West only;
- The potential "worst-case" extent of the area to be impacted by the turbine blades (the rotor swept area envelope) as shown in Figure 4.

This Specialist Impact Assessment Report is required to inform and contribute towards the EIA Phase of the environmental application in terms of NEMA, and also to satisfy the requirements of Appendix 6 of GN.R982 of NEMA.

The terms of reference detailed the following tasks:

- A focussed and relevant description of all baseline characteristics and conditions of the receiving environment (e.g.: site and/or surrounding land uses including urban and agricultural areas as applicable) in relation to the Specialist's field of interest, based on all relevant available data, reports and maps, and information obtained from any field work investigations undertaken to date (to be acquired by Specialist).
- A detailed evaluation of the predicted impacts of the project on the receiving environment, or of the receiving environment on the project as per the methodology to be prescribed by Aurecon, that uses the criteria of extent, duration and intensity to quantify the significance of the potential impact (refer to excel spreadsheet 'Impofu_EIA_Impact Assessment.xlsx'). The evaluation of impacts should include:

- An assessment of impacts for all phases of the life-cycle of the project, namely construction, operation, and decommissioning phases, as well as the direct and indirect impacts;
- An assessment of the probability of each impact occurring, the reversibility of each impact and the level of confidence in each potential impact;
- An assessment of the significance of each impact before and after mitigation;
- The identification of any residual risks that will remain after implementation of design and planning mitigation; and
- An assessment of the No-Go option.

- Refer to the Aurecon standard assessment methodology (to be provided by Aurecon) as well as any discipline specific methodology that was used to inform the assessment of impacts.
- Consider and evaluate the cumulative impacts in terms of the current and proposed activities in the area.
- Recommendations to avoid negative impacts. Where this will not be possible then provide feasible and practical mitigation, management and/or monitoring options to reduce negative impacts and enhance positive impacts that can be included in the Environmental Management Programme.
- Identify any additional measures to ensure that the project contributes towards sustainability goals or provides a positive contribution to the environment.
- Where relevant, recommendations and instructions regarding any additional authorisation, permitting or licensing procedures, or any other requirements pertaining to legislation and policies relevant to the Specialist's field of interest.
- Where more data or fieldwork is required for your field of expertise, state clearly and upfront in your report that the findings/ assessment and information presented in your report is preliminary information based on the information obtained to date. The impact ratings presented in the report may change as more information becomes available. This should primarily only be required for the assessments where monitoring is still in progress (e.g. avifauna and bat assessments).

More detail on the aims of the specific data collection activities is provided below under the relevant sections.

2.2 General approach

The general approach to this study was as follows:

- An initial pre-feasibility/pre-construction bird monitoring design site visit was conducted by the specialist in June 2017.

- Twelve months (4 seasons) of pre-construction bird monitoring was initiated shortly thereafter on site. Each seasonal site visit consists of approximately 20 consecutive days on site by a team of two skilled observers, to record data on bird species and abundance on and near site. These seasonal site visits covered: summer (when summer migrants are present); winter (when raptors breed and Blue Cranes flock); spring (when summer migrants are arriving on site and many species start to breed; and autumn (when summer migrants are leaving and many raptors are preparing to breed), We believe this sampling was sufficient to capture data representative of conditions on site. The Kouga area is at the southernmost tip of the continent and bird migration routes and so does not really experience migration bottle necks of the type experiences elsewhere on the continent. This is supported by the absence of significant migration related fatalities at the nearby operational wind farms.
- During the past year several additional shorter visits were made by the specialist to examine specific avifaunal aspects.
- During October 2017 an avifaunal screening report and mapping information was submitted to Aurecon (Smallie, 2017).
- The avifaunal scoping study was compiled using the above described data for the site and submitted to Aurecon in September 2018.
- This EIA phase report was compiled and submitted to Aurecon in February 2019 and included an assessment of the new amended project layout based on scoping phase inputs from all parties.

Note that pre-construction bird monitoring and all specialist field assessments have been designed to assess the full Impofu Wind Farms site (i.e. all three Impofu Wind Farms). This is an advantage when it comes to the assessment of each site on its own, as data has been collected for a larger area. Since birds are mobile this presents a far stronger assessment than would otherwise be the case. **We have presented data for the consolidated Impofu Wind Farms site throughout this report but focused in on individual wind farm site specific findings where relevant.**

2.3 Data sources consulted for this study

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

- The pre-construction bird monitoring raw data and progress reports (Smallie 2017, 2018).
- The data captured by specialist site visits.
- The Southern African Bird Atlas Project data (SABAP1 - Harrison *et al*, 1997) for the relevant quarter degree squares covering the site, and the Southern African Bird Atlas Project 2 data,

available at the pentad level (http://sabap2.adu.org.za/v1/index.php)(accessedat www.mybirdpatch.adu.org.za))

- The conservation status of all relevant bird species was determined using Taylor *et al* (2015) & IUCN 2017.
- The vegetation classification of South Africa (Mucina & Rutherford, 2006) was consulted in order to determine which vegetation types occur on site.
- Aerial photography from the Surveyor General was used for planning purposes.
- The 'Avian Wind Farm Sensitivity Map: Criteria and procedures used. (Retief *et al,* 2011, update 2014).
- The Important Bird Areas programme was consulted (Marnewick *et al*, 2015).
- Information on bird species occurring in the broader area was available to us from our 3 years of experience working at the nearby operational Kouga Wind Farm, 4 years at the operational Jeffrey's Bay Wind Farm, 1 year at the operational Gibson Bay Wind Farm, and various other pieces of work in the Kouga area (much of this was our own work, but where relevant other authors are referenced in the text).
- A recent review report entitled "Wind energy's impacts on birds in South Africa: a preliminary review of the results of operational monitoring at the first wind farms of the Renewable Energy Independent Power Producer Procurement Programme Wind Farms in South Africa" (Ralston-Paton, Smallie, Pearson, & Ramalho, 2017) was consulted extensively.
- Pre-construction & operational phase bird monitoring reports for Kouga Wind Farm (Diamond, 2012; Strugnell 2016; Strugnell 2017), Jeffrey's Bay Wind Farm (Van Rooyen, Froneman & Laubscher, 2011; MacEwan & Smallie 2015, 2016), Tsitsikamma Wind Farm (Bio3 2013; Chris Van Rooyen Consulting, 2017), Ubuntu Wind Farm, Banna ba Pifhu Wind Farm (Van Rooyen, Froneman & Laubscher, 2013), Oyster Bay Wind Farm (Van Rooyen, Froneman & Laubscher, 2012), and Gibson Bay Wind Farm (Endangered Wildlife Trust 2014; Smallie & MacEwan 2018).
- The report entitled "The compilation of a habitat sensitivity map for Denham's Bustard, Blue Crane and White-bellied Korhaan in the Kouga Municipal area of the Eastern Cape Province" by Van Rooyen & Froneman (2013).
- Coordinated Avifaunal Road count data for the area (accessed at www.car.adu.org.za).
- Data and anecdotal information supplied to us by the St Francis Bay Bird Club and St Francis Kromme Trust (Mrs M. Langlands).
- The "Best practice guidelines for assessing and monitoring the impact of wind energy facilities on birds in southern Africa" Unpublished guidelines by BirdLife South Africa & Endangered Wildlife Trust (Jenkins *et al*, 2015).
- Anecdotal information of our own personal observations and those of our observer team in the broader area (one of which – Mr W Rossouw – resides in Jeffrey's Bay and birds extensively in the relevant area).

- Comments provided by stakeholders and interested and affected parties.

2.4 Primary data collection activities

The following sections describe the data collection activities on site. Figure 5 shows the layout of these monitoring activities on site. Note that the site boundary at the outset of pre-construction bird monitoring was different to that currently relevant to this specialist assessment. Monitoring activities were therefore designed for the original site boundary. The area monitored is larger and therefore of benefit to the project as birds are mobile.

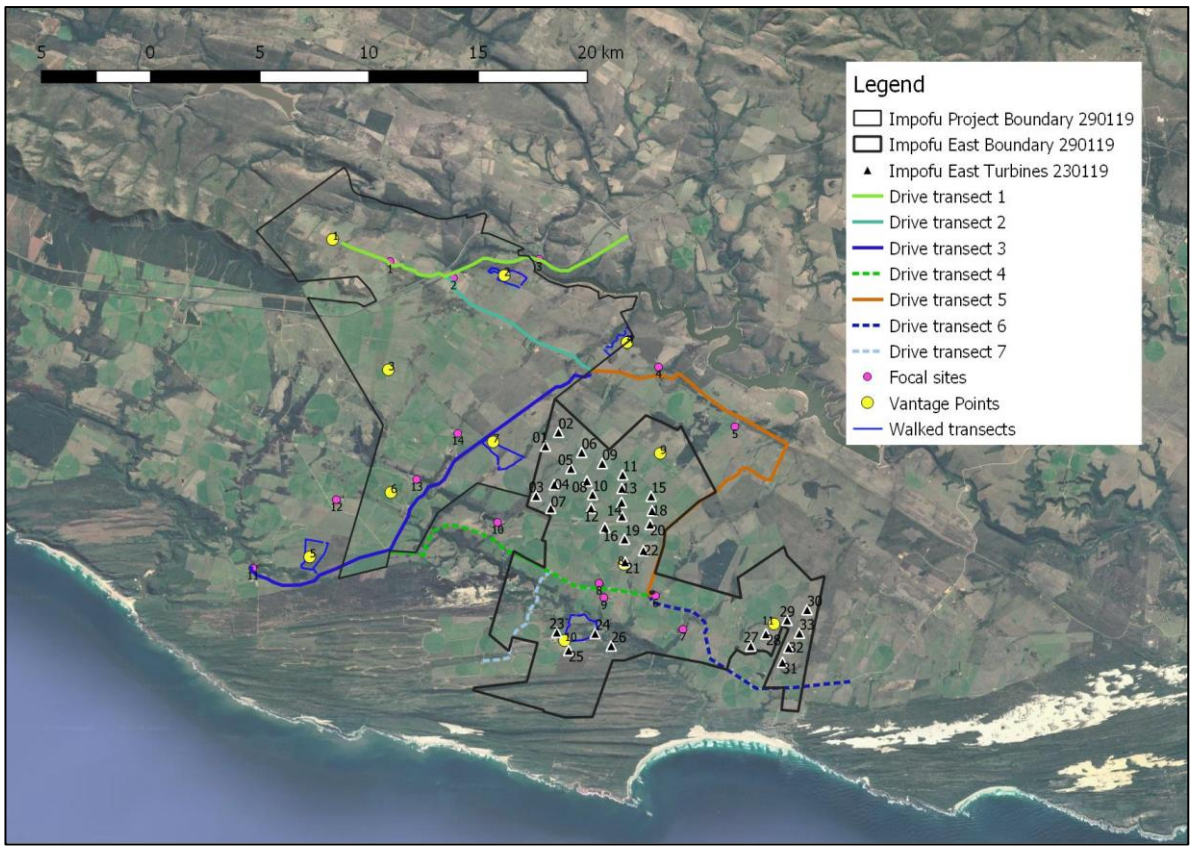

Figure 5. Layout of pre-construction bird monitoring activities on the Impofu Wind Farms site. Note: each depicted walked transect is in fact 3x1km transect, which does not show at this scale.

2.4.1. Sample counts of small terrestrial species

Although not traditionally the focus of wind farm–bird studies and literature, small terrestrial birds are an important component of any pre-construction bird monitoring programme. Due to the rarity of many of our threatened bird species, it is anticipated that statistically significant trends in abundance and density may be difficult to observe for these species. More common, similar species could provide early evidence for trends and point towards the need for more detailed future study. Given the large spatial scale of most wind farms, these smaller species may also be particularly vulnerable to displacement and habitat level effects. Sampling these species is aimed at establishing indices of

abundance for small terrestrial birds in the study area. These counts should be done when conditions are optimal. In this case this means the times when birds are most active and vocal, i.e. early mornings. Transects are counted by two observers walking along a line recording all birds seen and heard within 200m either side. Fifteen walked transects (WT) of approximately 1 kilometre length each were monitored on the Impofu Wind Farms site.

2.4.2. Counts of large terrestrial species & raptors

This is a very similar data collection technique to that above, the aim being to establish indices of abundance for large terrestrial species and raptors. These species are relatively easily detected from a vehicle, hence vehicle based (VT) transects are conducted in order to determine the number of birds of relevant species in the study area. Transects are counted by driving slowly (40-50km/hr) along the transect scanning for birds. Every two kilometres or at suitable vantage points observers get out of the vehicle to stand and scan with binoculars. Detection of these large species is less dependent on their activity levels and calls, so these counts can be done later in the day. Seven VT's were established on farm roads in the area, ranging between 4 and 14km in length and totalling 61km (Figure 5). These transects are each counted twice on each site visit. For more detail on exact methods of conducting Vehicle transects see Jenkins *et al* (2015).

2.4.3. Focal site surveys & monitoring

Fourteen Focal Sites (FS) were initially identified for this programme, all of them farm dams. The location of these Focal Sites is shown in Figure 5. In addition to these, the Martial Eagle nest found in October 2017 was added as a focal site. The (off-site) Kouga Denham's Bustard *Neotis denhamii* lek site east of the proposed Impofu Wind Farms site was also monitored as a focal site in the spring site visit (when male bustards display). Blue Crane roost surveys were also conducted on and near the site.

2.4.4. Direct observation of bird flight on site

The aim of direct observation is to record bird flight activity on site. An understanding of this flight behaviour will help explain any future interactions between birds and the wind farm. Spatial patterns in bird flight movement may also be detected, which will allow for input into turbine placement. Direct observation was conducted through counts at 11 fixed vantage points (VP) in the study area (Figure 5). These VP's provide coverage of a reasonable and representative proportion of the entire study area. VP's were identified using GIS (Geographic Information Systems), and then fine-tuned during the project setup, based on access and other factors such as viewsheds and representativity of habitats. Since these VP's aim at capturing both usage and behavioural data, they were positioned mostly on high ground to maximise visibility. The survey radius for VP counts is 2 kilometres (although large birds are sometimes detected further). VP counts are conducted by two observers. Birds are recorded 360° around observers. Data should be collected during representative conditions, so the sessions are spread throughout the day, with each VP being counted over 'early to mid-morning', 'mid-morning to

early afternoon', and 'mid-afternoon to evening'. Each VP session is 4 hours long, which is believed to be towards the upper limit of observer concentration span, whilst also maximising duration of data capture relative to the travel time to the Vantage Points. A maximum of two VP sessions are conducted per day, to avoid observer fatigue compromising data quality. For more detail on exact criteria recorded for each flying bird observed, see Jenkins *et al* (2015).

One of the most important attributes of any bird flight event is its height above ground, since this will determine its risk of collision with turbine blades. Since it is possible that the turbine model (and hence the exact height of the rotor swept zone) could still change on this project, actual flight height is estimated rather than assigning flight height to broad bands (such as proposed by Jenkins *et al* 2015). This 'raw' data will allow flexibility in assigning to classes later on depending on final turbine specifications.

It is not practical to record all bird species flying by this method, it focuses rather on the physically large species and particularly Red Listed or otherwise important species.

2.4.5. Control site

A control site is monitored to the west of the Impofu Wind Farms site. Monitoring at this site consists of 2 Vantage Points, 3 Walked Transects, 2 Drive Transects and 4 Focal Sites. This data is not directly relevant to the EIA study and will not be discussed further.

2.5 Limitations & assumptions

Certain biases and challenges are inherent in the methods that have been employed to collect data in this programme. It is not possible to discuss all of them here, and some will only become evident with time and operational phase data, but the following are some of the key points:

- The presence of the observers on site is certain to have an effect on the birds itself. For example during walked transects, certain bird species will flush more easily than others (and therefore be detected), certain species may sit undetected, certain species may flee, and yet others may be inquisitive and approach the observers. Likewise with the vantage point counts, it is extremely unlikely that two observers sitting in position for four hours at a time will have no effect on bird flight. Some species may avoid the vantage point position, because there are people there, and others may approach out of curiosity. In almost all data collection methods large bird species will be more easily detected, and their position in the landscape more easily estimated. This is particularly relevant at the vantage points where a large eagle may be visible several kilometres away, but a smaller Rock Kestrel perhaps only within 800 metres. A particularly important challenge is that of estimating the height at which birds fly above the

ground. With no reference points against which to judge, it is exceptionally difficult and subjective. It is for this reason that the flight height data has been treated cautiously by this report, and much of the analysis conducted using flights of all height. With time, and data from multiple sites it will be possible to tease out these relationships and establish indices or measures of these biases.

- The questions that one can ask of the data collected by this programme are almost endless. Most of these questions however become far more informative once post construction data has been collected and effects can be observed. For this reason some of the analysis in this report is relatively crude. The raw data has however been collected and will be stored until such time as more detailed analysis is possible and necessary. This challenge is faced by all wind farm assessments. However, in this case, as there are a number of operational wind farms directly adjacent to or close to the proposed site, all the operational data and assessments from these sites has allowed this assessment to be far more robust than normal.

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

- It is well known that the 2016 period was a drought period in this study area (and most of the country). As a result there is a risk that the data collected may not be perfectly typical of conditions in the area. Given that pre-construction bird monitoring for wind farms samples one year, and the wind farm will operate for at least 20 years (and may only be constructed five years from now), we will always face this challenge of greater variability in environmental conditions occurring during the project lifespan than during the impact assessment of the project. In general we would expect the abundance of certain bird species to decrease in drought periods, so the abundance data presented in this report should be considered a minimum.

- Spotting and identifying birds whilst walking is a significant challenge, particularly when only fleeting glimpses of birds are obtained. As such, there is variability between observers' ability and hence the data obtained. The above data is therefore by necessity subjective to some extent. In order to control for this subjectivity, the same pair of observers has been used for the full duration of the project, and it is hoped this can be maintained for the post construction phase. Despite this subjectivity, and a number of assumptions that line transects rely on (for more details see Bibby *et al*, 2000), this field method returns the greatest amount of data per

unit effort (Bibby *et al*, 2000) and was therefore deemed appropriate for the purposes of this programme. Likewise, in an attempt to maximise the returns from available resources, the walked transects were located close to each Vantage Point. This systematic selection may result in some as yet unknown bias in the data but it has numerous logistical benefits.

- No thresholds for fatality rates for priority species have been established in South Africa to date. This means that impact assessments such as this one need to make subjective judgements on the acceptability of the estimated precicted fatalities for each species.

3. BASELINE DESCRIPTION

3.1 Vegetation and habitat

The Impofu East Wind Farm site is comprised predominantly of two vegetation types (Mucina & Rutherford, 2006): 'Tsitsikamma Sandstone Fynbos' and 'Southern Cape Dune Fynbos'. Smaller portions of 'Southern Afrotemperate Forest' also exist. A map of these vegetation types can be seen below in Figure 6.

The relevance of this vegetation type description to avifauna is somewhat reduced by the very high level of transformation of vegetation in the study area for the purposes of pasture and crop production. Effectively, a number of bird micro habitats are available to birds in the area including: man made dams; wetlands; rocky ridges; pasture/crops; Fynbos; exotic trees; and thicket (see Figure 7). The habitat in the study area is suited to bird species which are able to adapt to use crop lands and pastures.

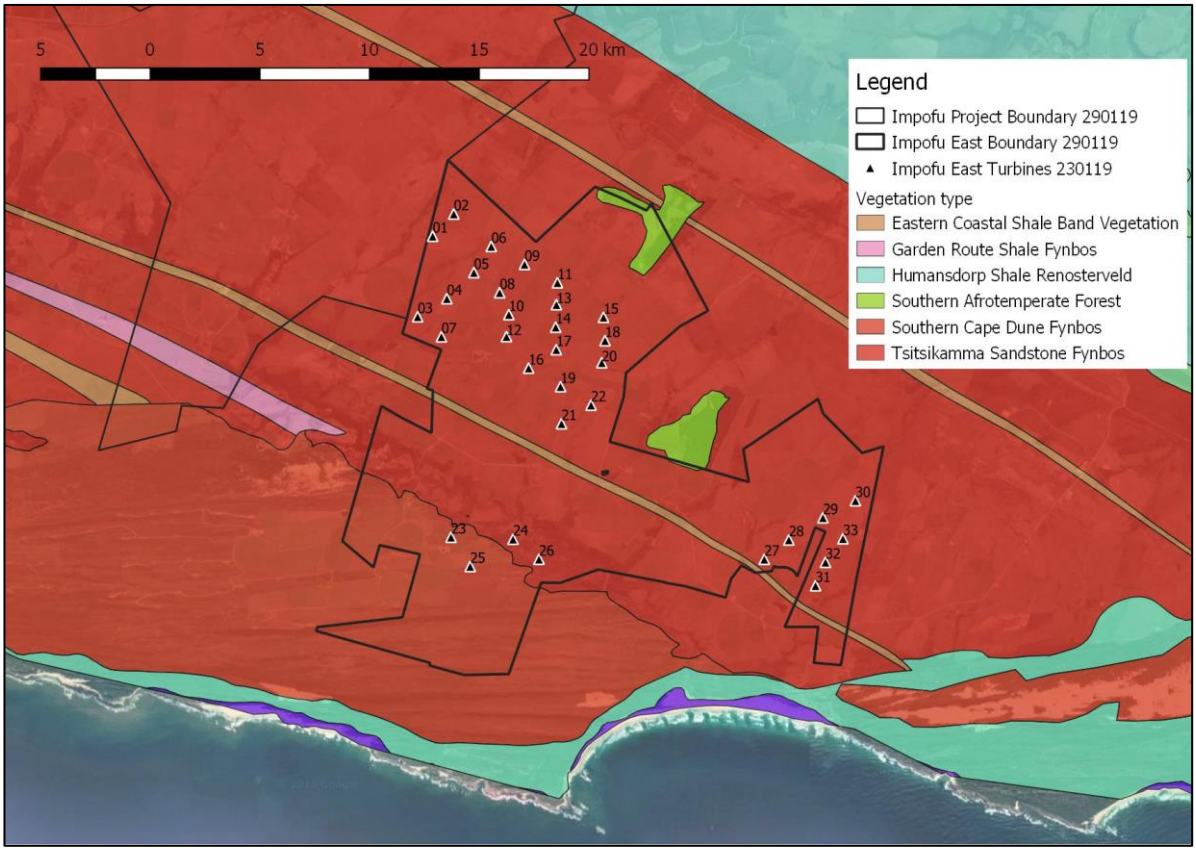

Figure 6. The vegetation classification for the Impofu East Wind Farm (Mucina & Rutherford, 2006).

Figure 7. Typical micro-habitats available to birds in the Impofu Wind Farms study area. (From top left, left to right: dams; arable lands/pastures; wetlands; Fynbos; thicket; exotic trees; and rocky ridges).

3.2 Priority bird species for this impact assessment

For clarity we have included a description of our final priority species at this point. A total of 190 bird species were recorded on the overall Impofu Wind Farms site during the year using all methods (descriptions to follow in Section 3.3), with a peak in species richness in summer (149), followed by spring (143), autumn (127) and winter (113) (see Appendix 1).

In order to narrow down the focus of this impact assessment it was necessary to take some decisions on which species are most important as it is not possible to effectively assess the risk to 190 species. In terms of identifying the priority species for this impact assessment the following steps were followed:

1. Identification of theoretical high risk species. This was done at the beginning of pre-construction bird monitoring through considering: Jordan & Smallie (2010) who summarise which taxonomic groups of birds have been found to be vulnerable to collision with wind turbines in the USA, UK, EU, Australia and Canada; Ralston-Paton, Smallie, Pearson & Ramalho (2017) who summarise experience with bird-turbine fatalities to date in South Africa; and the document entitled "Avian Wind Farm Sensitivity Map for South Africa: Criteria and procedures used" (Retief, Diamond, Anderson, Smit, Jenkins & Brooks, 2011, updated 2014) which classified all bird species theoretically in terms of their risk of interaction with wind energy; and the regional conservation status (Taylor *et al*, 2015). The identified priority species tend to all be physically large species because the direct mortality impact of wind farms, turbine collisions, is most important for these species and the regionally Red Listed bird species in the study area are all large species. This does not mean to say that impacts on smaller species are not important. However priority has been given to those species for which the implications of fatalities are greater. Priority was also given to Red Listed or otherwise important species. At the Impofu Wind Farms site we have not recorded any regionally Red listed small bird species, and relatively few small endemics. Further, the more uncommon small species tend to use the natural vegetation areas, which have been avoided in the design phase of this project and will not be affected. The small bird community is therefore not the topmost priority for this study.

2. Identification of final priority bird species. This was done by examining the data collected at other operating and proposed wind farms in the vicinity (various authors cited elsewhere in this report), and our own data collected on Impofu Wind Farms (Section 3.3). Since wind farms already exist in the area and fatalities have occurred certain species have emerged as priority for the Kouga area. In some cases these species have not been recorded at Impofu Wind Farms or have been recorded so seldom that they do not warrant priority species status for Impofu Wind Farms itself. An example of such a species is Black Harrier, which is of concern in the Kouga area and for cumulative impacts but was recorded very seldom on Impofu Wind Farms.

Species which were high risk for either the Kouga area generally, or Impofu Wind Farms specifically were identified as priority species for this impact assessment.

The final priority species are: Denham's Bustard; White-bellied Korhaan *Eupodotis senegalensis*; Blue Crane; Black Harrier; African Marsh-Harrier *Circus ranivorus*; Martial Eagle; African Fish-Eagle *Haliaeetus vocifer*; Jackal Buzzard; and White Stork *Ciconia ciconia*.

3.3 Avifaunal community

3.3.1 Small terrestrial bird species

A total of 84 small bird species were recorded on the 15 Walked Transects conducted (See Appendix 2 for the full data set) on the overall Impofu Wind Farms site. This includes 2 185 individual birds from 1 314 records. Table 1 shows the data for those species for which 20 or more individuals were recorded (the full data set is too large to include here). In each case the number of birds, number of records, and number of birds per kilometre of transect are presented. The index of birds per kilometre is relatively crude. However, since this will be used primarily to compare the effects of the facility on these species post construction, this index is considered adequate at this stage. If more complex analysis is required during post construction monitoring in order to demonstrate effects, the raw data is available for this purpose.

The most abundant species on the overall Impofu Wind Farms site were not surprisingly all species already known to be common in the area, such as: Cape Canary *Serinus canicollis*; Barn Swallow *Hirundo rustica*; African Pipit *Anthus cinnamomeus*; Red-eyed Dove *Streptopelia semitorquata*; Grey-backed Cisticola *Cisticola subruficapilla* and African Stonechat *Saxicola torquatus*.

Of the 84 species recorded, none are regionally Red Listed (Taylor *et al*, 2015) and nine are regionally endemic. This is a relatively low level of endemism in our view, possibly as a result of the majority of the site being comprised of transformed habitat and therefore less likely to provide habitat for habitat specialist species. The endemic species recorded include: Cape Weaver *Ploceus capensis*; Cape White-eye *Zosterops virens*; Karoo Prinia *Prinia maculosa*; Cape Grassbird *Sphenoeacus afer*; Cape Bulbul *Pycnonotus capensis*; Fiscal Flycatcher *Sigelus silens*; Greater Double-collared Sunbird *Cinnerys afer*; Sentinel Rock Thrush *Monticola exploratory*; and Knysna Turaco *Tauraco corythaix*. The first four of these species were abundant on site and recorded in all 3 seasons. The latter five species were uncommon and recorded only once or twice each. These endemic species are all fairly well represented in a variety of habitat including arable lands, except for the Sentinel Rock Thrush (grasslands) and Knysna Turaco (forest) which are found more in the natural vegetation.

Overall species richness showed little seasonal variation – with a slight peak in spring of 53 species, followed by winter (52), autumn (51), and summer (49).

3.3.2 Large terrestrial species & raptors

A total of 15 large terrestrial and raptor species were recorded across the 7 drive transects totalling 488 kilometres on the overall Impofu Wind Farms site. This included 781 individual birds from 174 records. These data are shown in Table 2. In each case the species' regional Red List status and endemism is shown. Three of the 15 species are regionally Red Listed: Denham's Bustard (Vulnerable); Blue Crane (Near-threatened); and Secretarybird *Sagittarius serpentarius* (Vulnerable). Two species are endemic to the region: Blue Crane and Jackal Buzzard. The most abundant species recorded by this method to date is the White Stork, which was recorded in high numbers in summer only (as it is a summer migrant to the region). The second most abundant species, Denham's Bustard, was recorded in all four seasons at a combined density of 0.08birds/km. Jackal Buzzard was third most abundant, recorded at relatively high abundance in all seasons, with a combined abundance of 0.06birds/km. Blue Crane was fourth most abundant (0.06birds/km) but recorded only in spring by this method. Only 1 record of a single Secretarybird was made, in spring. It is notable that species such as Martial Eagle, White-bellied Korhaan and Black Harrier were not recorded at all by this method on the overall Impofu Wind Farms site.

Table 3 presents summary data from the Coordinated Avifaunal Roadcount (CAR - www.car.adu.org.za) project for the two routes closest to the Impofu Wind Farms site (EH03 and EH06 in 2014 and 2015 - see Figure 8), for the purposes of comparison with our data. These routes are mostly off the Impofu Wind Farms site, but EH03 does pass through Impofu East for part of its' length. The CAR project uses the same methods as our driven transects (in fact the best practice guidelines developed this method on the basis of the CAR methods). Five species typically recorded by the CAR project are relevant to our data: Blue Crane; Denham's Bustard; White-bellied Korhaan; Secretarybird and White Stork. For Blue Crane the 2014 abundance recorded by CAR was significantly higher than our results. In 2015 the results were slightly more comparable, but still higher than our findings. The EH06 CAR route passes through an area that is significantly preferred by Blue Crane (and off the proposed wind farm site) (including the Grasmere and Soutvlei roost sites) which may explain this much higher abundance. The CAR data show very high inter-annual variation for Blue Crane. We do not believe these findings indicate that the species abundance varies greatly in the area between years. Most of this variation is from the winter CAR count. We suggest this is most likely due to the species gathering into a few large flocks in winter. CAR observers therefore either see the flock and get high abundance for the species or do not see the flock and get lower abundance. We likewise believe that our own lower recorded abundance is likely due to the large flocks not frequenting the consolidated Impofu Wind Farms site. We are confident that we would have detected flocks on our 7 transects each done 8 times to date if these flocks did routinely utilise the site. Denham's Bustard was recorded at considerably higher abundance by CAR than our recorded rate across all four seasons of 0.08birds/km. This is presumably

on account of both CAR routes passing the Kouga lek area which is a known high concentration of the species, whilst our driven transects did not pass this area as it is off the Impofu Wind Farms site. White Stork was also recorded by the CAR project at much higher abundance (overall, an exception being EH06 in 2015) than our own recorded overall rate of 1.77birds/km. Once again we interpret this as an indication that areas sampled by the CAR routes off the proposed wind farm site are preferred by this species. The CAR project did not record any White-bellied Korhaan, in line with our own findings. We believe this is likely a result of the difficulty in detecting the species unless it is flushed. As with our own results, Secretarybird was recorded at low abundance. This is a solitary species which naturally occurs at low abundance, so this finding is expected.

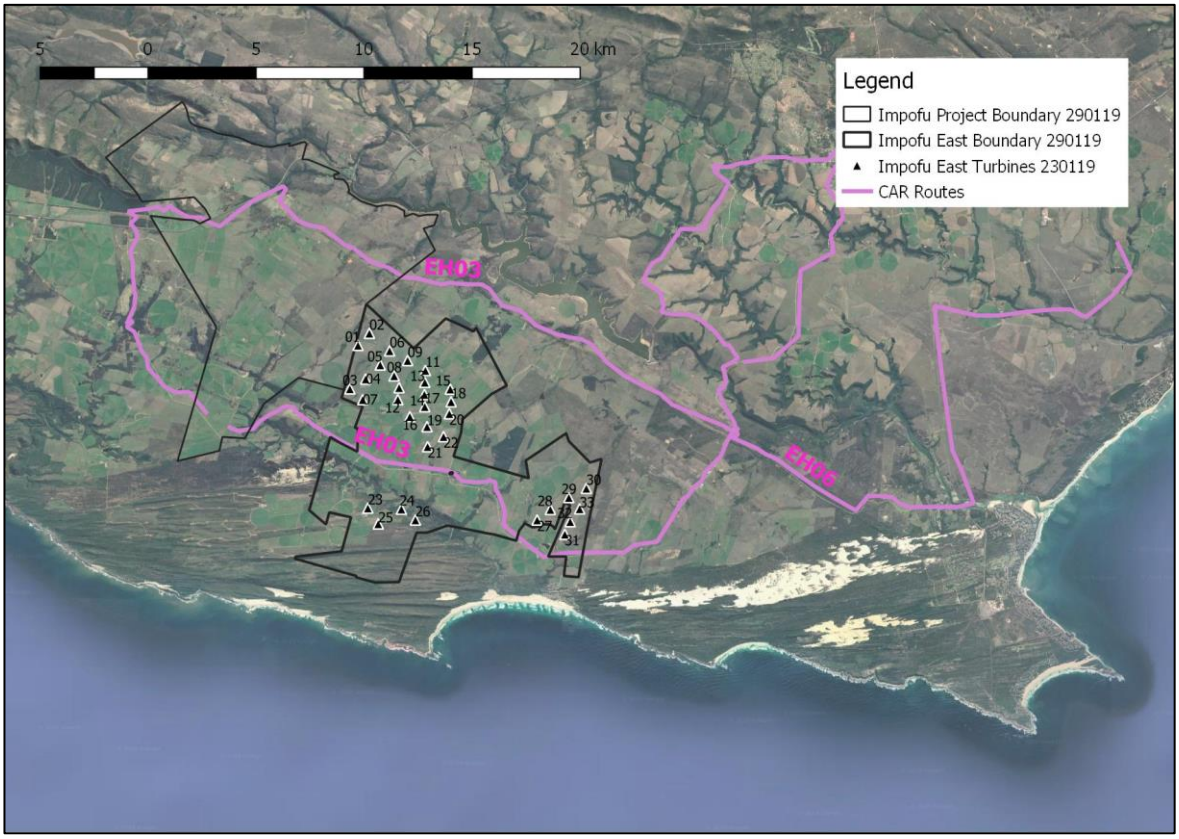

Figure 8. Location of Co-ordinated Avifaunal Roadcount routes relative to Impofu East Wind Farm.

3.3.3 Focal Site surveys

At the multiple farm dam focal sites across the overall Impofu Wind Farms site a typical assortment of water fowl and waders were recorded including: Egyptian Goose *Alopochen aegyptiaca*, Reed Cormorant *Microcarbo africanus*, Yellow-billed Duck *Anas undulata*, Red-billed Teal *Anas erythrorhyncha*, White-faced Duck *Dendrocygna viduata*, African Darter *Anhinga rufa*, Common Moorhen *Gallinula chloropus*, Red-knobbed Coot *Fulica cristata*, Little Grebe *Tachybaptus ruficollis*, Cape Shoveler *Anas smithii*, Black-winged Stilt *Himantopus himantopus*, South African Shelduck

Tadorna cana, White-breasted Cormorant *Phalacrocorax lucidus*. These findings have little consequence for this report and are not discussed further.

At the outset of pre-construction bird monitoring we suspected that a pair of Martial Eagles must breed somewhere in the broader area. Despite not recording the species flying frequently on site, or recording any behaviour indicative of breeding, we surveyed a number of likely areas during the monitoring period, all of which were off site but close enough to be relevant. In October 2017 the nest was finally found, by surveying the small gorges feeding the Impofu Dam from a kayak. The nest is located on the northern side of the Impofu Dam as shown in Figure 9. A young fledgling eagle was recorded at the nest in October (Figure 10), indicating that breeding had taken place successfully during the 2017 breeding season. Figure 11 shows the nest itself. The presence of this nest (approximately 2km from the original Impofu Wind Farms site boundary at its closest point) had significant implications for the development. In order to avoid risks to these eagles a 6km radius around the nest site was declared a No-Go area during the design phase (see Section 4.1).

Figure 9. The location of the Martial Eagle nest site.

Figure 10. The young fledgling Martial Eagle.

Figure 11. The Martial Eagle nest structure.

The Kouga Denham's Bustard lek site is located off the Impofu Wind Farms site to the east (approximately 3.2km from nearest turbine position on Impofu East – T30). This was monitored during the bustards' display period to determine the number of breeding/displaying males. A total of 13 Denham's Bustards were recorded in spring (5 separate records, 4 of which were displaying males). Each displaying male had between 1 and 4 females in close attendance. The location of this lek site and the individual records is shown in Figure 12. The proposed Impofu East Wind Farm is too far from this lek, and removed from it by a ridge line, to have any effect on it. This aspect is reported for the sake of thoroughness and as a baseline against which any future effcts can be measured.

Figure 12. The off-site Kouga Denham's Bustard lek site and the location of displaying male birds.

On the consolidated Impofu Wind Farms site itself, 6 records of displaying male Denham's Bustard were made during the spring site visit. Four of these records were on the Impofu East Wind Farm site, but three of these (a congregation in the far south) were of the same bird on different days (Figure 13). We therefore recorded 2 separate displaying male bustards on the Impofu East site. There is normally high fidelity to these display sites (meaning males will display in the same area each year) so these sites are of some significance in terms of infrastructure micro siting. However we do not consider these to be lek areas based on current evidence. A lek would be defined as a congregation or assemblage of more than 1 male in an area, which we have not yet detected on site – having detected only single displaying birds. Since no-one (to our knowledge) has located any nest sites of the birds from the Kouga lek off site, we do not adequately understand the spatial relationship between the lek sites and breeding sites, i.e. how far apart they are. We do take the records of displaying males on the Impofu site as indication that the species probably breeds somewhere within a few kilometres of those locations. Data collected to date at the operational Kouga Wind Farm point towards males continuing to display even within 50-100m of operational turbines. This indicates that the species may be fairly tolerant of the turbines once operational.

Figure 13. The location of displaying male Denham's Bustards recorded during spring monitoring.

Blue Cranes roost communally in the shallows of dams or other open water sources. Cranes enter the roost late in the evening and exit early morning (when visibility is lower and risk of collision with obstacles higher). Placing new overhead infrastructure such as turbines or power lines close to roosts is therefore not advisable. We collated information on known Blue Crane roosts (dams) on and near site, using local knowledge of one of our observers (Wessel Rossouw) and the St Francis Bay Bird Club. Two confirmed roost sites have been identified, both of which are well off the Impofu Wind Farms site to the east (Grasmere – 13km & Soutvlei 20km – T30) (Figure 14). We have not identified any roost sites on the Impofu East Wind Farm site. The severe drought in the area means that dams are not at typical levels which somewhat reduces our confidence in this finding as with improved dam levels in future cranes may roost in certain dams. It however seems likely that most of the crane population in this area roosts in the two above mentioned roosts, well off the Impofu East Wind Farm site. As a precautionary measure all medium to large dams in high Blue Crane sensitivity areas identified by Van Rooyen and Froneman (2013) were avoided during the project design phase by applying a No-Go buffer.

Figure 14. Confirmed Blue Crane roost sites in the vicinity of the Impofu Wind Farms site.

Blue Crane roosts are important features because they concentrate larger than normal numbers of Blue Cranes spatially, and therefore result in higher collision risk. Another factor which concentrates cranes in this area is farmers' feeding troughs, particularly during winter. Cranes have learnt to feed from these troughs and on waste feed around them. These sites are temporary in nature and cannot be mapped and fixed over the lifespan of the wind farm. We recommend elsewhere in this report that if Blue Crane turbine or power line collision fatalities occur once the facility is operational as a result of livestock feeding sites this will need to be mitigated, probably by restricting farmers from feeding too close (200-300m) to turbines and power lines or by covering/ obstructing the feeding points in some way that prevents the birds from easily feeding from them (as was done successfully with fence wires in the Overberg area for feeding points for sheep). Landowners should be made aware of this possibility at the outset of the project.

3.3.4 Incidental Observations of target bird species

A total of 20 species were recorded on the Impofu Wind Farms site as Incidental Observations, with a peak in species richness of 16 in summer and a low of 8 species in spring (Table 4). The most abundant species recorded by this method was White Stork, recorded in high numbers in summer only. Denham's Bustard was the second most frequently recorded species and was recorded in all four seasons. Greater Flamingo *Phoenicopterus ruber* was recorded in autumn only. These records were all

of the same flock of 15 birds on the same dam. Eight of the species recorded by this method are regionally Red Listed. These include two Endangered species (Grey Crowned Crane and African Marsh-Harrier); four Vulnerable species (Denham's Bustard, Lanner Falcon, White-bellied Korhaan and Secretarybird); and two Near-threatened species (Blue Crane and Greater Flamingo). Since these data are not the product of systematic data collection methods, it should be used cautiously and we do not discuss it any further here.

3.3.5 Bird flight activity on site

A total of 132 sessions of bird flight observation were completed, of 4 hours each, totalling 528 hours of observation at Vantage Points across the overall Impofu Wind Farms site. In total, 21 target bird species were recorded flying on the overall Impofu Wind Farms site during the 528 hours of observation. These data are shown in Table 5. Six of these 21 species are regionally Red Listed (Taylor *et al,* 2015): Martial Eagle (Endangered); Black Harrier (Endangered); African Marsh-Harrier (Endangered); Denham's Bustard (Vulnerable); Lanner Falcon *Falco biarmicus* (Vulnerable); and Blue Crane (Near-threatened). Two species are regionally endemic: Blue Crane and Jackal Buzzard.

The most frequently recorded flying species was White Stork with 215 individual birds recorded across 120 records. All but one of these was in summer, with a single bird recorded flying once in winter. The mean flight height above ground of all recorded White Stork flights was 49.42m, well within the proposed rotor swept area. Blue Crane was second most frequent flier, with 159 birds recorded across 45 records. The species was recorded flying in all four seasons to date at a mean height above ground of 45.7m (within rotor zone). Denham's Bustard was the third most frequent flying species, with 130 birds from 77 records (all four seasons). This species flew at a mean height of 23.15m above ground, just below the rotor swept zone. Jackal Buzzard was recorded flying 78 times for 97 individual birds (all four seasons) at a mean height of 60.68m above ground, which is well within the rotor zone. Interestingly, African Marsh-Harrier emerges as fifth most frequent flier. This species was recorded a total of 67 times, 66 of which were single birds. One record of a pair of birds was made. This is a far higher flight activity level for this species than we have recorded previously elsewhere. This species flew mostly at low altitude (15.03m above the ground on average), well below the rotor swept area, and we are not aware of any fatalities recorded at operational wind farms to date. However, experience with the similar Black Harrier on other sites has shown us that species such as this can be killed through turbine collisions despite very seldom being recorded flying at rotor height. Based on this we are not prepared to totally dismiss the collision risk to African Marsh-Harrier.

A pair of Grey Crowned Crane was resident on the consolidated Impofu Wind Farms site during summer and was recorded flying 6 times, although this was not on the Impofu East site. Martial Eagle was recorded flying only five times on Impofu Wind Farms. None of these flights were on Impofu East. No records were made of Black Harrier flying on Impofu East. Based on the data collected on site we do

not believe the Impofu East Wind Farm site is preferred by Black Harrier within this broader Kouga area.

3.3.6 Estimating turbine collision fatality rates

Crude turbine collision fatality rates were calculated for each species in order to estimate how many birds the proposed Impofu East Wind Farm could kill once operational. This was based on the species' passage rates (number of birds recorded flying per hour) recorded on site. Generally speaking we expect those species which fly more often to be more susceptible to turbine collision. In order to calculate crude passage rates for each species, we assumed that the 2km radius around vantage points was approximately equal to the maximum distance over which sightings were made, and that the coverage was approximately circular. This meant that at each vantage point an area of 12.57km² was sampled ($A = \pi r^2$). Secondly, we assumed that the area of the wind farm directly presenting a collision risk is described by the area of each turbine's rotor zone multiplied by the number of turbines. We assumed a turbine model of the maximum of 150m rotor diameter (see Section 1.1) or 75m radius and the current proposed layout of 33 turbines. This equates to a wind farm collision risk area of 0.583158km² (33 x 17 671.46m²). Thirdly, we assumed that the survey areas around each of the vantage points was a representative sample of the area in which built turbines will operate. Fourthly we assumed that species passage rates calculated from our four seasons of sampling can be reasonably extrapolated to annual passage rates (by multiplying hourly passage rates by 12 x 365 in the case of resident diurnal species (12 daylight hours) and 12 x 365 x 0.5 in the case of migrants (present in the study area for only 6 months). We also assumed a 98% avoidance rate for these birds, i.e. 2% of birds passing through the rotor zone would collide with blades (as recommended by Scottish Natural Heritage guidance for species for which no established avoidance rate is available, www.project-gpwind.eu). Finally, we used all recorded flights of all heights above ground for this analysis, since all flight represents some risk, particularly given that species flight behaviour may change once wind turbines are operational, and that estimation of bird height above ground is subjective.

We believe that the estimated fatality rates calculated represent a worst case scenario, for the following reasons: flights of all heights above ground were included, whereas in reality some flights would be below or above rotor zone; no consideration is given to actual turbine locations relative to actual flight path positions (and extensive avoidance of collision risk has been applied in turbine siting already); and a relatively conservative avoidance rate of 98% was used. Although the calculations we have made are not a Collision Risk Model (CRM-Scottish Natural Heritage) some of the principles and assumptions made are similar. In South Africa, one of the main reasons CRM is not often used is that we have not established accurate species specific avoidance rates yet, and the model is so sensitive to these avoidance rates. For example if we used a 99% avoidance rate it would halve the estimated number of fatalities calculated as described below.

Our confidence in these estimates is therefore low, but the exercise is worthwhile nonetheless,

particularly for the cumulative impact assessment later in this report (Section 4.3).

Using the above described methods it is estimated that approximately 7.6 fatalities could be recorded at Impofu East Wind Farm per year across the 21 target bird species recorded flying on site. This includes the following priority species fatalities: 1.1 White Storks; 1.6 Blue Cranes; 1.3 Denham's Bustards; 1 Jackal Buzzard; and 0.7 African Marsh-Harrier. Importantly the fatality rates for several species, including: Martial Eagle (0.05 fatalities/year); Black Harrier (0.02 birds fatalities/year); Lanner Falcon (0.17 fatalities/year); and Grey Crowned Crane (0.12 fatalities/year), are very low. It is noted that the above calculated fatality rates have decreased by approximately 40% in the EIA Phase due to the reduced number of planned turbines assessed in the Scoping Phase. See Table 6 for more information. Human caused fatalities of Red listed or otherwise threatened bird species are always cause for concern and should be avoided as far as possible. There are currently no established thresholds for acceptable impacts on bird species in South Africa. To establish these thresholds would require complex modelling incorporating accurate information on many factors for each species (including population size, age specific fatality rates, breeding productivity etc). Such modelling and information is not available in South Africa at present. In the absence of this information we are forced to make a subjective finding as to the acceptability of the above estimated estimates (see Section 4.2 and Table 14 for our assessment). In our view the above fatality rates are of moderate significance for these species. Regional populations of these bird species are not likely to be driven towards extinction by these fatalities in our view. It is however essential that all mitigation measures recommended in this report be accepted to ensure that these fatality rates are reduced where possible. It is also essential that an adaptive management approach be adopted, ensuring that the wind farm is prepared to respond timeously and effectively if unsustainable impacts are detected.

Table 1. Small passerine bird data from walked transects for all 4 seasons for the consolidated Impofu Wind Farms (only those species where >20 individuals were recorded) – see Appendix 2 for full dataset.

			Full year			Winter			Spring			Summer			Autumn		
		# species	**84**			**52**			**53**			**49**			**51**		
		Transect length	**64.96**			**16.24**			**16.24**			**16.24**			**16.24**		
Common name	**Scientific name**	**Regional status**	**Birds**	**Rec.**	**Birds /km**	**Birds**	**Rec.**	**Birds /km**	**Birds**	**Rec.**	**Birds /km**	**Birds**	**Rec.**	**Birds /km**	**Birds**	**Rec.**	**Birds /km**
Barn Swallow	*Hirundo rustica*		227	76	3.49							172	21	10.59	55	14	3.39
Cape Canary	*Serinus canicollis*		176	44	2.71	76	10	4.68	49	24	3.02	48	7	2.96	3	2	0.18
African Pipit	*Anthus cinnamomeus*		142	92	2.19	61	32	3.76	8	6	0.49	40	21	2.46	33	15	2.03
Grey-backed Cisticola	*Cisticola subruficapilla*		101	81	1.55	20	15	1.23	32	25	1.97	23	15	1.42	26	14	1.60
Red-eyed Dove	*Streptopelia semitorquata*		100	52	1.54	36	18	2.22	7	7	0.43	44	14	2.71	13	9	0.80
African Stonechat	*Saxicola torquatus*		92	64	1.42	22	14	1.35	33	25	2.03	22	10	1.35	15	10	0.92
Bokmakierie	*Telophorus zeylonus*		78	52	1.20	14	8	0.86	13	9	0.80	33	17	2.03	18	13	1.11
Speckled Pigeon	*Columba guinea*		77	60	1.19	6	4	0.37	9	3	0.55	11	2	0.68	51	2	3.14
Cape Longclaw	*Macronyx capensis*		67	45	1.03	16	10	0.99	18	12	1.11	25	15	1.54	8	5	0.49
Yellow Bishop	*Euplectes capensis*		66	35	1.02	9	5	0.55	21	16	1.29	29	7	1.79	7	3	0.43
Red-capped Lark	*Calandrella cinerea*		64	35	0.99	35	11	2.16	19	15	1.17	2	1	0.12	8	2	0.49
Neddicky	*Cisticola fulvicapilla*		61	49	0.94	8	6	0.49	27	23	1.66	19	13	1.17	7	4	0.43
Common Fiscal	*Lanius collaris*		50	48	0.77	14	14	0.86	8	8	0.49	16	14	0.99	12	11	0.74
Rufous-naped Lark	*Mirafra africana*		49	43	0.75	7	6	0.43	26	22	1.60	15	14	0.92	1	1	0.06
Common Quail	*Coturnix coturnix*		48	36	0.74				34	28	2.09	14	8	0.86			
Common Waxbill	*Estrilda astrild*		43	31	0.66				5	2	0.31	10	1	0.62	28	3	1.72
Cape Turtle-Dove	*Streptopelia capicola*		42	40	0.65	14	13	0.86	7	6	0.43	4	4	0.25	17	12	1.05
Cape White-eye	*Zosterops virens*	Endemic	41	15	0.63	7	2	0.43	11	2	0.68	15	3	0.92	8	2	0.49
Cape Weaver	*Ploceus capensis*	Endemic	38	8	0.58	7	3	0.43	25	3	1.54	6	2	0.37			
Sombre Greenbul	*Andropadus importunus*		38	35	0.58	5	5	0.31	8	7	0.49	13	11	0.80	12	7	0.74
Fork-tailed Drongo	*Dicrurus adsimilis*		35	20	0.54	10	8	0.62	12	4	0.74	10	5	0.62	3	2	0.18

Common name	Scientific name	Regional status	Birds	Rec.	Birds /km	Birds	Rec.	Birds /km	Birds	Rec.	Birds /km	Birds	Rec.	Birds /km	Birds	Rec.	Birds /km
African Quailfinch	*Ortygospiza atricollis*		32	14	0.49				22	4	1.35				10	5	0.62
Red-winged Starling	*Onychognathus morio*		30	1	0.46				30	1	1.85						
Levaillant's Cisticola	*Cisticola tinniens*		26	14	0.40	4	3	0.25				18	7	1.11	4	4	0.25
Karoo Prinia	*Prinia maculosa*	Endemic	24	14	0.37	1	1	0.06	6	5	0.37	13	4	0.80	4	3	0.25
Bar-throated Apalis	*Apalis thoracica*		23	21	0.35	3	3	0.18	10	9	0.62	5	4	0.31	5	3	0.31
Cape Grassbird	*Sphenoeacus afer*	Endemic	23	22	0.35	3	2	0.18	10	10	0.62	5	5	0.31	5	5	0.31
Zitting Cisticola	*Cisticola juncidis*		23	16	0.35	2	1	0.12	9	6	0.55	11	8	0.68	1	1	0.06
Malachite Sunbird	*Nectarinia famosa*		21	16	0.32	5	4	0.31	11	7	0.68				5	4	0.31
Cape Robin-Chat	*Cossypha caffra*		20	18	0.31	5	4	0.31	8	7	0.49	2	2	0.12	5	4	0.31

Table 2. Large terrestrial & raptor species recorded on the drive transects at the consolidated Impofu Wind Farms site.

			Full year			Winter			Spring			Summer			Autumn		
		Transect length	488			122			122			122			122		
		# species	15			4			9			9			3		
Common name	Scientific name	Regional status	Birds	Rec.	Birds/km	Birds	Rec.	Birds/km	Birds	Rec.	Birds/km	Birds	Rec.	Birds/km	Birds	Rec.	Birds/km
White Stork	*Ciconia ciconia*		649	87	1.33							649	87	5.32			
Denham's Bustard	*Neotis denhamii*	Vulnerable	40	23	0.08	7	5	0.06	22	11	0.18	1	1	0.01	10	6	0.08
Jackal Buzzard	*Buteo rufofuscus*	Endemic	29	25	0.06	14	10	0.11	4	4	0.03	5	5	0.04	6	6	0.05
Blue Crane	*Anthropoides paradiseus*	Near-threatened	27	7	0.06				27	7	0.22						
Steppe Buzzard	*Buteo buteo*		13	12	0.03							13	12	0.11			
Yellow-billed Kite	*Milvus parasitus*		10	4	0.02				1	1	0.01	9	3	0.07			
African Fish-Eagle	*Haliaeetus vocifer*		3	3	0.01	1	1	0.01	1	1	0.01				1	1	0.01
Booted Eagle	*Aquila pennatus*		2	1	0.00				2	1	0.02						
African Harrier-Hawk	*Polyboroides typus*		2	2	0.00				1	1	0.01	1	1	0.01			
Rock Kestrel	*Falco rupicolus*		1	1	0.00	1	1	0.01									

Common name	Scientific name	Regional status	Birds	Rec.	Birds/km	Birds	Rec.	Birds/km	Birds	Rec.	Birds/km	Birds	Rec.	Birds/km	Birds	Rec.	Birds/km
Long-crested Eagle	*Lophaetus occipitalis*		1	1	0.00				1	1	0.01						
Secretarybird	*Sagittarius serpentarius*	Vulnerable	1	1	0.00				1	1	0.01						
Amur Falcon	*Falco amurensis*		1	1	0.00							1	1	0.01			
Black-shouldered Kite	*Elanus caeruleus*		1	1	0.00							1	1	0.01			
Forest Buzzard	*Buteo trizonatus*		1	1	0.00							1	1	0.01			

Table 3. Summary data from Co-ordinated Avifaunal Roadcount routes EH03 & EH06 in 2014 & 2015 (www.car.adu.org.za).
Species not recorded during these particular transects are not shown, e.g. White-bellied Korhaan.

Year	Route	Length	Blue Crane		Denham's Bustard		Secretarybird		White Stork	
			Birds	Birds/km	Birds	Birds/km	Birds	Birds/km	Birds	Birds/km
2014	**EH03**	110.6	148	1.34	51	0.46	0	0	968	8.75
	EH06	108.9	108	0.99	40	0.37	2	0.02	250	2.30
2015	**EH03**	113.1	4	0.04	63	0.56	0	0	450	3.98
	EH06	112	52	0.46	36	0.32	3	0.03	143	1.28

Table 4. Summary of Incidental Observations of relevant species on the consolidated Impofu Wind Farms site.

			Full year		Winter		Spring		Summer		Autumn	
		# species	20		10		8		16		9	
Common name	Taxonomic name	Regional status	Birds	Rec.	Birds	Rec.	Birds	Rec.	Birds	Rec.	Birds	Rec.
White Stork	*Ciconia ciconia*		989	131					989	131		
Denham's Bustard	*Neotis denhamii*	Vulnerable	286	102	126	30	33	21	41	21	86	30
Greater Flamingo	*Phoenicopterus ruber*	Near-threatened	69	5							69	5
Jackal Buzzard	*Buteo rufofuscus*		53	46	13	12	5	5	16	13	19	16
Steppe Buzzard	*Buteo buteo*		52	45					52	45		
Blue Crane	*Anthropoides paradiseus*	Near-threatened, endemic	47	18	3	1	9	5	9	5	26	7
Amur Falcon	*Falco amurensis*		42	8					42	8		
Black-winged Lapwing	*Vanellus melanopterus*		34	7	11	2	19	4	4	1		

Common name	Taxonomic name	Regional status	Birds	Rec.	Birds	Rec.	Birds	Rec.	Birds	Rec.	Birds	Rec.
African Fish-Eagle	*Haliaeetus vocifer*		18	16	4	4	3	3	8	6	3	3
Yellow-billed Kite	*Milvus parasitus*		13	13			2	2	11	11		
African Marsh-Harrier	*Circus ranivorus*	Endangered	10	8					6	6	4	2
Long-crested Eagle	*Lophaetus occipitalus*		5	4	1	1	3	2	1	1		
Grey Crowned Crane	*Balearica regulorum*	Endangered	4	2					4	2		
Lanner Falcon	*Falco biarmicus*	Vulnerable	4	4	1	1			1	1	2	2
White-bellied Korhaan	*Eupodotis senegalensis*	Vulnerable	6	3	2	1	2	1	2	1		
Black Sparrowhawk	*Accipiter melanoleucus*		3	3	1	1			2	2		
Spotted Eagle-Owl	*Bubo africanus*		1	1	1	1						
African Harrier-Hawk	*Polyboroides typus*		1	1							1	1
Forest Buzzard	*Buteo trizonatus*		1	1					1	1		
Secretarybird	*Sagittarius serpentarius*	Vulnerable	1	1							1	1

Table 5. Target bird species recorded during vantage point counts at the consolidated Impofu Wind Farms site.

			Full year		Winter		Spring		Summer		Autumn	
		# species	21		13		14		16		12	
Common name	Scientific name	Regional status	Birds	Rec.	Birds	Rec.	Birds	Rec.	Birds	Rec.	Birds	Rec.
		All species	892	556	195	107	180	118	382	246	135	85
White Stork	*Ciconia ciconia*		215	120	1	1			214	119		
Blue Crane	*Anthropoides paradiseus*	Near-threatened, endemic	159	45	27	9	79	22	20	5	33	9
Denham's Bustard	*Neotis denhamii*	Vulnerable	130	77	65	34	17	14	6	4	42	25
Jackal Buzzard	*Buteo rufofuscus*	Endemic	97	78	39	29	24	22	15	12	19	15
African Marsh-Harrier	*Circus ranivorus*	Endangered	68	67	14	14	20	20	18	18	16	15
Steppe Buzzard	*Buteo buteo*		53	46					47	43	6	3
Black-winged Lapwing	*Vanellus melanopterus*		46	17	35	6	11	11				
Yellow-billed Kite	*Milvus parasitus*		20	20			5	5	15	15		
Amur Falcon	*Falco amurensis*		17	7					17	7		

Common name	Scientific name	Regional status	Birds	Rec.	Birds	Rec.	Birds	Rec.	Birds	Rec.	Birds	Rec.
Lanner Falcon	*Falco biarmicus*	Vulnerable	17	16	4	4	4	4	6	5	3	3
African Fish-Eagle	*Haliaeetus vocifer*		13	12	1	1	3	3	2	2	7	6
Grey Crowned Crane	*Balearica regulorum*	Endangered	12	6					12	6		
Black Sparrowhawk	*Accipiter melanoleucus*		11	11	1	1	8	8	2	2		
Rock Kestrel	*Falco rupicolus*		7	7	4	4	2	2			1	1
Black-shouldered Kite	*Elanus caeruleus*		6	6			2	2	3	3	1	1
Booted Eagle	*Aquila pennatus*		5	5			2	2	3	3		
Martial Eagle	*Polemaetus bellicosus*	Endangered	5	5	2	2			1	1	2	2
African Harrier-Hawk	*Polyboroides typus*		5	5	1	1					4	4
Long-crested Eagle	*Lophaetus occipitalis*		3	3	1	1	1	1			1	1
Black Harrier	*Circus maurus*	Endangered	2	2			2	2				
Montagu's Harrier	*Circus pygargus*		1	1					1	1		

Table 6. Target bird species passage rates and estimated turbine collision fatalities at the consolidated Impofu Wind Farms site.

Common name	Regional status	Birds	Birds/hr at VP	Birds/yr at VP	Imp E Birds/yr through rotor zone	Imp N Birds/yr through rotor zone	Imp W Birds/yr through rotor zone	Imp E Ann. Fat. rate (98% avoidance)	Imp N Ann. Fat. rate (98% avoidance)	Imp W Ann. Fat. rate (98% avoidance)	Impofu Wind Farms Ann. Fat. rate (98% avoidance)
	All species	757	1.91	8168.26	378.95	378.95	333.02	7.58	7.58	6.66	21.82
White Stork		215	0.54	1189.02	55.16	55.16	48.48	1.10	1.10	0.97	3.18
Blue Crane	Near-threatened, endem-ic	159	0.40	1758.64	81.59	81.59	71.70	1.63	1.63	1.43	4.70
Denham's Bustard	Vulnerable	130	0.33	1437.88	66.71	66.71	58.62	1.33	1.33	1.17	3.84
Jackal Buzzard	Endemic	97	0.24	1072.88	49.77	49.77	43.74	1.00	1.00	0.87	2.87
African Marsh-Harrier	Endangered	68	0.17	752.12	34.89	34.89	30.66	0.70	0.70	0.61	2.01
Steppe Buzzard		53	0.13	293.11	13.60	13.60	11.95	0.27	0.27	0.24	0.78
Black-winged Lap-wing		46	0.12	508.79	23.60	23.60	20.74	0.47	0.47	0.41	1.36
Yellow-billed Kite		20	0.05	110.61	5.13	5.13	4.51	0.10	0.10	0.09	0.30
Amur Falcon		17	0.04	94.02	4.36	4.36	3.83	0.09	0.09	0.08	0.25
Lanner Falcon	Vulnerable	17	0.04	188.03	8.72	8.72	7.67	0.17	0.17	0.15	0.50
African Fish-Eagle		13	0.03	143.79	6.67	6.67	5.86	0.13	0.13	0.12	0.38
Grey Crowned Crane		12	0.03	132.73	6.16	6.16	5.41	0.12	0.12	0.11	0.35
Black Sparrowhawk		11	0.03	121.67	5.64	5.64	4.96	0.11	0.11	0.10	0.32
Rock Kestrel		7	0.02	77.42	3.59	3.59	3.16	0.07	0.07	0.06	0.21
Black-shouldered Kite		5	0.01	55.30	2.57	2.57	2.25	0.05	0.05	0.05	0.15
Booted Eagle		5	0.01	55.30	2.57	2.57	2.25	0.05	0.05	0.05	0.15
Martial Eagle	Endangered	5	0.01	55.30	2.57	2.57	2.25	0.05	0.05	0.05	0.15
African Harrier-Hawk		5	0.01	55.30	2.57	2.57	2.25	0.05	0.05	0.05	0.15
Long-crested Eagle		3	0.01	33.18	1.54	1.54	1.35	0.03	0.03	0.03	0.09

Black Harrier	2	0.01	22.12	1.03	1.03	0.90	0.02	0.02	0.02	0.06
Montagu's Harrier	1	0.00	11.06	0.51	0.51	0.45	0.01	0.01	0.01	0.03

3.3.7 Spatial location of flight records

The spatial location of all target bird species flight records for Impofu East, for all four seasons, can be seen below in Figure 15. In general flight records show little evidence of strong spatial patterns associated with any underlying land use, habitat or topographic features.

Figures 16 to 20 present the fight paths for the 5 most frequent flying species across the Impofu East Wind Farm site (as per Table 5) individually. These species are: White Stork; Blue Crane; Denham's Bustard; Jackal Buzzard; and African Marsh-Harrier. White Stork flights are dispersed over the site, with two particular concentrations evident close to turbines 21 & 28 (Figure 16). Very few Blue Crane flights were recorded on the Impofu East Wind Farm site, and as a result no patterns are evident (Figure 17). Denham's Bustard flights are also fairly dispersed on site, with no strong concentrations evident (Figure 18). Jackal Buzzard flight activity on site was high, with several concentrations evident in Figure 19, particularly in the vicinity of Turbines 21, 23, 25, 28 and 29. African Marsh-Harrier showed a strong concentration of flights immediately south of Vantage Point 10, in the vicinity of Turbines 23 and 25 (Figure 20).

Based on this information we have identified Turbines 21, 23, 25, 28, and 29 as particularly high risk. Since the risk at these turbine locations is predominantly based on Jackal Buzzard (a non Red Listed species) and African Marsh-Harrier (for which no turbine collision fatalities have been reported at operational wind farms to date) we do not recommend that these turbines be moved or not built. We rather recommend that these turbine be searched weekly at a minimum and according to the full best practice protocol once post construction bird fatality searches start (i.e. it should not be one of the turbines subject to less frequent or thorough searching).

Figure 15. Recorded target bird species flight paths at Impofu East Wind Farm (all species, 4 seasons).

Figure 16. White Stork flight paths at Impofu East Wind Farm (all 4 seasons).

Figure 17. Blue Crane flight paths at Impofu East Wind Farm (all 4 seasons).

Figure 18. Denham's Bustard flight paths at Impofu East Wind Farm (all 4 seasons).

Figure 19. Jackal Buzzard flight paths at Impofu East Wind Farm (all 4 seasons).

Figure 20. African Marsh-Harrier flight paths at Impofu East Wind Farm (all 4 seasons).

3.4 Assessment of risk to priority bird species

Table 7 presents the seasonal presence of each species on the consolidated Impofu Wind Farms site and a qualitative assessment of the risk of each type of impact (pre-mitigation) occurring for each of the priority species if the proposed wind farm is built. This assessment has been made on the basis of the data collected on site during this programme, reported on in Section 3.3. The proposed facility could pose risk to avifauna in 5 main ways: collision with turbines; collision with or electrocution on power lines; habitat destruction during construction; disturbance during construction and operation; and displacement from the site once operational. A discussion of each species follows Table 7.

Note: In this context, risk does not equal significance. Risk to a species as described in this section can be High, but if that species is not Red Listed it is possible that the significance of impacts on the species could ultimately be Moderate (see Section 4).

Table 7. Final priority species for the consolidated Impofu Wind Farms site. In each case the species seasonal presence and a qualitative assessment of risk to each species is also presented.

Common name	Taylor *et al* 2015	TOPS list	IUCN 2017	Endemic /near	WI	SP	SU	AU	Kouga/Cumulative risk	Impofu East Wind Farms risk	Turbine collision risk	Power line electr. & collision risk	Habitat destr. risk	Disturbance risk	Displacement risk
Denham's Bustard	VU	P	NT		√	√	√	√	High	Moderate	Mod	High - collision	Mod	Mod	Mod
White-bellied Korhaan	VU		LC		√	√	√		High	Low	Low	Low	Low	Low	Low
Blue Crane	NT	EN	VU	E	√	√	√	√	High	Moderate	Mod	High - collision	Mod	Mod	Mod
Black Harrier	EN		EN	NE		√			High	Low	Low	Low	Low	Low	Low
African Marsh-Harrier	EN	P	LC		√	√	√	√	Moderate	High	High	Mod	Mod	Mod	Mod
Martial Eagle	EN	VU	VU		√		√	√	Moderate	Moderate	Low	Mod	High	High	High
African Fish-Eagle			LC		√	√	√	√	Moderate	Low	Low	Low	Low	Low	Low
Jackal Buzzard			LC	E	√	√	√	√	High	Moderate	High	Mod – collision	Mod	Mod	Mod
White Stork			LC		√		√		High	Moderate	Mod	High	Low	Low	Low

EN=Endangered; VU=Vulnerable; NT=Near-threatened; LC=Least Concern; P=Protected; E=Endemic; NE=Near-endemic.

WI=Winter; SP=Spring; SU=Summer; AU=Autumn

Denham's Bustard

The Denham's Bustard is classified as Vulnerable by Taylor *et al* (2015) and Near-threatened globally (IUCN 2017) and its population and range has decreased over the last few decades due to habitat destruction and disturbance. Allan & Anderson (2010) adjudged the Denham's Bustard to be the topmost priority amongst bustards for conservation attention, on account of it facing the widest range of known threats. This classification was too early to consider wind turbines as a threat but this new threat would have probably sealed the species' position at the top of the list. The southern African population of this species is estimated at < 5 000 birds (Allan 2003, in Hockey *et al*, 2005). In 1984 the Eastern Cape population was estimated at 100-200 birds (Brooke, 1984) and there does not appear to be a more recent provincial estimate. The Kouga area is to our knowledge the only area in the Eastern Cape where the species is abundant.

Denham's Bustard could be susceptible to five possible impacts: habitat destruction, disturbance, displacement and collision with turbine blades and power lines. At the operational Kouga Wind Farm, disturbance and displacement does not seem to have been significant (Strugnell 2016, 2017, Smallie 2018), since males are still displaying within 50 - 100m of operating turbines. It is however noted that any displacement of Denham's Bustard off the Kouga Wind Farm would have been to the west, and Impofu Wind Farms now poses a barrier to the west. There is a chance then that Denham's Bustard could be left with nowhere to go. In terms of collisions this species is well known to be vulnerable to collision with overhead power lines (for e.g. Shaw, 2009). Although an overhead cable is very different to a wind turbine blade, this does give us cause to believe that they could be at risk of collision with the turbines. To our knowledge only one turbine collision fatality has been recorded for this species at operational facilities to date at a wind farm in the Kouga area (Ralston-Paton *et al* 2017; pers obs). It does remain a concern though until bustards and turbines have coexisted for a while longer.

We recorded the species flying on Impofu Wind Farms consolidated site 77 (130 individual birds) times during the year. A total of 28 of these records (43 birds) were on the Impofu East site.

Based on the species' conservation status, the importance of this consolidated site as habitat, and its susceptibility to collision with overhead power lines, we consider this species to be at Moderate risk at this site.

White-bellied Korhaan

White-bellied Korhaan is classified as Vulnerable regionally (Taylor *et al*, 2015). This species has also undergone a reduction in population and range (Taylor *et al,* 2015). The Kouga area holds a localised strong population of these birds and concern has been expressed previously for the risk posed to the species by wind farms in this area (for e.g. Van Rooyen & Froneman, 2013). This species prefers longer grassland or pasture and is also found in Fynbos/Renosterveld and thicket. Habitat loss is once again

the primary threat to the species.

This species was believed likely to be susceptible to wind turbine collisions, but to date no fatalities have been recorded to our knowledge (Ralston-Paton *et al,* 2017; pers obs), although fatalities have been recorded for other korhaans (Blue *Eupodotis caerulescens* & Southern Black *Afrotis afra*) elsewhere in the country outside of the Kouga area.

We did not record this species flying on the Impofu Wind Farms site at all.

We consider this species to be at Low risk on the Impofu East Wind Farm site.

Blue Crane

The Blue Crane is classed as Near-threatened regionally by Taylor *et al* (2015) and Vulnerable globally (IUCN, 2017). It is almost endemic to South Africa (a small population exists in Namibia) and is our national bird. It has the most restricted range of any of the 15 crane species worldwide. The population is estimated at a minimum of 25 000 birds (Taylor *et al*, 2015).

This species is highly susceptible to collision with overhead power lines, and more recently has been recorded as turbine collision fatalities at at-least 3 operational wind farms in SA (pers obs, Ralston-Paton *et al* 2017). At one of these wind farms, in the Overberg of the Western Cape, Blue Crane abundance on site is high, and the relatively low number of fatalities recorded indicates that the species may be fairly adept at avoiding turbine collisions (pers obs). In the Kouga region 2 fatalities have been recorded at the Kouga Wind Farm.

We have recorded the species on site by all data collection methods. Most important of these is flying birds, of which we have 45 records of a total of 159 individual birds. Nine of these records (24 birds) were on Impofu East. We have not located any confirmed roost sites on the consolidated Impofu site to date, indicating that the birds may move further east each evening to the large known roosts at Soutvlei and Grasmere, or may roost only in small numbers on site.

Based on its' prevalence on site and high flight activity in combination with evidence that the species is fairly adept at avoiding collisions, this species is considered at Moderate risk.

Black Harrier

The conservation status of the endemic Black Harrier has recently been re-appraised across its' limited world distribution and been reclassified as Endangered in southern Africa and Globally as Vulnerable (Taylor *et al,* 2015; IUCN 2017). Fynbos destruction and fragmentation are known to be the main causes of decline, but limited genetic variation now add to the concern over this species. Additional

mortality factors due to operational wind farms (Smallie 2015; Ralston-Paton *et al*, 2017) in its tiny breeding range in South Africa mean that this species is now more threatened than ever.

Several wind turbine collision fatalities for this species have been recorded at a wind farm (within the Kouga area), demonstrating that the species is susceptible to collision in the Kouga area.

We have recorded this species flying twice on the Impofu Wind Farms site (both single birds in spring) and neither of the records was on Impofu East.

We do anticipate that it will be an occasional visitor to the consolidated site but it does not appear that the Impofu site provides preferred habitat. We consider this species to be at Low risk at Impofu East.

African Marsh-Harrier

African Marsh-Harrier is classified as Endangered regionally (Taylor *et al,* 2015) and Least Concern globally (IUCN 2017). It has undergone a significant reduction in population size and range in recent decades. This species is very dependent on wetlands, although it does also forage over pastures, grassland, arable lands and Fynbos/Renosterveld. The main threat it faces is habitat destruction, particularly that of wetlands.

We are not aware of any recorded fatalities for this species at operational wind farms to date (Ralston-Paton *et al*, 2017; pers obs).

We have recorded a total of 67 records of 68 birds on Impofu Wind Farms. Approximately half of these records (31 birds) were on the Impofu East Wind Farm.

We consider this species to be at High risk at Impofu East.

Martial Eagle

The Martial Eagle is classified as globally Vulnerable and regionally Endangered (Taylor *et al* 2015, IUCN 2017).

Martial Eagle has proven susceptible to collision with wind turbines (Ralston-Paton, Smallie, Pearson & Ramalho, 2017) particularly in close association with nests (MacEwan & Smallie, 2016; Simmons & Martins, 2016). Turbine collision fatalities have been recorded at a wind farm in the Kouga area.

This is a wide ranging species, which can best be protected from wind turbine collision risk close to its' breeding sites. A breeding site exists just north of the Impofu Wind Farms site as described in Section 3.3.

Despite the proximity of this nest we have recorded this species flying on the Impofu Wind Farms site only 5 times (5 birds) none of which was on Impofu East itself.

This species' general presence in the broader area; location of a breeding site 6km to the north of Impofu Wind Farms; conservation status; proven susceptibility to wind turbine collisions (and electrocution and collision on overhead power lines); are all factors which render it at high risk at a new wind farm in the area.

However given that we have already applied risk avoidance through the application of a 6km buffer around the nest site, and have not recorded the species flying on site, we conclude that it is at Moderate risk at Impofu East.

African Fish-Eagle

Although not Red Listed, this is a species to consider important for this assessment. It has proven susceptible to wind turbine collision elsewhere (Ralston-Paton *et al* 2017)(including at operational facilities in the Kouga area) and is likely to be resident at the Impofu Dam or higher up the river, at the Klipdrif Dam and possibly one or two of the other larger dams.

We recorded the species flying 12 times on Impofu Wind Farms (13 birds). None of these records were on Impofu East.

We conclude on that basis that this species will be at Low risk at Impofu East.

Jackal Buzzard

The Jackal Buzzard is a fairly common species throughout South Africa and on this site. It is a generalist in terms of habitat, although does favour shorter vegetation. It hunts mostly in flight, meaning that a large proportion of its time is spent flying, and thereby at some risk of collision with vertical obstacles.

Early observations on constructed wind farms under monitoring indicate that this species is highly susceptible to collision with turbines (pers obs; Ralston-Paton *et al,* 2017), including at operational wind farms in the Kouga area.

On the Impofu Wind Farms 78 records have been made of 98 birds. This includes 8 records of 8 birds on the Impofu East site.

We conclude that this species is at Moderate risk. Due to its relatively common status this anticipated risk does not carry as much significance as it would if the species were Red Listed. However concern is

growing for this species based on the number being killed at operational wind farms in SA.

White Stork

White Stork is a common to abundant species with a global population of 500 000 to 530 000 birds (Hockey *et al*, 2005). It is a summer migrant to South Africa, being present in the country from approximately October to March-May each year.

This species has been recorded as wind turbine fatalities at several operational facilities including facilities in the Kouga area (pers obs; Ralston-Paton *et al,* 2017). However, given the high number of birds and flight activity on these sites and relatively low numbers of fatalities we consider this species to be fairly adept at avoiding turbines whilst in flight.

We have recorded 215 individual birds flying on the Impofu Wind Farms site (120 records), of which 56 records or 111 birds were on Impofu East.

We conclude that the species will be at Moderate risk given its high levels of flight activity but apparent adeptness in avoiding collisions with turbines.

3.5 Existing avifaunal-wind energy impacts in the area

The Kouga area has four operational wind farms, the first of which was commissioned in approximately 2014. Table 8 presents information on the wind farms which are operational within the area.

Table 8. Other wind energy projects to be considered as part of the baseline environment (Aurecon).

Name	Status	# turbines
Kouga Wind Farm In The Kouga Local Municipality, Eastern Cape Province	Operational	32
Gibson Bay Wind Farm	Operational	37
Tsitsikamma Community Wind Energy Facility, Eastern Cape Province	Operational	31
Jeffrey's Bay Wind Energy Project, Kouga Local Municipality, Eastern Cape Province	Operational	60

Table 9 summarises what we know about the avifaunal impacts recorded to date at the four operational wind farms.

Destruction of habitat

This impact normally refers to the transformation of natural habitat. In this area however three of the key bird species (Blue Crane, Denham's Bustard, White-bellied Korhaan) are highly dependent on already transformed land in the form of crop lands and pastures. For this reason we have not distinguished between natural and transformed habitat for this analysis. Table 9 presents the information obtained from the 4 operational wind farms (only 2 of which reported habitat

transformation). An average of 1.26 hectares was transformed per turbine at these facilities when all habitat transformation is considered (for turbines, roads, substations, switching stations). This was established for each site through a combination of spatial information supplied by wind farm operators and manual digitisation of these features using aerial photography. If this is multiplied by the 160 operational turbines the result is a total of approximately 201.74 ha transformed by the four operational faciltiies.

Displacement of birds

No evidence of displacement of key species has been recorded at the four operational wind farms (various authors). We therefore conclude that this is not a significant risk for the consolidated Impofu Wind Farms as these species seem able to co-exist spatially with turbines (based on evidence at hand to date). This is of course not necessarily good news from the turbine collision perspective as birds co-existing with turbines in close proximity would be at higher collision risk than if they had been displaced away from turbines. We also note that as more wind farms are added to the area displacement effects may become greater. It is possible that species can tolerate a certain degree of intrusion into their area by turbines, but then reach a tipping point when more are added.

Disturbance of birds

Likewise no evidence of disturbance has been reported at the operational wind farms.

Direct mortality of birds through collision with turbines

At the four operational facilities a total of 160 turbines are operational and monitoring data is available for a combined total of 85 months (Table 9). During this period the following fatalities of priority species were recorded: 1 Denham's Bustard; 2 Blue Crane; 4 Black Harrier; 2 Martial Eagle; 2 African Fish-Eagle; 35 Jackal Buzzard; and 3 White Stork. Note that these are the number of fatalities unadjusted for searcher efficiency (% of carcasses found) and scavenger removal (rate at which carcasses are removed by scavengers and hence not found). Our experience is that with large bird species and raptors searcher efficiency is typically 100% and scavenger removal rate is very slow, so in our view these data do not require adjustment. No fatalities have been recorded for White-bellied Korhaan and African Marsh-Harrier. A total of 295 fatalities of all bird species were recorded. The vast majority of fatalities were of small passerine species. For some of these species these fatalities are very concerning. However a long term perspective is important as we have seen that these fatalities seem to often be clumped temporally. For example, the two Martial Eagle fatalities occurred in a space of 3 months despite there being no fatalities for 24 months prior and several months subsequently. Table 9 presents the fatality rates calculated from these data. Annual fatality rates were calculated as follows: at each facility, the number of fatalities were divided by number of months operating and multiplied by twelve to get an annual rate; these rates at each facility were summed to get a combined fatality rate for the four facilities. The calculated annual fatality rates for these priority species are as follows: 1.2

Denham's Bustard; 0.17 Blue Crane; 1.23 Black Harrier; 0.62 Martial Eagle; 1.31 African Fish-Eagle; 21.19 Jackal Buzzard; 1.62 White Stork; and 209.15 birds of all species (including the priority species).

These data represent the baseline for wind turbine bird fatalities in the study area.

Table 9. Summary of key baseline avifaunal impacts at existing wind farms in the Impofu Wind Farms study area.

	Kouga	Gibson Bay	Tsitsikamma	Jeffrey's Bay	Combined absolute	Combined Fat/year
Status	Operational	Operational	Operational	Operational		
Area transformed (ha)	16	n/a	n/a	100		
# Turbines.	32	37	31	60	160	
Months operational data	24	10	12	39	85	
ME Fat.	0	0	0	2	2	0.62
BC Fat.	2	0	0	0	2	0.17
DB Fat.	0	1	0	0	1	1.20
BH Fat.	0	0	0	4	4	1.23
AFE Fat.	0	0	1	1	2	1.31
WS Fat.	0	0	1	2	3	1.62
JB Fat.	13	1	9	12	35	21.19
All species fatalities	94	38	52	111	295	209.15

ME=Martial Eagle, BC=Blue Crane; DB=Denham's Bustard; BH=Black Harrier; AFE=African Fish-Eagle; WS=White Stork; JB=Jackal Buzzard

3.6 Avifaunal sensitivity of the site

The "Avian Wind Farm Sensitivity map for South Africa (Retief *et al,* 2011) and the Important Bird & Biodiversity Areas programme data (IBBA - Marnewick *et al*, 2015) were consulted to determine the sensitivity of the Impofu Wind Farms site in national terms. Figure 21 shows that the site falls between the lowest and second lowest sensitivity category in terms of avifauna (darker colours indicate higher risk), although the scores were based on the first atlas project data as the second bird atlas data was inadequate at that point. For a full discussion on the methods used in producing this map see Retief *et al* (2011, 2014). The site does not fall within any IBBA's (Marnewick *et al*, 2015). The closest IBBA's are approximately 31km north (Kouga-Baviaans) and 31km west (Tsitsikamma National Park). These were considered far enough away to not be discussed any further.

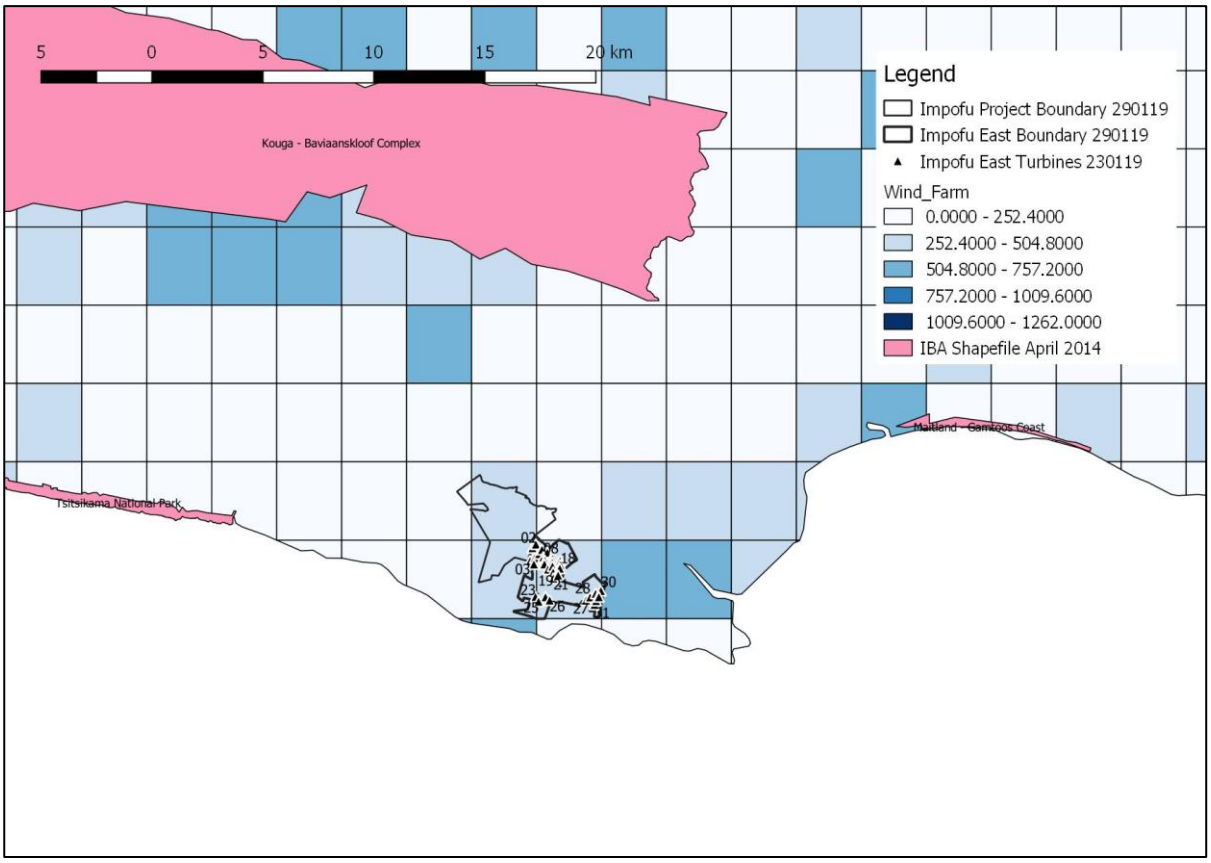

Figure 21. The position of the Impofu Wind Farms relative to the Avian wind farm sensitivity map (Retief *et al*, 2011)(Darker colours indicate higher avifaunal sensitivity) & Important Bird & Biodiversity Areas (Marnewick *et al* 2015).

On a national level, the Kouga area has been identified previously as an important stronghold for 3 large terrestrial bird species: Blue Crane; Denham's Bustard; and White-bellied Korhaan (for e.g. Van Rooyen & Froneman 2013). Furthermore, these species were identified as warranting a strategic study (by Van Rooyen & Froneman 2013) on the basis of their expected susceptibility to habitat destruction and turbine collision. The importance of the consolidated Impofu Wind Farms site for these species within the Kouga area would however appear on the basis of our data to be lower than the more eastern parts of the Kouga area. Figure 22 shows the sensitivity map for these 3 species (combined) compiled by Van Rooyen *et al* (2013) superimposed on the Impofu East site boundary. The highest risk areas are clearly east of the Impofu East Wind Farms site. Isolated areas of high risk exist to the south of turbines on Impofu East, around Turbines 29 and 30.

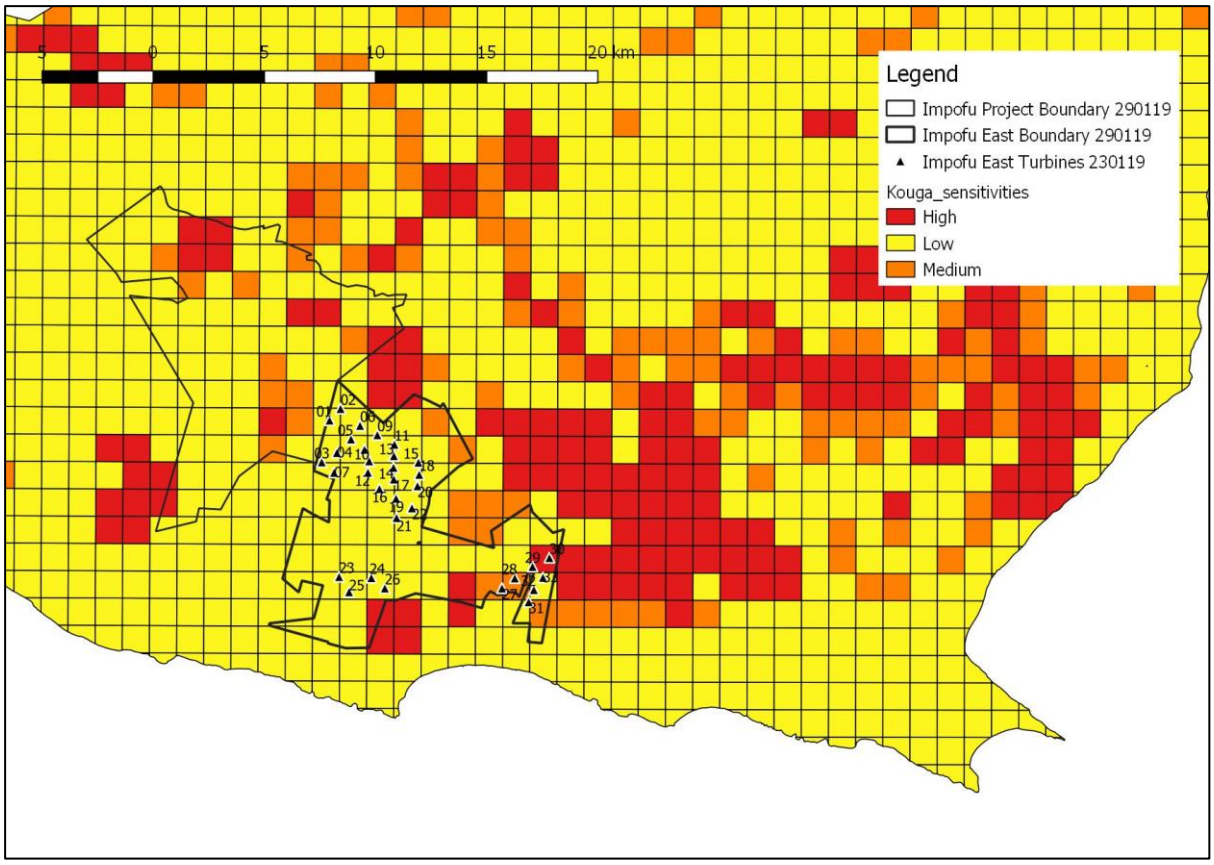

Figure 22. The sensitivity map for Denham's Bustard, Blue Crane & White-bellied Korhaan (Van Rooyen *et al,* 2013) relative to the Impofu East Wind Farm boundary. (darker colours indicate higher risk).

Overall then it is our opinion that the proposed site falls in an area of Low to Moderate sensitivity on a national scale.

The on site sensitivity was assessed during the project design phase and considered: wetlands and associated drainage lines/streams; dams; mini gorges; Fynbos/Renosterveld; and the Martial Eagle nest. All of these aspects were avoided during the design phase.

4. IMPACT ASSESSMENT

4.1 Avifaunal risk avoidance already implemented

The avoidance of avifaunal risk at Impofu Wind Farms has been an iterative process resulting from ongoing communication between specialists, the developer and the EAP. The degree to which mitigation or avoidance can make a material difference to avifaunal risk at a wind farm is higher earlier in the project. In the case of Impofu Wind Farms most avifaunal risk avoidance has already been accepted and implemented by the developer at the time the layout was presented for assessment in the scoping report. Further changes were then made prior to this EIA Phase report. The various avoidance measures already applied are therefore described here, in order to ensure that this is understood:

- The adaptation of the first turbine layout to accommodate wetlands and dams, in particular a large precautionary buffer (600m) around Impofu Dam (early 2017).
- The acceptance of 30m above ground as the lowest that the lower tip of the proposed turbine blades can be (early 2017).
- The sensitive features on site such as: wetlands and associated drainage lines/streams; dams; mini gorges; Fynbos/Renosterveld; and the Martial Eagle nest (late 2017, early 2018).
- The internal screening phase input supplied to Aurecon prior to scoping (late 2017).
- The Martial Eagle nest described earlier in this report (late 2017). These eagles would be at risk of collision with turbines, collision and electrocution on overhead power lines, disturbance of breeding, displacement and habitat destruction if the wind farm was built too close to this nest site. In order to mitigate these risks we identified a No-Go buffer area around the nest of 6km radius. To determine the size of this buffer we consulted the most recent and comprehensive tracking based study of Martial Eagle breeding ecology that we are aware of (Van Eeden *et al,* 2017). This study was conducted in the Kruger National Park and determined a mean (n=6) home range size of 108km² implying a home range radius of 6km if a circular home range is assumed.
- The reduction in turbine numbers from 41 to 33 between scoping and EIA phase (January 2019). Although this reduction was primarily on the basis of bat information it did also result in benefits to birds. This is most evident in the estimated turbine collision fatality rates for priority bird species (Section 3.3.6), which have been reduced by approximately 40% by the reduction in turbine numbers.

The avifaunal sensitivity map is presented in Figure 23.

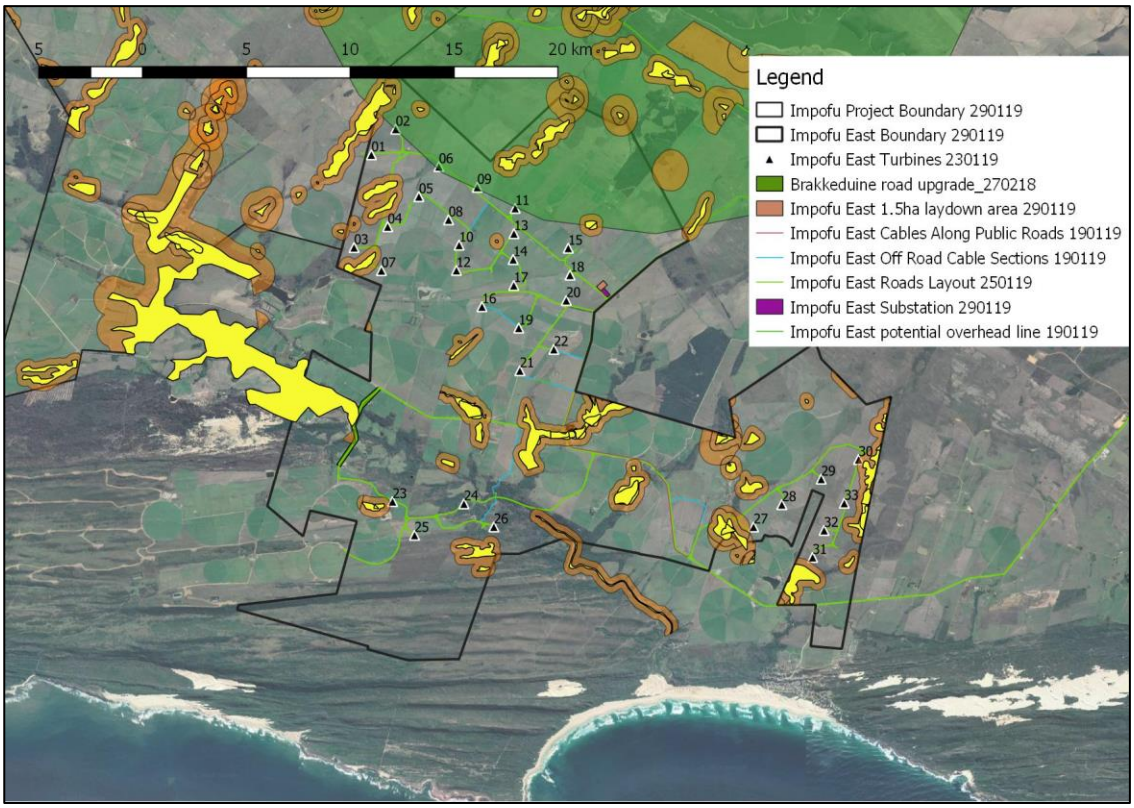

Figure 23. Avifaunal sensitivity map for Impofu East Wind Farm.

4.2 Impacts of the Impofu East Wind Farm on birds

Using the data and risk assessment for each species described in Section 3 as the basis, the potential impacts of the proposed Impofu East Wind Farm have been formally assessed and rated according to the criteria (supplied by Aurecon and shown in Appendix 3). Tables 10 to 16 present these assessments.

Habitat destruction

Based on the average of 1.26 hectares per turbine of land that has been transformed on the operational wind farms in this area, and using the maximum of 95 turbines to be constructed over the consolidated wind farms we estimate that apprixmately 119.7ha of land will be transformed for roads, turbines, hard stands, switching station, electrical cables at the consolidated Impofu Wind Farms. If one looks at the full 11 838 ha of land signed up for these wind farms this works out at 1% of the total land being transformed. At Impofu East Wind Farm, approximately 41.6ha would be affected. Given the importance of arable lands for key bird species (Denham's Bustard, Blue Crane, White-bellied Korhaan, White Stork) avoiding the other sensitive habitats does not fully mitigate the significance of this impact. We judge this impact to be of Low to Moderate negative significance.

Mitigation

- An avifaunal walk down should be conducted to confirm final layout and identify any sensitivities that may arise between the EIA and construction.
- All construction activities should be strictly managed according to generally accepted environmental best practice standards, so as to avoid any unnecessary impact on the receiving environment.

Table 10. Assessment of destruction of bird habitat during the construction phase.

Project phase	**Construction**			
Impact	**Destruction of bird habitat**			
Description of impact	**Areas previously available to birds as habitat are transformed into roads, hard stands, turbines, offices, substations and are no longer useful to birds**			
Mitigatability	Low	Mitigation does not exist; or mitigation will slightly reduce the significance of impacts		
Potential mitigation	**Avoidance already applied. Avifaunal walk through for final layout. General environmental best practice standards at construction**			
Assessment	**Without mitigation**		**With mitigation**	
Nature	Negative		Negative	
Duration	Permanent	Impact may be permanent, or in excess of 20 years	Permanent	Impact may be permanent, or in excess of 20 years
Extent	Limited	Limited to the site and its immediate surroundings	Limited	Limited to the site and its immediate surroundings
Intensity	Moderate	Natural and/ or social functions and/ or processes are moderately altered	Moderate	Natural and/ or social functions and/ or processes are moderately altered
Probability	Certain / definite	There are sound scientific reasons to expect that the impact will definitely occur	Certain / definite	There are sound scientific reasons to expect that the impact will definitely occur
Confidence	High	Substantive supportive data exists to verify the assessment	High	Substantive supportive data exists to verify the assessment
Reversibility	High	The affected environmental will be able to recover from the impact	High	The affected environmental will be able to recover from the impact
Resource irreplaceability	Low	The resource is not damaged irreparably or is not scarce	Low	The resource is not damaged irreparably or is not scarce
Significance	**Moderate - negative**		**Moderate - negative**	
Comment on significance	Comfortable with finding of Moderate, but would also be happy with Low-Moderate if that category was available.			
Cumulative impacts	See section 4.2			

Disturbance of birds during construction and decommissioning

The avoidance measures already taken to protect the Martial Eagle nest and territory have reduced the significance of this impact to Negligible negative significance.

Mitigation

- An avifaunal walk down should be conducted to confirm final layout and identify any sensitivities that may arise between the EIA and construction.
- Monitoring of breeding status of Martial Eagles should be conducted in all breeding seasons post acceptance of the project as preferred bidder (to establish baseline) and including during and post construction.

- All construction and decommissioning activities should be strictly managed according to generally accepted environmental best practice standards, so as to avoid any unnecessary impact on the receiving environment.

Table 11. Assessment of disturbance of birds during construction and decommissioning.

Project phase	**Construction**			
Impact	**Disturbance of birds**			
Description of impact	**Breeding birds disturbed by human, vehicular & machinery activity on site, including noise and vibration. Breeding productivity reduced, or breeding fails or breeding site abandoned.**			
Mitigatability	Low	Mitigation does not exist; or mitigation will slightly reduce the significance of impacts		
Potential mitigation	**Avoidance already applied. One sensitive species breeding site has been located - the Martial Eagle nest, and 6km no go buffer applied. Recommend monitoring of breeding status at this nest in all breeding seasons prior to and during construction, once project achieves preferred bidder. Avifaunal walk through of final layout should confirm no new new sensitive species breeding sites.**			
Assessment	**Without mitigation**		**With mitigation**	
Nature	Negative		Negative	
Duration	Permanent	Impact may be permanent, or in excess of 20 years	Permanent	Impact may be permanent, or in excess of 20 years
Extent	National	Impacts felt at a national level	National	Impacts felt at a national level
Intensity	Low	Natural and/ or social functions and/ or processes are somewhat altered	Low	Natural and/ or social functions and/ or processes are somewhat altered
Probability	Rare / improbable	Conceivable, but only in extreme circumstances, and/or might occur for this project although this has rarely been known to result elsewhere	Rare / improbable	Conceivable, but only in extreme circumstances, and/or might occur for this project although this has rarely been known to result elsewhere
Confidence	High	Substantive supportive data exists to verify the assessment	High	Substantive supportive data exists to verify the assessment
Reversibility	High	The affected environmental will be able to recover from the impact	High	The affected environmental will be able to recover from the impact
Resource irreplaceability	Medium	The resource is damaged irreparably but is represented elsewhere	Medium	The resource is damaged irreparably but is represented elsewhere
Significance	**Negligible - negative**		**Negligible - negative**	
Comment on significance	Comfortable with finding of negligible significance			
Cumulative impacts	See section 4.2			

Disturbance of birds during operations

The indications from operational wind farms are that this impact may be of fairly low importance, although it is acknowledged that a longer term or more detailed means of measuring this impact may be required. For Impofu East we consider this impact to be of Minor negative significance.

Mitigation

- None required.

Table 12. Assessment of disturbance of birds during operations.

Project phase	**Operation**			
Impact	**Disturbance of birds**			
Description of impact	**Breeding birds disturbed by human, vehicular & machinery activity on site. Breeding productivity reduced, or breeding fails or breeding site abandoned.**			
Mitigatability	Low	Mitigation does not exist; or mitigation will slightly reduce the significance of impacts		
Potential mitigation	**Avoidance already applied. One sensitive species breeding site has been located - the Martial Eagle nest.**			
Assessment	**Without mitigation**		**With mitigation**	
Nature	Negative		Negative	
Duration	Permanent	Impact may be permanent, or in excess of 20 years	Permanent	Impact may be permanent, or in excess of 20 years
Extent	National	Impacts felt at a national level	National	Impacts felt at a national level
Intensity	Low	Natural and/ or social functions and/ or processes are somewhat altered	Low	Natural and/ or social functions and/ or processes are somewhat altered
Probability	Unlikely	Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur	Unlikely	Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur
Confidence	Medium	Determination is based on common sense and general knowledge	Medium	Determination is based on common sense and general knowledge
Reversibility	Low	The affected environment will not be able to recover from the impact - permanently modified	High	The affected environmental will be able to recover from the impact
Resource irreplaceability	Medium	The resource is damaged irreparably but is represented elsewhere	Medium	The resource is damaged irreparably but is represented elsewhere
Significance	**Minor - negative**		**Minor - negative**	
Comment on significance	Comfortable with Minor significance			
Cumulative impacts	See section 4.2			

Displacement of birds during operational phase

As for disturbance above, the indications from operational wind farms are that this impact may be of fairly low importance, although it is acknowledged that a longer term or more detailed means of measuring this impact may be required. For Impofu East we consider this impact to be of Negligible negative significance after the avoidance measures already implemented.

Mitigation

- An avifaunal walk down should be conducted to confirm final layout and identify any sensitivities that may arise between the EIA and construction.
- Monitoring of breeding status of Martial Eagles should be conducted in all breeding seasons post acceptance of the project as preferred bidder (to establish baseline) and including during and post construction.
- All construction activities should be strictly managed according to generally accepted environmental best practice standards, so as to avoid any unnecessary impact on the receiving environment.

Table 13. Assessment of displacement of birds during operations.

Project phase	**Operation**			
Impact	**Displacement of birds**			
Description of impact	**Birds displaced from the site thereby losing that area for their foraging, roosting, breeding etc**			
Mitigatability	Low	Mitigation does not exist; or mitigation will slightly reduce the significance of impacts		
Potential mitigation	**Avoidance already applied. One sensitive species breeding site has been located - the Martial Eagle nest, and 6km no go buffer applied. Recommend monitoring of breeding status at this nest in all breeding seasons prior to and during construction, once project achieves preferred bidder. Avifaunal walk through of final layout should confirm no new new sensitive species breeding sites.**			
Assessment	**Without mitigation**		**With mitigation**	
Nature	Negative		Negative	
Duration	Permanent	Impact may be permanent, or in excess of 20 years	Permanent	Impact may be permanent, or in excess of 20 years
Extent	Limited	Limited to the site and its immediate surroundings	Limited	Limited to the site and its immediate surroundings
Intensity	Very low	Natural and/ or social functions and/ or processes are slightly altered	Very low	Natural and/ or social functions and/ or processes are slightly altered
Probability	Unlikely	Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur	Unlikely	Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur
Confidence	Low	Judgement is based on intuition	Low	Judgement is based on intuition
Reversibility	High	The affected environmental will be able to recover from the impact	High	The affected environmental will be able to recover from the impact
Resource irreplaceability	Low	The resource is not damaged irreparably or is not scarce	Low	The resource is not damaged irreparably or is not scarce
Significance	**Negligible - negative**		**Negligible - negative**	
Comment on significance	Comfortable with the finding of negligible significance			
Cumulative impacts	See section 4.2			

Turbine collision fatalities

Human caused fatalities of Red listed or otherwise threatened bird species are always cause for concern and should be avoided as far as possible. The estimated fatalities we have predicted are therefore cause for concern. There are currently no established thresholds for acceptable impacts on bird species in South Africa. To establish these thresholds would require complex modelling incorporating accurate information on many factors for each species (including population size, age specific fatality rates, breeding productivity etc). Such modelling and information is not available in South Africa at present. In the absence of this information we are forced to make a subjective finding as to the acceptability of the above estimated estimates.

In order to assess the importance of the fatality impacts for the relevant bird species it is necessary to estimate the population size within the study area for each species, the importance of this population, and its distribution in the study area relative to the proposed wind farms. This exercise is fraught with assumptions as no accurate source of population information is available for most relevant species. We have made the estimates as transparent as possible so that our assumptions are clear. Table 14 summarises this information for the priority bird species and presents the final estimated population sizes. The significance of turbine collision fatality impacts on this local population for the species overall is judged in each case. The significance is Moderate for six species: Denham's Bustard; Blue Crane; African Marsh-Harrier; Martial Eagle; Jackal Buzzard and White Stork. The reduction in turbine numbers from 41 in the scoping phase to 33 in the EIA phase is not sufficient to reduce this categorical rating to Low significance.

Table 14. Population estimates for the priority species in the study area.

Species	Regional status	Regional population (Taylor *et al* 2015)	Area of Occupancy (Taylor *et al*, 2015) (km²)	Area study area represents (%)	Estimated study area population (30km radius)	Significance of turbine collision fatalities at Impofu East Wind Farm	Basis for estimate
Denham's Bustard	EN	<10 000 adults, >5% of global popn.	117451	2.75	300	Moderate	Taylor *et al*, 2015; CAR; monitoring data
White-bellied Korhaan	VU	<10 000 adults, >5% of global popn.	67249	4.81	480	Low – no flights recorded	Taylor *et al,* 2015; CAR; monitoring data
Blue Crane	NT, endemic	25 500 adults	300546	1.08	250	Moderate	Taylor *et al*, 2015; CAR; monitoring data
Black Harrier	EN,endemic	<1000 adults, majority of global popn.	174886	1.85	3 br prs, roost of 30	Low	Simmons 2017, Walton pers com.
African Marsh-Harrier	VU	<2 500 adults, >5% of global popn.	n/a	n/a	10 br prs	Moderate	Other projects reports, rough estimate

Species	Regional status	Regional population (Taylor *et al* 2015)	Area of Occupancy (Taylor *et al*, 2015) (km²)	Area study area represents (%)	Estimated study area population (30km radius)	Significance of turbine collision fatalities at Impofu East Wind Farm	Basis for estimate
Martial Eagle	EN	800 adults, >5% of global range	272647	1.19	5br pr/10 adults, 3 floaters	Moderate	2 known nests 20km apart, assuming a similar inter nest distance throughout, an additional 3 nests could exist
African Fish-Eagle	Least concern	Unknown, global is 100 000 -200 000 pairs	n/a	n/a	15 br prs	Low	Estimate based on available large dams, rivers, estuaries
Jackal Buzzard	Least concern, Endemic	n/a	n/a	n/a	100 br prs, 30 floaters	Moderate	1 pr/30km² in W Cape most similar habitat, Hockey *et al* 2005
White Stork	Not considered of cons. concern	Unknown, global is 500 000 - 520 000 birds, South Africa 25 500 birds	n/a	n/a	1500	Moderate	Hockey *et al*, 2005

Avoidance measures imposed during the design phase have reduced the significance of this impact to Moderate but not lower.

Mitigation

- An avifaunal walk down should be conducted to confirm final layout and identify any sensitivities that may arise between the EIA and construction.
- Given that the impact of bird collision with turbines could occur once the wind farm is operational and require mitigation, we recommend strongly that an appropriate mitigation budget be provided for by the developer. At this stage it is not possible to determine what mitigation may be appropriate, and in the time between writing this report and the mitigation need arising (likely several years) new mitigation methods may be developed. However if such a need arises and suitable mitigation is identified it cannot be argued by the wind farm operator that mitigation was not budgeted for. Mitigation could cost the operator either in the form of additional costs or lost productivity as a result of changes to turbine operations. We suggest proceeding as follows in terms of budgeting:
    - Operational Year 1: R 0.00 - no mitigation budget required as operational phase data would still need to be collected and impacts detected and measured.

- Operational Year 1 & 2: – R500 000.00 per annum (subject to 6% escalation p.a. from 2018 to the relevant year) – likely to cover mitigation that is preliminary, research based or experimental in nature.
- Operational Year 3 to 5: R 500 000.00 per annum (subject to 6% escalation p.a. from 2018 to the relevant year) for implementation of full mitigation
- Operational Year 6 onwards: -unknown – to be determined by prior 5 years.
- Any of the above budget not used in the relevant year must be kept aside and available up to and including Year 10.

» If Blue Crane turbine or power line collision fatalities occur as a result of livestock feeding points once the facility is operational this will need to be mitigated, probably by restricting farmers from feeding too close (200-300m) to turbines and power lines or by covering/ obstructing the feeding points in some way that prevents the birds from easily feeding from them (as was done successfully with fence wires at in the Overberg area for feeding points for sheep). Landowners should be made aware of this possibility at the outset of the project.

Table 15. Assessment of bird collision with turbine blades during operations.

Project phase	**Operation**			
Impact	**Bird fatality through collision with turbine blades**			
Description of impact	**Birds in flight collide with turbine blades and are killed or injured**			
Mitigatability	Low	Mitigation does not exist; or mitigation will slightly reduce the significance of impacts		
Potential mitigation	**Avoidance applied already. Provide mitigation contingency budget for operational phase as described in report above. Avifaunal walk down of final layout**			
Assessment	**Without mitigation**		**With mitigation**	
Nature	Negative		Negative	
Duration	Permanent	Impact may be permanent, or in excess of 20 years	Permanent	Impact may be permanent, or in excess of 20 years
Extent	National	Impacts felt at a national level	National	Impacts felt at a national level
Intensity	Moderate	Natural and/ or social functions and/ or processes are moderately altered	Moderate	Natural and/ or social functions and/ or processes are moderately altered
Probability	Likely	The impact may occur	Likely	The impact may occur
Confidence	High	Substantive supportive data exists to verify the assessment	High	Substantive supportive data exists to verify the assessment
Reversibility	Medium	The affected environment will only recover from the impact with significant intervention	Medium	The affected environment will only recover from the impact with significant intervention
Resource irreplaceability	Medium	The resource is damaged irreparably but is represented elsewhere	Medium	The resource is damaged irreparably but is represented elsewhere
Significance	**Moderate - negative**		**Moderate - negative**	
Comment on significance	Comfortable with above finding of Moderate significance			
Cumulative impacts	See section 4.2			

Collision and electrocution on overhead power line and in substation/switching station

These impacts have the potential to be of Minor negative significance pre mitigation, but are relatively easily mitigated to Negligible negative significance.

Mitigation

- An avifaunal walk down should be conducted to confirm final layout and identify any new sensitivities.
- Overhead conductors or earth wires should be fitted with an Eskom approved anti bird collision line marking device to make cables more visible to birds in flight and reduce the likelihood of collisions.
- Pylons or poles must be designed according to Eskom approved bird friendly designs to ensure that perching large birds cannot be electrocuted.

Table 16. Assessment of bird collision & electrocution on overhead power lines & in substation & switching station.

Project phase	**Operation**			
Impact	**Bird collision & electrocution on overhead power lines (& at substation)**			
Description of impact	**Birds in flight collide with overhead cables and are killed or injured. Birds perching on pylons are electrocuted and killed.**			
Mitigatability	High	Mitigation exists and will considerably reduce the significance of impacts		
Potential mitigation	**Overhead conductors or earth wires fitted with anti bird collision line marking devices to make cables more visible to birds. Pylons built according to Eskom approved bird friendly design so that perching birds cannot bridge critical clearances. Avifaunal walk down of final layout**			
Assessment	**Without mitigation**		**With mitigation**	
Nature	Negative		Negative	
Duration	Permanent	Impact may be permanent, or in excess of 20 years	Permanent	Impact may be permanent, or in excess of 20 years
Extent	National	Impacts felt at a national level	National	Impacts felt at a national level
Intensity	Low	Natural and/ or social functions and/ or processes are somewhat altered	Low	Natural and/ or social functions and/ or processes are somewhat altered
Probability	Probable	The impact has occurred here or elsewhere and could therefore occur	Rare / improbable	Conceivable, but only in extreme circumstances, and/or might occur for this project although this has rarely been known to result elsewhere
Confidence	High	Substantive supportive data exists to verify the assessment	High	Substantive supportive data exists to verify the assessment
Reversibility	Low	The affected environment will not be able to recover from the impact - permanently modified	Low	The affected environment will not be able to recover from the impact - permanently modified
Resource irreplaceability	High	The resource is irreparably damaged and is not represented elsewhere	High	The resource is irreparably damaged and is not represented elsewhere
Significance	**Minor - negative**		**Negligible - negative**	
Comment on significance	Agree with above significance.			
Cumulative impacts	See section 4.2			

4.3 Cumulative Impacts of wind energy facilities on birds in this area

A cumulative impact, in relation to an activity, means the past, current and reasonable foreseeable future impact of an activity, considered together with the impact of activities associated with that activity, that in itself may not be significant, but may be significant when added to the existing and reasonable foreseeable impacts eventuating from similar or diverse activities (as defined by NEMA EIA Reg 1).

It was agreed between Aurecon and DEA that: Those wind farms already operational in the Kouga area would be considered as part of the baseline (see Section 3.5); and those proposed wind farms and their associated transmission lines, with a valid Environmental Authorisation (EA), within a 30 km radius of the Impofu Wind Farms site will be included in the assessment of cumulative impacts. Table 17 and Figure 24 show the details of the operational and authorised wind farms in the area.

Table 17. Other wind energy projects to be considered in the cumulative assessment (Aurecon).

Name	Status	# turbines
Kouga Wind Farm In The Kouga Local Municipality, Eastern Cape Province	Operational	32
Gibson Bay Wind Farm	Operational	37
Tsitsikamma Community Wind Energy Facility, Eastern Cape Province	Operational	31
Jeffrey's Bay Wind Energy Project, Kouga Local Municipality, Eastern Cape Province	Operational	60
Oyster Bay, Kouga Local Municipality, Eastern Cape	Approved and Preferred Bidder	41
Ubuntu Wind Energy project near Jeffreys Bay, Eastern Cape*	Approved	50
Banna Ba Pifhu Windfarm Project near Humansdorp, Eastern Cape DEA	Approved	17

* This is a worst case scenario as it is unlikely that Ubuntu wind farm will have a valid EA after June this year. The reason for this is that after the Ubuntu Wind Energy project was approved it was found that there were high numbers of Black Harriers present on the site around the proposed turbine positions at certain times of year, which is not mitigatable. Thus the cumulative numbers presented below are likely to be inflated given that the Ubuntu Wind Farm makes up 46% of the additional turbines potentially added by wind farms with approved EA's in the area.

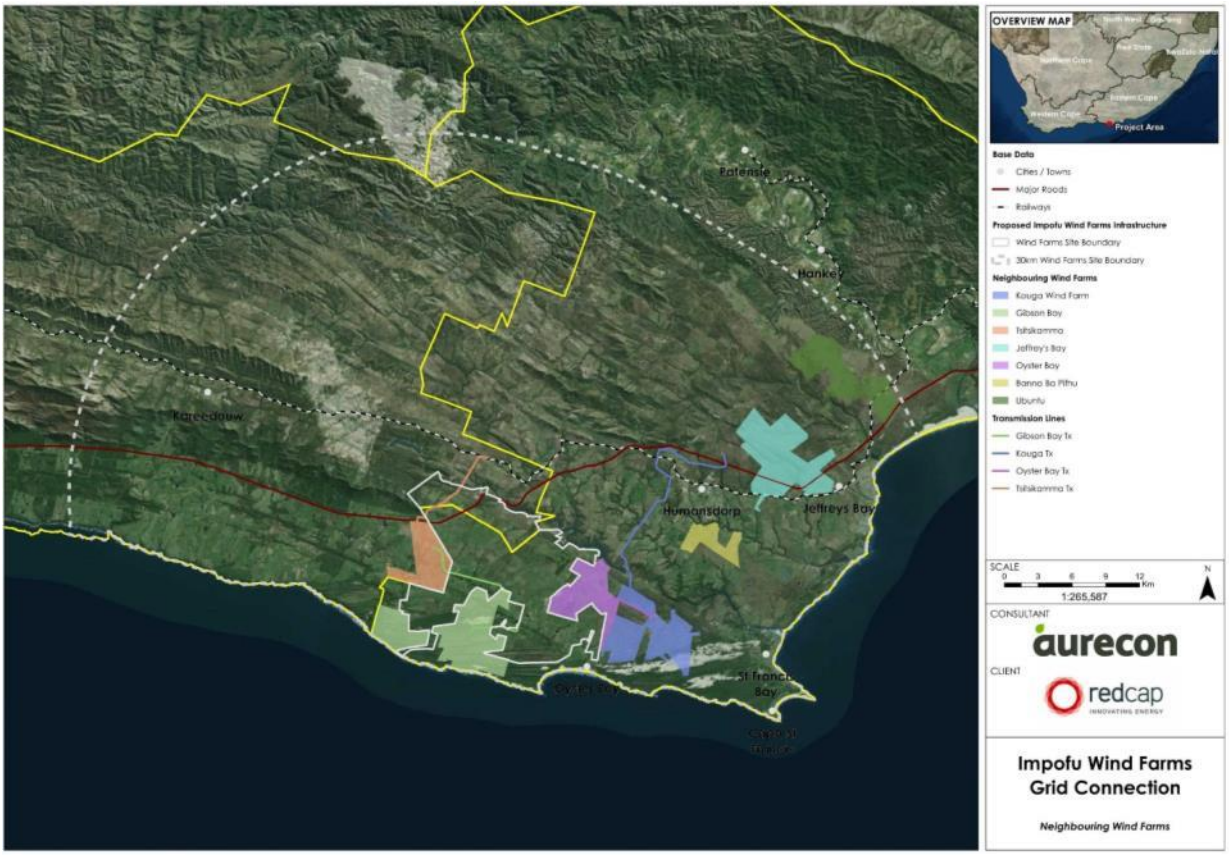

Figure 24. Identified projects relevant to the cumulative assessment at Impofu Wind Farms (Aurecon).

It was further stipulated by Aurecon that 2 cumulative scenarios would be assessed, as depicted in Figure 25. Scenario 1 would assess the baseline plus the three Impofu Wind Farms; and Scenario 2 would assess the baseline plus the three Impofu Wind Farms plus the 3 authorised wind farms (Banna ba Pifhu, Oyster Bay and Ubuntu).

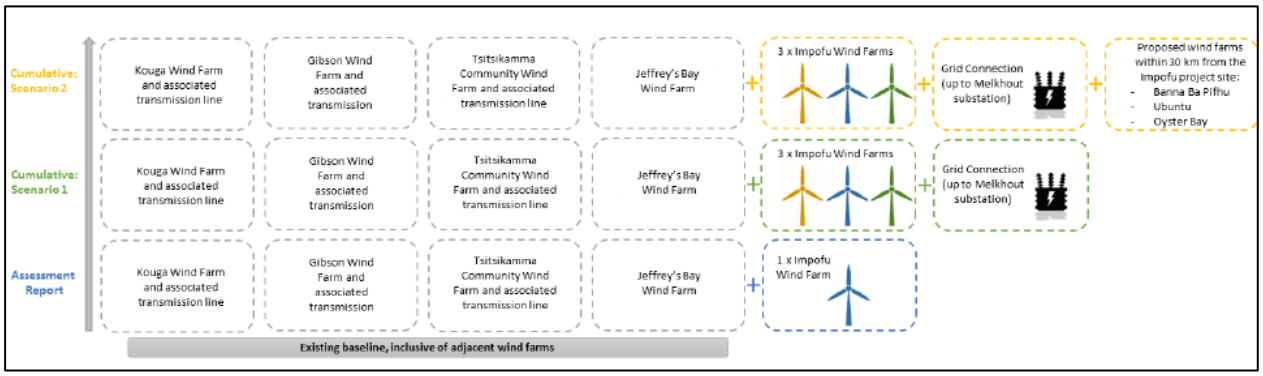

Figure 25. The two cumulative assessment scenarios as supplied by Aurecon.

Furthermore, the cumulative impacts of wind energy on avifauna in the Kouga area have been assessed according to the guidance in the DEA (DEAT (2004) Cumulative Effects Assessment, Integrated Environmental Management, Information Series 7, Department of Environmental Affairs and Tourism

(DEAT), Pretoria); and the IFC guidelines (Good Practice Handbook - Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets". Specifically, the steps to be undertaken in the cumulative impact assessment section of the study will be as follows:

1. Define and assess the impacts of the Impofu Wind Farms project.
2. Identify and obtain details for all operational and authorised overhead power lines and wind farms (within 30km radius of Impofu Wind Farms).
3. Identify impacts of the proposed Impofu Wind Farms which are also likely or already exist at the other projects.
4. Obtain reports and data for other projects.
5. As far as possible quantify the effect of all projects on key bird species local populations (will need to be defined and estimated).
6. Express the likely impacts associated with the Impofu Wind Farms project as a proportion of the overall impacts on key species.
7. A reasoned overall opinion will be expressed on the suitability of the proposed development against the above background (i.e. whether the receiving environment can afford to accommodate additional similar impacts). This will include a cumulative impact assessment statement.
8. The decision making process with respect to the above will be clearly documented in the report.

4.3.1. Scenario 1: Operational four wind farms plus Impofu Wind Farms (three wind farms)

Destruction & alteration of habitat

We have found (Section 3.5) that approximately 201.7 ha of habitat was transformed by the four operational facilities. In our view this is relatively small amount of habitat transformation given the scale of the projects and amount of energy production. In addition, since these species are using transformed habitat which is not particularly unique or limited in this area, this reduces the significance of this effect. In Section 4.2 we have estimated that the consolidated Impofu Wind Farms will transform approximately 119.7ha. We concluded that habitat destruction at Impofu Wind Farms is of Low to Moderate significance. The effect of large dispersed infrastructure projects such as wind farms on birds is likely to be far more complex through factors such as habitat fragmentation, disruption of territories and other factors. These effects have however proven extremely difficult to measure. In order to apply a cautious approach we conclude that the overall cumulative significance of habitat destruction in this area by wind farms is Moderate, and that the contribution by Impofu Wind Farms to this impact is Low to Moderate.

Displacement of birds from the site.

No displacement impacts have been recorded at the operational wind farms. We have concluded in Section 4.2 that this impact will be of Negligible negative significance. Overall we conclude then that the cumulative impact of displacement of birds by wind farms in the Kouga area is of Low significance and the contribution to this by Impofu Wind Farms is Low.

Disturbance of breeding during construction and/or operations.

Similarly to above for displacement, we conclude that the cumulative impact of displacement of birds by wind farms in the Kouga area is of Low significance and the contribution to this by Impofu Wind Farms is Low.

Direct mortality of birds through collision with turbines.

Section 3.5 has described the turbine collision fatality rates recorded at the four operational wind farms to date. Table 18 presents the *actual* turbine fatality rates for the four operational wind farms plus the *predicted* fatality rates for Impofu Wind Farms (calculated in Section 3.3.6 – Table 6) for priority bird species (nine species – see Table 18). Assuming that the fatality rates at the operation wind farms remain constant each year (which in itself is unlikely) these four operational sites are responsible for 30.07 fatalities per year of the priority species. Impofu Wind Farms (all 3 sites) would add an estimated 17.19 birds to bring the cumulative total fatalities of priority species to 47.26 birds per year. Impofu Wind Farms' fatalities amount to 36.37% of the cumulative total fatalities, whilst the operational sites' contribution is 63.63%. Of the 47.26 fatalities approximately half are non Red Listed bird species (Jackal Buzzard, African Fish-Eagle and White Stork). The remainder is comprised most importantly of 5.04 Denham's Bustards, 5.7 Blue Cranes, 1.29 Black Harriers and 2.01 African Marsh-Harriers per year.

Based on these figures we conclude that the cumulative turbine collision impact of wind farms on the priority bird species in the Kouga area is High. The contribution by Impofu Wind Farms to the cumulative impact is High if all 3 wind farms are built but this is the worst case scenario as detailed below.

In addition to the above presented data, factors we have considered in making this conclusion, and which indicate why we think it is the worst case scenario, include:

- This analysis does not take account of the avoidance measures already implemented at Impofu Wind Farms, which would reduce collision fatalities. For example, the only 2 Martial Eagles that have been killed in the area by wind turbines were at the same wind farm (meaning the other 3 operational wind farms had no fatalities of the species), where a nest is present in the middle of the wind farm, with turbines as close as 1km to the nest. The remaining 3 operational wind

farms which had no known nests close to them killed no eagles. At Impofu Wind Farms we have applied a 6km buffer around the known nest and believe that this places the wind farm in line with the 3 sites where no fatalities have occurred.

- Our experience across multiple operational wind farms has been that actual fatality rates are lower than those predicted during impact assessment.

When the above four impacts (Habitat destruction – Low to Moderate; Displacement – Low; Disturbance – Low; Turbine collision – High) are combined **the overall significance of the cumulative impact of wind farms on birds (Scenario 1) in this area is Moderate.**

4.3.2. Scenario 2: Operational four wind farms plus Impofu Wind Farms (three) plus three authorised wind farms

Destruction & alteration of habitat

We have found (Section 3.5) that approximately 201.7 ha of habitat was transformed by the four operational facilities. In our view this is relatively small amount of habitat transformation given the scale of the projects and amount of energy production. In addition, since these species are using transformed habitat which is not particularly unique or limited in this area, this reduces the significance of this effect. In Section 4.2 we have estimated that Impofu Wind Farms will transform approximately 119.7ha. We concluded that habitat destruction at Impofu Wind Farms is of Low to Moderate significance. The three authorised and planned wind farms will transform an estimated 133.6ha (1.26ha x 106 turbines). This brings the total habitat transformation by wind farms in the area under Scenario 2 to 455ha.

As mentioned, the effect of large dispersed infrastructure projects such as wind farms on birds is likely to be far more complex through factors such as habitat fragmentation, disruption of territories and other factors. These effects have however proven extremely difficult to measure. In order to apply a cautious approach we conclude that the cumulative significance of habitat destruction in this area (including the planned wind farms) is Moderate, and that the contribution by Impofu Wind Farms to this impact is Moderate.

Displacement of birds from the site.

No displacement impacts have been recorded at the operational wind farms. We have concluded in Section 4.2 that this impact will be of Negligible negative significance for the proposed Impofu Wind Farms. The three authorised wind farms' avifaunal assessments made the following findings: Banna ba Pifhu – a possibility of displacement of White-bellied Korhaan and Denham's Bustard was identified (Van Rooyen *et al,* 2013); Ubuntu – a possibility of displacement of Denham's Bustard was identified (Van Rooyen *et al,* 2012); Oyster Bay – a potential displacement of Blue Cranes (Van Rooyen *et al*,2012). Overall we conclude then that the cumulative impact of displacement of birds by wind farms

in the Kouga area is of Low significance and the contribution to this by Impofu Wind Farms is Low.

Disturbance of breeding during construction and/or operations.

Similarly to above for displacement, we conclude that the cumulative impact of displacement of birds by wind farms in the Kouga area is of Low significance and the contribution to this by Impofu Wind Farms is Low. The three authorised wind farms' avifaunal assessments did not discuss disturbance separately to displacement (Van Rooyen et al, 2013; Van Rooyen *et al*, 2012; Van Rooyen *et al,* 2012).

Direct mortality of birds through collision with turbines.

Table 19 presents the data for Scenario 2. In this scenario the three authorised wind farms would add a further: 3.29 (Banna ba Pifhu); 2.97 (Ubuntu); and 3.4 (Oyster Bay) priority species fatalities per year. Estimated fatality rates were calculated for these three wind farms using passage rates reported in the specialist reports and the same calculation methods as we used for Impofu Wind Farms (Section 3.3.6). This brings the total estimated bird fatalities to 56.92 priority birds per year (nine priority species – see Table 19). In this scenario the contribution of Impofu Wind Farms to this estimated cumulative impact is 30.20%.

Based on these figures we conclude that the cumulative turbine collision impact of wind farms on the priority bird species in the Kouga area is High. The contribution by Impofu Wind Farms to the cumulative impact is High if all 3 wind farms and the three authorised wind farms are built.

In addition to the above presented data, factors we have considered in making this conclusion include:

- As with Cumulative Scenario 1, this analysis does not take account of the avoidance measures already implemented at Impofu Wind Farms, which would reduce collision fatalities. For example, the only 2 Martial Eagles that have been killed in the area by wind turbines were at the same wind farm (meaning the other 3 operational wind farms had no fatalities of the species), where a nest is present in the middle of the wind farm, with turbines as close as 1km to the nest. The remaining 3 operational wind farms which had no known nests close to them killed no eagles. At Impofu Wind Farms we have applied a 6km buffer around the known nest and believe that this places the wind farm in line with the 3 sites where no fatalities have occurred.
- Our experience across multiple operational wind farms has been that actual fatality rates are lower than those predicted during impact assessment.
- As indicated it is unlikely that the Ubuntu Wind Farm will be developed. Thus the cumulative numbers presented are likely to be inflated given that the Ubuntu Wind Farm makes up 46% of the additional turbines potentially added by wind farms with approved EA's in the area.

- The turbine model used for the calculations for Impofu Wind Farms has a 150m rotor diameter. This is considerably larger than those used for the three authorised facilities: Banna ba Pifhu (13 turbines, 112m rotor diameter); Ubuntu (47 turbines, 97m rotor diameter); and Oyster Bay (46 turbines, 112m diameter). In our view there is a likelihood that the turbine models for the Banna ba Pifhu and Ubuntu wind farms may be amended to larger models at these sites given our experience across the industry to date, with amendments to larger turbines common as construction dates draw nearer (Oyster Bay is starting construction this year so it is too late for its turbine models to change). This means that the estimated fatality rates at these two sites may be an underestimate relative to that at Impofu Wind Farms (however, as indicated it is unlikely that Ubuntu Wind Farm will have a valid EA after June this year so its impacts are likely to be 0). However, any amendments in this regard would have to consider in their impact assessment the affect on the cumulative impact from this change along with the impacts of the other proposed wind farms in this area.

When the above four impacts (Habitat destruction – Low to Moderate; Displacement – Low; Disturbance – Low; Turbine collision – High) are combined **the overall significance of the cumulative impact of wind farms on birds (Scenario 2) in this area is Moderate.**

Table 18. Estimated priority bird species turbine collision fatalities for Scenario 1 cumulative assessment.

Common name	Regional status	Kouga	Gibson Bay Fatalities/year (Actual)	Tsitsikamma Fatalities/year (Actual)	Jeffreys Bay Fatalities/year (Actual)	4 Operational sites combined Fatalities/year (Actual)	Impofu Wind Farms Fatalities/year (98% avoidance)	Total cumulative fatalities	Impofu Wind Farms %
All below species	All species	7.50	4.80	11.00	6.77	30.07	17.19	47.26	36.37
Denham's Bustard	VU		1.20			1.20	3.84	5.04	76.19
White-bellied Korhaan	VU					0.00		0.00	n/a
Blue Crane	NT, E	1.00				1.00	4.70	5.70	82.46
Black Harrier	EN				1.23	1.23	0.06	1.29	4.65
African Marsh-Harrier	EN					0.00	2.01	2.01	100.00
Martial Eagle	EN				0.62	0.62	0.15	0.77	19.60
African Fish-Eagle				1.00	0.31	1.31	0.38	1.69	22.52
Jackal Buzzard	E	6.50	2.40	9.00	3.69	21.59	2.87	24.46	11.73
White Stork			1.20	1.00	0.92	3.12	3.18	6.30	50.45

EN=Endangered; VU=Vulnerable; NT=Near-threatened; E=Endemic

Table 19. Estimated priority bird species turbine collision fatalities for Scenario 2 cumulative assessment.

Common name	Regional status	Kouga	Gibson Bay Fatalities/year (Actual)	Tsitsikamma Fatalities/year (Actual)	Jeffreys Bay Fatalities/year (Actual)	4 Operational sites combined Fatalities/year (Actual)	Impofu Wind Farms Fatalities/year (98% avoidance)	Banna Fatalities/year (98% avoidance)	Ubuntu Fatalities/year (98% avoidance)	Oyster Bay Fatalities/year (98% avoidance)	Total cumulative impact	Impofu Wind Farms %
All below species	All species	7.50	4.80	11.00	6.77	30.07	17.19	3.29	2.97	3.40	56.92	30.20
Denham's Bustard	VU		1.20			1.20	3.84	0.35	0.65	1.03	7.07	54.32
White-bellied Korhaan	VU					0.00		0.01	0.25	0.00	0.26	0.00
Blue Crane	NT, E	1.00				1.00	4.70	2.58	0.87	0.58	9.72	48.35
Black Harrier	EN				1.23	1.23	0.06		0.57		1.86	3.22
African Marsh-Harrier	EN					0.00	2.01	0.13	0.24	0.09	2.47	81.25
Martial Eagle	EN				0.62	0.62	0.15		0.01	0.01	0.78	19.16
African Fish-Eagle				1.00	0.31	1.31	0.38	0.12	0.09	0.11	2.01	18.89
Jackal Buzzard	E	6.50	2.40	9.00	3.69	21.59	2.87	0.08	0.24	0.57	25.35	11.32
White Stork			1.20	1.00	0.92	3.12	3.18	0.02	0.05	1.02	7.39	43.01

EN=Endangered; VU=Vulnerable; NT=Near-threatened; E=Endemic

Mitigation for cumulative impacts

Cumulative impacts warrant a cumulative approach to mitigation in order to achieve maximum effectiveness. In the Kouga area a unique situation exists where an entity already exists for the purpose of strategically managing such issues, the Greater Kromme Stewardship Association. We recommend that the Impofu Wind Farms should become a fully paid up member during construction and operation of this Association for the purpose of further research and mitigation into the impacts of wind farms on priority species in the Kouga area.

5. CONSIDERATION OF ALTERNATIVES

The NEMA requires the consideration and assessment of feasible and reasonable alternatives in the EIA process. Alternatives can include: Location of the proposed activity; Type of activity; Layout alternatives; Technology alternatives; and No-Go alternative.

No alternatives, other than the No-Go option, have been assessed in this specialist report. The site and layouts considered and assessed in this report are the preferred alternatives. Site alternatives were screened out of the project scope in the Screening Phase.

The No-Go option would result in no wind farm and associated infrastructure being built on site. As a result none of the impacts on birds described in Section 4 would take place. The significance of impacts of the No-Go option on avifauna would therefore be Low.

Various conceptual layouts for the wind farms have been undertaken to date, but were not considered feasible from a technical or environmental perspective. The latest layout is the one that has been assessed and it appears to be a feasible alternative that minimises the predicted negative impacts.

6. CONCLUSION & RECOMMENDATIONS

We make the following conclusions regarding the avifaunal community and potential impacts of the Impofu East Wind Farm:

- We classified nine species as top most priority for this assessment: Denham's Bustard, White-bellied Korhaan, Blue Crane, Black Harrier, African Marsh-Harrier, Martial Eagle, African Fish-Eagle, Jackal Buzzard and White Stork.
- Eighty-four small bird species were recorded on the overall Impofu Wind Farms site through walked transects. None of these species are regionally Red Listed and 9 are regionally endemic or near-endemic (a relatively low level of endemism in our view). Endemic species included: Cape Weaver; Cape White-eye; Karoo Prinia; Cape Grassbird; Cape Bulbul; Fiscal Flycatcher; Greater Double-collared Sunbird; Sentinel Rock Thrush and Knysna Turaco. Overall species richness showed little seasonal variation.
- Fifteen large terrestrial or raptor species were recorded on the overall Impofu Wind Farms site through driven transects. The most abundant was White Stork, followed by Denham's Bustard, Jackal Buzzard and Blue Crane. Three of these species are regionally Red Listed: Denham's Bustard (Vulnerable); Blue Crane (Near-threatened); and Secretarybird (Vulnerable). Two species are endemic or near-endemic: Blue Crane and Jackal Buzzard. Whilst Blue Crane and Denham's Bustard abundance was high, it appears to be relatively lower than elsewhere in this Kouga region. White-bellied Korhaan and Martial Eagle were not recorded on either the overall Impofu Wind Farms site or the Impofu East by this method.
- A Martial Eagle nest was found to the north of Impofu Dam (well off the Impofu East Wind Farm site), with a recently fledged chick (in October 2017) in attendance at the nest.
- No Blue Crane roost sites were confirmed on Impofu East or the overall Impofu Wind Farms site to date, the only known sites being approximately 12-19km to the east of Impofu East at Grasmere and Soutvlei.
- Two separate displaying Denham's Bustard males were recorded on the Impofu East site during September-October 2017. These were single birds and in our view, whilst an important factor, did not constitute a lek site for the species. The Kouga Denham's Bustard lek site was monitored although it is approximately 3.2km east of the Impofu East Wind Farm closest turbines.
- Twenty target species were recorded as Incidental Observations on site during the monitoring programme. Most abundant of these was White Stork, followed by Denham's Bustard.
- Twenty-one relevant bird species were recorded flying on the overall Impofu Wind Farms site. Six of these are regionally Red Listed: Martial Eagle, Black Harrier and African Marsh-Harrier (Endangered); Denham's Bustard and Lanner Falcon (Vulnerable); and Blue Crane (Near-threatened). The most frequently recorded flying species were: White Stork (summer only);

Blue Crane; Denham's Bustard; Jackal Buzzard; and African Marsh-Harrier. Martial Eagle and Black Harrier were however not recorded flying on the Impofu East wind farm site. White-bellied Korhaan and Secretarybird were not recorded flying at all on the overall Impofu Wind Farms site. African Fish-Eagle was recorded on the overall site but not specifically on the Impofu East Wind Farm. Based on the spatial location of bird flight records we have identified Turbines 21, 23, 25, 28, and 29 as particularly high risk. Since the risk at these turbine locations is predominantly based on Jackal Buzzard (a non Red Listed species) and African Marsh-Harrier (for which no turbine collision fatalities have been reported at operational wind farms to date) we do not recommend that these turbines at Impofu East be moved or not built. We rather recommend that these turbines be searched weekly at a minimum and according to the full best practice protocol once post construction bird fatality searches start (i.e. it should not be one of the turbines subject to less frequent or thorough searching).

- Crude turbine collision fatality rates were calculated for each species in order to estimate how many birds the proposed Impofu East Wind Farm could kill. This calculation is considered to be a worst case scenario and is fraught with assumptions. Using the above described methods it is estimated that approximately 7.6 fatalities could be recorded at Impofu East Wind Farm per year across the 21 target bird species recorded flying on site. This includes the following priority species fatalities: 1.1 White Storks; 1.6 Blue Cranes; 1.3 Denham's Bustards; 1 Jackal Buzzard; and 0.7 African Marsh-Harrier. Importantly the fatality rates for several species, including: Martial Eagle (0.05 fatalities/year); Black Harrier (0.02 birds fatalities/year); Lanner Falcon (0.17 fatalities/year); and Grey Crowned Crane (0.12 fatalities/year), are very low. It is noted that the above calculated fatality rates have decreased by approximately 40% in the EIA Phase due to the reduced number of planned turbines assessed in the Scoping Phase. See Table 6 for more information. Human caused fatalities of Red listed or otherwise threatened bird species are always cause for concern and should be avoided as far as possible. There are currently no established thresholds for acceptable impacts on bird species in South Africa. To establish these thresholds would require complex modelling incorporating accurate information on many factors for each species (including population size, age specific fatality rates, breeding productivity etc). Such modelling and information is not available in South Africa at present. In the absence of this information we are forced to make a subjective finding as to the acceptability of the above estimated estimates (see Section 4.2 and Table 14 for our assessment). In our view the above fatality rates are of moderate significance for these species. Regional populations of these bird species are not likely to be driven towards extinction by these fatalities in our view. It is however essential that all mitigation measures recommended in this report be accepted to ensure that these fatality rates are reduced where possible. It also essential that an adaptive management approach be taken through ensuring that the wind farm is prepared to respond timeously and effectively if unsustainable impacts are detected.

Based on this assessed risk, we assessed the potential impacts on birds according to the methods

provided by Aurecon, and made the following findings:

- Destruction of bird habitat during construction will be of Low to Moderate negative significance.
- Disturbance of birds during construction will be of Negligible negative significance.
- Disturbance of birds during operations will be of Minor negative significance.
- The displacement of birds from the site during operations will be of Negligible negative significance.
- Bird fatalities through collision with turbine blades will be of Moderate negative significance.
- Bird fatalities through collision and electrocution on any sections of overhead power line on site are of Minor negative significance pre mitigation. This can be mitigated successfully to Negligible negative significance.
- The 'during' and post-construction bird monitoring programme outlined in Appendix 4 must be implemented and adhere to any updated versions of the best practice guidelines for this work (Jenkins *et al,* 2015) available by the time of implementation.
- Considering all available information we are of the opinion that wind farms will cumulatively have a Moderate impact on avifauna in this study area. Under the No-Go alternative impacts on birds will not occur and hence be of Low significance.

Although extensive avoidance of impacts has already been applied on this project, we have identified the following mitigation measures which are required to further reduce the significance of impacts on birds:

- An avifaunal walk down should be conducted to confirm final layout and identify any sensitivities that may arise between the EIA and construction.
- All construction activities should be strictly managed according to generally accepted environmental best practice standards, so as to avoid any unnecessary impact on the receiving environment.
- Monitoring of breeding status of Martial Eagles should be conducted in all breeding seasons post acceptance of the project as preferred bidder (to establish baseline) and including during and post construction.
- Given that the impact of bird collision with turbines could occur once the wind farm is operational and require mitigation, we recommend strongly that an appropriate mitigation budget be provided for by the developer. At this stage it is not possible to determine what mitigation may be appropriate, and in the time between writing this report and the mitigation need arising (likely several years) new mitigation methods may be developed. However if such a need arises and suitable mitigation is identified it cannot be argued by the wind farm operator that mitigation was not budgeted for. Mitigation could cost the operator either in the

form of additional costs or lost productivity as a result of changes to turbine operations. We have suggested a budget for this aspect in Section 4.2.

- If Blue Crane turbine or power line collision fatalities occur as a result of livestock feeding points once the facility is operational this will need to be mitigated, probably by restricting farmers from feeding too close to (200-300m) turbines and power lines or by covering/ obstructing the feeding points in some way that prevents the birds from easily feeding from them (as was done successfully with fence wires in the Overberg area for feeding points for sheep). Landowners should be made aware of this possibility at the outset of the project.
- The overhead conductors or earth wires of any overhead power lines should be fitted with an Eskom approved anti bird collision line marking device to make cables more visible to birds in flight and reduce the likelihood of collisions.
- Pylons or poles of any overhead power line must be designed according to Eskom approved bird friendly designs to ensure that perching large birds cannot be electrocuted.
- The during construction and post construction monitoring programme outlined in Appendix 4 should be implemented according to the latest available version of the best practice guidelines at the time.
- Cumulative impacts warrant a cumulative approach to mitigation in order to achieve maximum effectiveness. In the Kouga area a unique situation exists where an entity already exists for the purpose of strategically managing such issues, the Greater Kromme Stewardship Association. We recommend that the Impofu Wind Farms should become a fully paid up member during construction and operation of this Association for the purpose of further research and mitigation into the impacts of wind farms on priority species in the Kouga area.

We have no objections should the Impofu East Wind Farm proceed.

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APPENDIX 1. BIRD SPECIES RECORDED ON THE CONSOLIDATED IMPOFU WIND FARMS SITE.

'1' denotes presence not abundance

Taylor et al 2015 – most recent regional conservation status for species.

IUCN – Global conservation status

Endemic (E)/near endemic (NE)– whether the species is endemic or near endemic to South Africa.

TOPS – National Environmental Management Act – Threatened or Protected Species List

Retief et al 2014 – the species ranking in terms of turbine collision risk – as per Avian Wind Farm Sensitivity Map.

Winter, Spring, Summer, Autumn – recorded in these seasons by preconstruction bird monitoring.

Roberts VII	Roberts VII	Taylor *et al* 2015	TOPS list	IUCN 2019	Endemic/near	Retief *et al* 2014	Winter	Spring	Summer	Autumn
African Black Swift	*Apus barbatus*							1	1	
African Darter	*Anhinga rufa*						1	1	1	1
African Dusky Flycatcher	*Muscicapa adusta*						1	1	1	1
African Emerald Cuckoo	*Chrysococcyx cupreus*							1		
African Fish-Eagle	*Haliaeetus vocifer*			LC		29	1	1	1	1
African Goshawk	*Accipiter tachiro*					190		1		
African Harrier-Hawk	*Polyboroides typus*					83	1		1	1
African Hoopoe	*Upupa africana*						1	1	1	1
African Marsh-Harrier	*Circus ranivorus*	EN	P	LC		24	1	1	1	1
African Olive-Pigeon	*Columba arquatrix*							1		
African Paradise-Flycatcher	*Terpsiphone viridis*							1		
African Pipit	*Anthus cinnamomeus*						1	1	1	1
African Quailfinch	*Ortygospiza atricollis*						1	1	1	1
African Sacred Ibis	*Threskiornis aethiopicus*						1	1	1	1
African Snipe	*Gallinago nigripennis*							1	1	
African Spoonbill	*Platalea alba*						1	1	1	1

Roberts VII	Roberts VII	Taylor *et al* 2015	TOPS list	IUCN 2019	Endemic/near	Retief *et al* 2014	Winter	Spring	Summer	Autumn
African Stonechat	*Saxicola torquatus*						1	1	1	1
Alpine Swift	*Tachymarptis melba*							1	1	
Amethyst Sunbird	*Chalcomitra amethystina*						1	1	1	1
Amur Falcon	*Falco amurensis*					68			1	
Ant-eating Chat	*Myrmecocichla formicivora*								1	
Banded Martin	*Riparia cincta*						1	1	1	
Barn Swallow	*Hirundo rustica*					127		1	1	1
Bar-throated Apalis	*Apalis thoracica*						1	1	1	1
Black Cuckoo	*Cuculus clamosus*							1	1	
Black Crake	*Amaurornis flavirostris*									1
Black Harrier	*Circus maurus*	EN		EN	NE	6		1		
Black Saw-wing	*Psalidoprocne holomelaena*							1	1	1
Black Sparrowhawk	*Accipiter melanoleucus*					101	1	1	1	1
Black-backed Puffback	*Dryoscopus cubla*							1	1	
Black-bellied Starling	*Lamprotornis corruscus*							1	1	1
Black-collared Barbet	*Lybius torquatus*						1	1	1	1
Black-crowned Tchagra	*Tchagra senegalus*						1			
Black-headed Heron	*Ardea melanocephala*					141	1	1	1	1
Black-headed Oriole	*Oriolus larvatus*						1	1	1	1
Black-shouldered Kite	*Elanus caeruleus*					94		1	1	1
Blacksmith Lapwing	*Vanellus armatus*					159	1	1	1	1
Black-winged Lapwing	*Vanellus melanopterus*					97	1	1	1	1
Black-winged Stilt	*Himantopus himantopus*								1	1
Blue Crane	*Anthropoides paradiseus*	NT	E	VU	E	11	1	1	1	1
Bokmakierie	*Telophorus zeylonus*						1	1	1	1
Booted Eagle	*Aquila pennatus*			LC		55		1	1	
Brimstone Canary	*Crithagra sulphuratus*						1	1	1	1
Brown-hooded Kingfisher	*Halcyon albiventris*						1	1	1	1
Brown-throated Martin	*Riparia paludicola*						1	1	1	1

Roberts VII	Roberts VII	Taylor *et al* 2015	TOPS list	IUCN 2019	Endemic/near	Retief *et al* 2014	Winter	Spring	Summer	Autumn
Burchell's Coucal	*Centropus burchellii*								1	
Cape Batis	*Batis capensis*						1	1	1	1
Cape Bulbul	*Pycnonotus capensis*				E	181	1	1	1	1
Cape Canary	*Serinus canicollis*						1	1	1	1
Cape Clapper Lark	*Mirafra apiata*				E	122	1			
Cape Crow	*Corvus capensis*						1	1	1	1
Cape Glossy Starling	*Lamprotornis nitens*						1	1	1	1
Cape Grassbird	*Sphenoeacus afer*				NE	156	1	1	1	1
Cape Longclaw	*Macronyx capensis*					178	1	1	1	1
Cape Robin-Chat	*Cossypha caffra*						1	1	1	1
Cape Shoveler	*Anas smithii*						1	1	1	1
Cape Sparrow	*Passer melanurus*							1		
Cape Sugarbird	*Promerops cafer*				E	152	1			
Cape Teal	*Anas capensis*						1			
Cape Turtle-Dove	*Streptopelia capicola*						1	1	1	1
Cape Wagtail	*Motacilla capensis*						1	1	1	1
Cape Weaver	*Ploceus capensis*				E	182	1	1	1	1
Cape White-eye	*Zosterops virens*				E	183	1	1	1	1
Capped Wheatear	*Oenanthe pileata*					167			1	
Cardinal Woodpecker	*Dendropicos fuscescens*							1		
Cattle Egret	*Bubulcus ibis*					189	1	1	1	1
Cloud Cisticola	*Cisticola textrix*						1	1	1	1
Common Fiscal	*Lanius collaris*						1	1	1	1
Common Moorhen	*Gallinula chloropus*						1	1	1	1
Common Quail	*Coturnix coturnix*							1	1	1
Common Ringed Plover	*Charadrius hiaticula*								1	
Common Starling	*Sturnus vulgaris*						1	1	1	1
Common Waxbill	*Estrilda astrild*						1	1	1	1
Crowned Lapwing	*Vanellus coronatus*						1	1	1	1

Roberts VII	Roberts VII	Taylor *et al* 2015	TOPS list	IUCN 2019	Endemic/near	Retief *et al* 2014	Winter	Spring	Summer	Autumn
Denham's Bustard	*Neotis denhami*	VU	P	NT		21	1	1	1	1
Eastern Clapper Lark	*Mirafra fasciolata*								1	1
Egyptian Goose	*Alopochen aegyptiaca*					162		1	1	1
Emerald-spotted Wood-Dove	*Turtur chalcospilos*								1	
European Bee-eater	*Merops apiaster*					172		1		
Fiery-necked Nightjar	*Caprimulgus pectoralis*					193				1
Fiscal Flycatcher	*Sigelus silens*				NE	187		1		
Forest Buzzard	*Buteo trizonatus*					100	1		1	
Forest Canary	*Crithagra scotops*						1			
Fork-tailed Drongo	*Dicrurus adsimilis*						1	1	1	1
Giant Kingfisher	*Megaceryle maximus*						1	1	1	1
Great Egret	*Egretta alba*								1	
Greater Double-collared Sunbird	*Cinnyris afer*				E	171	1	1	1	1
Greater Flamingo	*Phoenicopterus ruber*	NT		LC		27				1
Greater Honeyguide	*Indicator indicator*								1	
Greater Striped Swallow	*Hirundo cucullata*							1	1	1
Green Wood-Hoopoe	*Phoeniculus purpureus*						1	1		1
Green-backed Camaroptera	*Camaroptera brachyura*						1	1	1	1
Grey Crowned Crane	*Balearica regulorum*	EN	E	EN		15			1	
Grey Cuckooshrike	*Coracina caesia*						1			
Grey Heron	*Ardea cinerea*						1	1	1	1
Grey-backed Cisticola	*Cisticola subruficapilla*						1	1	1	1
Hadeda Ibis	*Bostrychia hagedash*						1	1	1	1
Hamerkop	*Scopus umbretta*					118	1		1	
Helmeted Guineafowl	*Numida meleagris*						1	1	1	1
House Sparrow	*Passer domesticus*						1	1	1	1
Jackal Buzzard	*Buteo rufofuscus*			LC	E	44	1	1	1	1
Jacobin Cuckoo	*Clamator jacobinus*								1	
Karoo Prinia	*Prinia maculosa*				NE	157	1	1	1	1

Roberts VII	Roberts VII	Taylor *et al* 2015	TOPS list	IUCN 2019	Endemic/near	Retief *et al* 2014	Winter	Spring	Summer	Autumn
Kelp Gull	*Larus dominicanus*						1	1	1	1
Kittlitz's Plover	*Charadrius pecuarius*							1	1	
Klaas's Cuckoo	*Chrysococcyx klaas*							1		1
Knysna Turaco	*Tauraco corythaix*								1	1
Lanner Falcon	*Falco biarmicus*	VU		LC		23	1	1	1	1
Laughing Dove	*Streptopelia senegalensis*							1		1
Lazy Cisticola	*Cisticola aberrans*							1		1
Lesser Striped Swallow	*Hirundo abyssinica*					151			1	
Lesser Swamp-Warbler	*Acrocephalus gracilirostris*							1	1	1
Levaillant's Cisticola	*Cisticola tinniens*						1	1	1	1
Little Egret	*Egretta garzetta*							1	1	
Little Grebe	*Tachybaptus ruficollis*						1	1	1	1
Little Rush-Warbler	*Bradypterus baboecala*							1		1
Little Swift	*Apus affinis*							1		1
Long-crested Eagle	*Lophaetus occipitalis*					84	1	1	1	1
Long-tailed Widowbird	*Euplectes progne*							1	1	
Malachite Sunbird	*Nectarinia famosa*						1	1	1	1
Martial Eagle	*Polemaetus bellicosus*	EN	VU	VU		4	1		1	1
Montagu's Harrier	*Circus pygargus*					67			1	
Namaqua Dove	*Oena capensis*								1	1
Neddicky	*Cisticola fulvicapilla*						1	1	1	1
Olive Bush-Shrike	*Telophorus olivaceus*							1	1	1
Olive Thrush	*Turdus olivaceus*						1		1	1
Olive Woodpecker	*Dendropicos griseocephalus*						1	1	1	
Orange-breasted Sunbird	*Anthobaphes violacea*					153			1	1
Pearl-breasted Swallow	*Hirundo dimidiata*					150			1	
Peregrine Falcon	*Falco peregrinus*		VU	LC		48			1	
Pied Crow	*Corvus albus*							1		
Pied Kingfisher	*Ceryle rudis*							1	1	1

Roberts VII	Roberts VII	Taylor *et al* 2015	TOPS list	IUCN 2019	Endemic/near	Retief *et al* 2014	Winter	Spring	Summer	Autumn
Pied Starling	*Spreo bicolor*				E	116	1	1		1
Pin-tailed Whydah	*Vidua macroura*						1	1	1	1
Plain-backed Pipit	*Anthus leucophrys*						1		1	1
Purple Heron	*Ardea purpurea*					163	1			
Red-billed Quelea	*Quelea quelea*						1	1		
Red-billed Teal	*Anas erythrorhyncha*						1	1	1	1
Red-capped Lark	*Calandrella cinerea*						1	1	1	1
Red-chested Cuckoo	*Cuculus solitarius*							1		
Red-eyed Dove	*Streptopelia semitorquata*						1	1	1	1
Red-faced Mousebird	*Urocolius indicus*							1		1
Red-fronted Tinkerbird	*Pogoniulus pusillus*								1	
Red-knobbed Coot	*Fulica cristata*						1	1	1	1
Red-necked Spurfowl	*Pternistis afer*						1	1	1	1
Red-winged Francolin	*Scleroptila levaillantii*								1	
Red-winged Starling	*Onychognathus morio*							1	1	1
Reed Cormorant	*Phalacrocorax africanus*						1	1	1	1
Rock Kestrel	*Falco rupicolus*					111	1	1		1
Rock Martin	*Hirundo fuligula*						1	1		
Ruff	*Philomachus pugnax*								1	1
Rufous-naped Lark	*Mirafra africana*						1	1	1	1
Secretarybird	*Sagittarius serpentarius*	VU		VU		12		1		1
Sentinel Rock-Thrush	*Monticola explorator*				E	120	1			
Sombre Greenbul	*Andropadus importunus*						1	1	1	1
South African Shelduck	*Tadorna cana*						1	1	1	1
Southern Boubou	*Laniarius ferrugineus*						1	1	1	1
Southern Double-collared Sunbird	*Cinnyris chalybeus*				E	184	1			
Southern Grey-headed Sparrow	*Passer diffusus*							1	1	1
Southern Masked-Weaver	*Ploceus velatus*							1	1	
Southern Red Bishop	*Euplectes orix*							1	1	1

Roberts VII	Roberts VII	Taylor *et al* 2015	TOPS list	IUCN 2019	Endemic/near	Retief *et al* 2014	Winter	Spring	Summer	Autumn
Speckled Mousebird	*Colius striatus*							1	1	1
Speckled Pigeon	*Columba guinea*						1	1	1	1
Spectacled Weaver	*Ploceus ocularis*							1		
Spotted Eagle-Owl	*Bubo africanus*					98	1	1		1
Spotted Thick-knee	*Burhinus capensis*						1	1		
Spur-winged Goose	*Plectropterus gambensis*						1	1	1	1
Spur-winged Lapwing	*Vanellus spinosus*							1		
Steppe Buzzard	*Buteo vulpinus*					69			1	1
Streaky-headed Seedeater	*Crithagra gularis*								1	
Terrestrial Brownbul	*Phyllastrephus terrestris*							1	1	1
Thick-billed Weaver	*Amblyospiza albifrons*							1		
Three-banded Plover	*Charadrius tricollaris*					140	1	1	1	1
Village Weaver	*Ploceus cucullatus*						1			
Wailing Cisticola	*Cisticola lais*							1	1	1
Water Thick-knee	*Burhinus vermiculatus*						1		1	
Whiskered Tern	*Chlidonias hybrida*							1	1	
White Stork	*Ciconia ciconia*			LC		61	1		1	
White-bellied Korhaan	*Eupodotis senegalensis*	VU		LC		36	1	1	1	
White-breasted Cormorant	*Phalacrocorax lucidus*						1	1	1	1
White-faced Duck	*Dendrocygna viduata*						1	1	1	1
White-necked Raven	*Corvus albicollis*						1	1	1	1
White-rumped Swift	*Apus caffer*							1	1	1
White-starred Robin	*Pogonocichla stellata*						1			
White-throated Swallow	*Hirundo albigularis*							1	1	1
Willow Warbler	*Phylloscopus trochilus*								1	
Wing-snapping Cisticola	*Cisticola ayresii*								1	
Wood Sandpiper	*Tringa glareola*									1
Yellow Bishop	*Euplectes capensis*						1	1	1	1
Yellow Canary	*Crithagra flaviventris*						1			

Roberts VII	Roberts VII	Taylor *et al* 2015	TOPS list	IUCN 2019	Endemic/near	Retief *et al* 2014	Winter	Spring	Summer	Autumn
Yellow-billed Duck	*Anas undulata*						1	1	1	1
Yellow-billed Kite	*Milvus parasitus*							1	1	
Yellow-fronted Canary	*Crithagra mozambicus*									1
Yellow-throated Petronia	*Petronia superciliaris*						1			
Zitting Cisticola	*Cisticola juncidis*						1	1	1	1

APPENDIX 2. SMALL PASSERINE BIRD SPECIES RECORDED ON THE CONSOLIDATED IMPOFU WIND FARMS SITE.

			Full year			Winter			Spring			Summer			Autumn		
		# species	84			52			53			49			51		
		Transect length	64.96			16.24			16.24			16.24			16.24		
Common name	Scientific name	Regional status	Birds	Rec.	Birds/ km	Birds	Rec.	Birds/ km	Birds	Rec.	Birds/ km	Birds	Rec.	Birds/ km	Birds	Rec.	Birds/ km
Barn Swallow	*Hirundo rustica*		227	76	3.49							172	21	10.59	55	14	3.39
Cape Canary	*Serinus canicollis*		176	44	2.71	76	10	4.68	49	24	3.02	48	7	2.96	3	2	0.18
African Pipit	*Anthus cinnamomeus*		142	92	2.19	61	32	3.76	8	6	0.49	40	21	2.46	33	15	2.03
Grey-backed Cisticola	*Cisticola subruficapilla*		101	81	1.55	20	15	1.23	32	25	1.97	23	15	1.42	26	14	1.60
Red-eyed Dove	*Streptopelia semitorquata*		100	52	1.54	36	18	2.22	7	7	0.43	44	14	2.71	13	9	0.80
African Stonechat	*Saxicola torquatus*		92	64	1.42	22	14	1.35	33	25	2.03	22	10	1.35	15	10	0.92
Bokmakierie	*Telophorus zeylonus*		78	52	1.20	14	8	0.86	13	9	0.80	33	17	2.03	18	13	1.11
Speckled Pigeon	*Columba guinea*		77	60	1.19	6	4	0.37	9	3	0.55	11	2	0.68	51	2	3.14
Cape Longclaw	*Macronyx capensis*		67	45	1.03	16	10	0.99	18	12	1.11	25	15	1.54	8	5	0.49
Yellow Bishop	*Euplectes capensis*		66	35	1.02	9	5	0.55	21	16	1.29	29	7	1.79	7	3	0.43
Red-capped Lark	*Calandrella cinerea*		64	35	0.99	35	11	2.16	19	15	1.17	2	1	0.12	8	2	0.49
Neddicky	*Cisticola fulvicapilla*		61	49	0.94	8	6	0.49	27	23	1.66	19	13	1.17	7	4	0.43
Common Fiscal	*Lanius collaris*		50	48	0.77	14	14	0.86	8	8	0.49	16	14	0.99	12	11	0.74
Rufous-naped Lark	*Mirafra africana*		49	43	0.75	7	6	0.43	26	22	1.60	15	14	0.92	1	1	0.06
Common Quail	*Coturnix coturnix*		48	36	0.74				34	28	2.09	14	8	0.86			
Common Waxbill	*Estrilda astrild*		43	31	0.66				5	2	0.31	10	1	0.62	28	3	1.72
Cape Turtle-Dove	*Streptopelia capicola*		42	40	0.65	14	13	0.86	7	6	0.43	4	4	0.25	17	12	1.05
Cape White-eye	*Zosterops virens*	Endemic	41	15	0.63	7	2	0.43	11	2	0.68	15	3	0.92	8	2	0.49
Cape Weaver	*Ploceus capensis*	Endemic	38	8	0.58	7	3	0.43	25	3	1.54	6	2	0.37			
Sombre Greenbul	*Andropadus importunus*		38	35	0.58	5	5	0.31	8	7	0.49	13	11	0.80	12	7	0.74
Fork-tailed Drongo	*Dicrurus adsimilis*		35	20	0.54	10	8	0.62	12	4	0.74	10	5	0.62	3	2	0.18
African Quailfinch	*Ortygospiza atricollis*		32	14	0.49				22	4	1.35				10	5	0.62

			Full year			Winter			Spring			Summer			Autumn		
		# species	84			52			53			49			51		
		Transect length	64.96			16.24			16.24			16.24			16.24		
Common name	Scientific name	Regional status	Birds	Rec.	Birds/ km	Birds	Rec.	Birds/ km	Birds	Rec.	Birds/ km	Birds	Rec.	Birds/ km	Birds	Rec.	Birds/ km
Red-winged Starling	*Onychognathus morio*		30	1	0.46				30	1	1.85						
Levaillant's Cisticola	*Cisticola tinniens*		26	14	0.40	4	3	0.25				18	7	1.11	4	4	0.25
Karoo Prinia	*Prinia maculosa*	Endemic	24	14	0.37	1	1	0.06	6	5	0.37	13	4	0.80	4	3	0.25
Bar-throated Apalis	*Apalis thoracica*		23	21	0.35	3	3	0.18	10	9	0.62	5	4	0.31	5	3	0.31
Cape Grassbird	*Sphenoeacus afer*	Endemic	23	22	0.35	3	2	0.18	10	10	0.62	5	5	0.31	5	5	0.31
Zitting Cisticola	*Cisticola juncidis*		23	16	0.35	2	1	0.12	9	6	0.55	11	8	0.68	1	1	0.06
Malachite Sunbird	*Nectarinia famosa*		21	16	0.32	5	4	0.31	11	7	0.68				5	4	0.31
Cape Robin-Chat	*Cossypha caffra*		20	18	0.31	5	4	0.31	8	7	0.49	2	2	0.12	5	4	0.31
Terrestrial Brownbul	*Phyllastrephus terrestris*		19	5	0.29							18	4	1.11	1	1	0.06
Black-bellied Starling	*Notopholia corruscus*		18	18											18	2	1.11
Cloud Cisticola	*Cisticola textrix*		18	12	0.28	12	6	0.74	4	4	0.25	1	1	0.06	1	1	0.06
Crowned Lapwing	*Vanellus coronatus*		16	10	0.25				3	2	0.18	8	3	0.49	5	3	0.31
Lazy Cisticola	*Cisticola aberrans*		16	11	0.25				16	11	0.99						
Red-necked Spurfowl	*Pternistis afer*		16	8	0.25	2	1	0.12	8	4	0.49	6	3	0.37			
Brimstone Canary	*Crithagra sulphuratus*		15	5	0.23	10	2	0.62	3	1	0.18				2	1	0.12
African Dusky Flycatcher	*Muscicapa adusta*		13	8	0.20	5	2	0.31	6	4	0.37				2	2	0.12
Southern Masked Weaver	*Ploceus velatus*		13	3	0.20				13	3	0.80						
Cape Wagtail	*Motacilla capensis*		12	10	0.18	4	3	0.25				2	1	0.12	6	3	0.37
Southern Red Bishop	*Euplectes orix*		12	1	0.18							12	1	0.74			
Black-headed Oriole	*Oriolus larvatus*		11	11	0.17	3	3	0.18	1	1	0.06	3	3	0.18	4	4	0.25
Pin-tailed Whydah	*Vidua macroura*		9	5	0.14				2	2	0.12	7	3	0.43			
Wailing Cisticola	*Cisticola lais*		9	9	0.14							4	4	0.25	5	3	0.31

			Full year			Winter			Spring			Summer			Autumn		
		# species	84			52			53			49			51		
		Transect length	64.96			16.24			16.24			16.24			16.24		
Common name	Scientific name	Regional status	Birds	Rec.	Birds/ km	Birds	Rec.	Birds/ km	Birds	Rec.	Birds/ km	Birds	Rec.	Birds/ km	Birds	Rec.	Birds/ km
Black-collared Barbet	*Lybius torquatus*		8	8	0.12	1	1	0.06				2	2	0.12	5	4	0.31
Cape Batis	*Batis capensis*		8	6	0.12	1	1	0.06	2	1	0.12	2	1	0.12	3	2	0.18
Olive Bush-Shrike	*Telophorus olivaceus*		8	7	0.12				3	3	0.18	3	2	0.18	2	2	0.12
Southern Boubou	*Laniarius ferrugineus*		8	6	0.12				8	6	0.49						
Plain-backed Pipit	*Anthus leucophrys*		7	4	0.11	1	1	0.06				4	1	0.25	2	1	0.12
Spotted Thick-Knee	*Burhinus capensis*		7	2	0.11	5	1	0.31	2	1	0.12						
Greater Striped Swallow	*Hirundo cucullata*		5	3	0.08				2	1	0.12	2	1	0.12	1	1	0.06
Green-backed Camaroptera	*Camaroptera brachyura*		5	5	0.08	1	1	0.06	2	2	0.12	2	2	0.12			
Southern Grey-headed Sparrow	*Passer diffusus*		5	5											5	2	0.31
Amethyst Sunbird	*Chalcomitra amethystina*		4	2	0.06	3	1	0.18							1	1	0.06
Black Saw-wing	*Psalidoprocne holomelaena*		4	4	0.06							1	1	0.06	3	2	0.18
Brown-hooded Kingfisher	*Halcyon albiventris*		4	4	0.06	2	2	0.12				1	1	0.06	1	1	0.06
Green Wood Hoopoe	*Phoeniculus purpureus*		4	1	0.06	4	1	0.25									
Olive Woodpecker	*Dendropicos griseocephalus*		4	3	0.06	2	1	0.12	1	1	0.06	1	1	0.06			
Rock Martin	*Hirundo fuligula*		4	3	0.06	4	3	0.25									
Three-banded Plover	*Charadrius tricollaris*		4	4	0.06	1	1	0.06	2	2	0.12				1	1	0.06
African Hoopoe	*Upupa africana*		3	3	0.05	2	2	0.12	1	1	0.06						
African Paradise Flycatcher	*Terpsiphone viridis*		3	2	0.05				3	2	0.18						
Cape Bulbul	*Pycnonotus capensis*	Endemic	3	1	0.05				3	1	0.18						
Greater Double-collared Sunbird	*Cinnyris afer*	Endemic	3	3	0.05	2	2	0.12							1	1	0.06
Knysna Turaco	*Tauraco corythaix*	Endemic	3	3											3	1	0.18

			Full year			Winter			Spring			Summer			Autumn		
		# species	84			52			53			49			51		
		Transect length	64.96			16.24			16.24			16.24			16.24		
Common name	Scientific name	Regional status	Birds	Rec.	Birds/ km	Birds	Rec.	Birds/ km	Birds	Rec.	Birds/ km	Birds	Rec.	Birds/ km	Birds	Rec.	Birds/ km
Blacksmith Lapwing	*Vanellus armatus*		2	2											2	1	0.12
Black-crowned Tchagra	*Tchagra senegalus*		2	2	0.03	2	2	0.12									
European Bee-eater	*Merops apiaster*		2	1	0.03				2	1	0.12						
Fiscal Flycatcher	*Sigelus silens*	Endemic	2	1	0.03	2	1	0.12									
Forest Canary	*Crithagra scotops*		2	1	0.03	2	1	0.12									
Olive Thrush	*Turdus olivaceus*		2	2	0.03	1	1	0.06							1	1	0.06
Sentinel Rock Thrush	*Monticola explorator*	Endemic	2	1	0.03	2	1	0.12									
White-rumped Swift	*Apus caffer*		2	1	0.03							2	1	0.12			
Alpine Swift	*Tachymarptis melba*		1	1	0.02				1	1	0.06						
Black-backed Puffback	*Dryoscopus cubla*		1	1	0.02							1	1	0.06			
Eastern Clapper Lark	*Mirafra fasciolata*		1	1	0.02				1	1	0.06						
Grey Cuckoo-Shrike	*Coracina caesia*		1	1	0.02	1	1	0.06									
Klaas's Cuckoo	*Chrysococcyx klaas*		1	1	0.02				1	1	0.06						
Long-tailed Widowbird	*Euplectes progne*		1	1	0.02				1	1	0.06						
Red-fronted Tinkerbird	*Pogoniulus pusillus*		1	1	0.02							1	1	0.06			
Water Thick-Knee	*Burhinus vermiculatus*		1	1	0.02	1	1	0.06									
White-throated Swallow	*Hirundo albigularis*		1	1											1	1	0.06
Willow Warbler	*Phylloscopus trochilus*		1	1	0.02							1	1	0.06			
Yellow Canary	*Crithagra flaviventris*		1	1	0.02	1	1	0.06									

APPENDIX 3. IMPACT ASSESSMENT CRITERIA (AURECON)

4.1.1 Overview

For each predicted impact, criteria are ascribed and these include the **intensity** (size or degree scale), which also includes the **type** of impact, being either a positive or negative impact; the **duration** (temporal scale); and the **extent** (spatial scale), as well as the **probability** (likelihood). The methodology is quantitative and generated through a spreadsheet but requires professional judgement in the application of the criteria. There is provision for your comment on the significance if you disagree with the level that is auto-calculated.

When assessing impacts, broader considerations are to also be taken into account, these include the **confidence** with which the assessment was undertaken, the **reversibility** of the impact and the resource **irreplaceability**.

Calculations

(as applied in the excel spreadsheet 'Impofu_EIA_Impact Assessment.xlsx')

For each predicted impact, certain criteria are applied to establish the likely **significance** of the impact, firstly in the case of no mitigation being applied and then with the most effective mitigation measure(s) in place.

These criteria include the **intensity** (size or degree scale), which also includes the **type** of impact, being either a positive or negative impact; the **duration** (temporal scale); and the **extent** (spatial scale). These numerical ratings are used in an equation whereby the **consequence** of the impact can be calculated. Consequence is calculated as follows:

Consequence = type x (intensity + duration + extent).

To calculate the significance of an impact, the **probability** (or likelihood) of that impact occurring is applied to the consequence.

Significance = consequence x probability

Depending on the numerical result, the impact would fall into a significance category as negligible, minor, moderate or major, and the type would be either positive or negative.

The following tables show the scales used to classify the above variables, and define each of the rating categories.

4.1.2 Intensity

The intensity refers to the degree of alteration of the affected environmental receptor. The relevant descriptor for intensity is selected by the user (refer to Table 3.1).

Table 4.1: Description of intensity and assigned numerical values

Numerical Rating	Intensity	
	Category	Description
1	Negligible	Natural and/ or social functions and/ or processes are negligibly altered
2	Very low	Natural and/ or social functions and/ or processes are slightly altered
3	Low	Natural and/ or social functions and/ or processes are somewhat altered
4	Moderate	Natural and/ or social functions and/ or processes are moderately altered
5	High	Natural and/ or social functions and/ or processes are notably altered
6	Very high	Natural and/ or social functions and/ or processes are majorly altered
7	Extremely high	Natural and/ or social functions and/ or processes are severely altered

*NOTE: Where applicable, the intensity of the impact is related to a relevant standard or threshold, or is based on specialist knowledge and understanding of that particular field.

4.1.2.1 Duration

The duration refers to the length of permanence of the impact on the environmental/social receptor. The relevant descriptor for duration is selected by the user (refer Table 4.2).

Table 4.2: Description of duration and assigned numerical values

Numerical Rating	Category	Descriptors
1	Immediate	Impact will self-remedy immediately
2	Brief	Impact will not last longer than 1 year
3	Short term	Impact will last between 1 and 5 years
4	Medium term	Impact will last between 5 and 10 years
5	Long term	Impact will last between 10 and 15 years
6	On-going	Impact will last between 15 and 20 years
7	Permanent	Impact may be permanent, or in excess of 20 years

4.1.2.2 Extent

The extent refers to the geographical scale of impact on the environmental/social receptor. The relevant descriptor for extent is selected by the user (refer Table 4.3).

Table 4.3: Description of extent and assigned numerical values

Numerical Rating	Category	Descriptors
1	Very limited	Limited to specific isolated parts of the site
2	Limited	Limited to the site and its immediate surroundings
3	Local	Extending across the site and to nearby settlements
4	Municipal area	Impacts felt at a municipal level
5	Regional	Impacts felt at a regional / provincial level
6	National	Impacts felt at a national level
7	International	Impacts felt at an international level

4.1.3 Probability

To calculate the significance of an impact, the probability (or likelihood) of that impact occurring is also taken into account. Refer to Table 4.4.

Table 4.4: Definition of probability ratings

Numerical Rating	Category	Descriptors
1	Highly unlikely / None	Expected never to happen
2	Rare / improbable	Conceivable, but only in extreme circumstances, and/or might occur for this project although this has rarely been known to result elsewhere
3	Unlikely	Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur
4	Probable	Has occurred here or elsewhere and could therefore occur
5	Likely	The impact may occur
6	Almost certain / Highly probable	It is most likely that the impact will occur
7	Certain / Definite	There are sound scientific reasons to expect that the impact will definitely occur

4.1.4 Significance

These are auto-calculated in the spreadsheet as described above and includes the following categories in Table 4.5. This table is just for information.

Table 4.5: Application of significance ratings

Range		Significance rating
-147	-109	Major (-)
-108	-73	Moderate (-)
-72	-36	Minor (-)
-35	-1	Negligible (-)
0	0	Neutral
1	35	Negligible (+)
36	72	Minor (+)
73	108	Moderate (+)
109	147	Major (+)

When assessing impacts, broader considerations should also be taken into account. These include the level of confidence in the assessment rating; the reversibility of the impact; and the irreplaceability of the resource as set out in Table 4.6, Table 4.7 and Table 4.8 respectively.

When assessing impacts, broader considerations should also be taken into account. These include the level of confidence in the assessment rating; the reversibility of the impact; and the irreplaceability of the resource as set out in Table 4.6, Table 4.7 and Table 4.8 respectively.

Table 4.6: Definition of confidence ratings

Rating	Descriptor
Low	Judgement is based on intuition
Medium	Determination is based on common sense and general knowledge
High	Substantive supportive data exists to verify the assessment

Table 4.7: Definition of reversibility ratings

Rating	Descriptor
Low	The affected environment will not be able to recover from the impact - permanently modified
Medium	The affected environment will only recover from the impact with significant intervention
High	The affected environmental will be able to recover from the impact

Table 4.8: Definition of irreplaceability ratings

Rating	Descriptor
Low	The resource is not damaged irreparably or is not scarce
Medium	The resource is damaged irreparably but is represented elsewhere
High	The resource is irreparably damaged and is not represented elsewhere

APPENDIX 4. DURING & POST CONSTRUCTION BIRD MONITORING PROGRAMME

The work done to date on the Impofu Wind Farms site has established a baseline understanding of the distribution, abundance and movement of key bird species on and near the site. However this is purely the 'before' baseline and aside from providing input into turbine micro-siting, it is not very informative until compared to post construction data. The following programme has therefore been developed to meet these needs. It is recommended that this programme be implemented by the Impofu East Wind Farm if constructed.

During construction monitoring

It will be necessary to monitor the breeding status and productivity of the Martial Eagle pair during all breeding seasons during construction. This can be done by a minimum of 3 specialist visits to the nest site per breeding season, or close enough to observe the eagles without disturbing them. Detailed requirements as follows:

- Independent avifaunal specialist to make 3 visits to nest site in each breeding season (May to October) during construction.
- Breeding status & productivity to be determined.
- Any response by eagles to construction disturbance to be documented.

Post construction monitoring

The intention with post construction bird monitoring is to repeat as closely as possible the methods and activities used to collect data pre-construction. This work will allow the assessment of the impacts of the proposed facility and the development of active and passive mitigation measures that can be implemented in the future where necessary. One very important additional component needs to be added, namely mortality estimates through carcass searches under turbines. The following programme has therefore been developed to meet these needs, and should start as soon as possible after the operation of the first phase of turbines (not later than 3 months):

Note that this framework is an interim draft. The most up to date version of the best practice guidelines (Jenkins *et al* 2015) should inform the programme design at the time.

Live bird monitoring

Note that due to the construction of the wind farm and particularly new roads it may be necessary to update the location of the below monitoring activities from those used pre-construction.

- The 15 walked transects of 1km each that have been done during pre-construction monitoring on the overall Impofu Wind Farms site should be continued. On Impofu East specifically 6 walked transects of 1km each should be done.
- The 7 vehicle based road count routes on the overall Impofu Wind Farms should be continued, and conducted twice on each site visit. On Impofu East specifically four drive transects should be done, transects 4, 5, 6, and 7.
- The 14 focal sites on the overall Impofu Wind Farms plus Martial Eagle nest and Kouga Denham's Bustard lek should be monitored. If any sensitive species are found breeding on site in future these nest sites should be defined as focal sites. At Impofu East Focal Sites FS6, FS7, FS8, FS9 and FS10 should be monitored, plus any new ones identified.
- All other incidental sightings of priority species (and particularly those suggestive of breeding or important feeding or roosting sites or flight paths) within the broader study area should be carefully plotted and documented.
- The 11 Vantage Points already established on the overall site should be used to continue data collection post construction. The exact positioning of these may need to be refined based on the presence of new turbines and roads. A total of 12 hours of observation should be conducted at each vantage point on each site visit, resulting in a total of 48 hours direct observation on site per site visit. At Impofu East, three Vantage Points should be monitored.
- The activities at the control site should be continued, i.e. 2 Vantage Points, 3 Walked Transects, 2 Vehicle Based transects, and 4 Focal Sites.
- Given the proximity of the proposed wind farm to a Martial Eagle nest and possible implications for this pair of birds and their offspring during the lifespan of the wind farm, there will be a need for more detailed research and monitoring of these birds, possibly including eagle tracking studies using satellite or GPS telemetry.

Bird Fatality estimates

This is now an accepted component of the post construction monitoring program and the newest guidelines (Jenkins *et* al, 2015) will be used to design the monitoring program. It is important that in addition to searching for carcasses under turbines, an estimate of the detection (the success rate that monitors achieve in finding carcasses) and scavenging rates (the rate at which carcasses are removed and hence not available for detection) is also obtained (Jenkins *et al*, 2015). Both of these aspects can be measured using a sample of carcasses of birds placed out in the field randomly. The rate at which these carcasses are detected and the rate at which they decay or are removed by scavengers should also be measured.

Fatality searches should be conducted as follows:

- The area surrounding the base of turbines should be searched (up to a radius equal to 75% of the maximum height of turbine) for collision victims.
- All turbines on Impofu East should be searched at least once a week (Monday to Friday).
- Any suspected collision casualty should be comprehensively documented (for more detail see Jenkins *et al*, 2015).
- A team of carcass searchers will need to be employed and these carcass searchers will work on site every day searching the turbines for mortalities.
- It is also important that associated infrastructure such as power lines and wind masts be searched for collision victims according to similar methods.
- Turbines 21, 23, 25, 28, and 29 are to be prioritised and must be searched fully every single week .

The most up to date version of the best practice guidelines (Jenkins *et al*, 2015) should inform the programme design at the time.