Bayview Wind Farm

Bayview Wind Power (Pty) Ltd

Avifaunal impact assessment

July 2018

ecological services

REPORT REVIEW & TRACKING

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EXECUTIVE SUMMARY

Bayview Wind Power (Pty) Ltd is a special purpose vehicle (SPV) established for the sole purpose of developing, owning and operating the proposed Bayview Wind Farm. The applicant intends to develop, construct and operate a Wind Energy Facility (WEF), the Bayview Wind Farm approximately thirty kilometres (30 km) north of Port Elizabeth in the Eastern Cape Province. The study area is situated in the Nelson Mandela Bay Municipality and will have an anticipated life span of 20 – 25 years. Depending on the grid connection option negotiated and agreed with Eskom post preferred bidder status, the following infrastructure may be constructed; forty-seven (47) turbine locations are being assessed for the proposed Bayview Wind Farm, however it is anticipated that a maximum of forty-five (45) wind turbines will be constructed with an expected output capacity of between 3 MW and 4.5 MW per turbine. The total output of the proposed Bayview Wind Farm will be a maximum of 140 MW net generating capacity, which will be dependent on the site wind resource, layout and number of turbines and their output capacity. Infrastructure required for the Bayview Wind Farm includes operational and maintenance buildings, internal roads, underground electrical cabling linking turbines, an on-site switching station, and an overhead line (132 kV) to an Eskom substation.

EOH-Coastal and Environmental Services (EOH-CES) was appointed to conduct the necessary environmental impact assessments for the proposed project and subsequently appointed WildSkies Ecological Services to conduct the avifaunal impact assessment. WildSkies has previously conducted four seasons of pre-construction bird monitoring on site in accordance with the best practice guidelines in this regard (Jenkins *et al,* 2015) under contract to VentuSA Energy (Pty) Ltd in 2014-2015 (Strugnell & Smallie 2016).

Key findings with respect to the avifaunal community on site are as follows:

- A total of 169 bird species were recorded on site. Species richness peaked in autumn, followed by summer, spring and winter.
- There are two dominant bird micro habitats available on site: the thicket, and open shorter vegetation. Several small pans and one drainage line are also present.
- Of the 42 bird species originally identified as target species for the site, 22 have been confirmed to occur on site. These include 9 regionally Red Listed bird species.
- Eighty small (i.e. not raptor or large terrestrial) bird species were recorded on site, of which 2 are regionally Red Listed species: Caspian Tern and Knysna Woodpecker. The most abundant small passerines species were Sombre Greenbul, Bar-throated Apalis and Southern Double-collared Sunbird. A large number of these 80 species are endemic (18) or near-endemic (9).
- Eleven target raptor or large terrestrial bird species were recorded on the drive transects on site. Most abundant of these were Denham's Bustard, Rock Kestrel and Blue Crane. However the Denham's Bustard and Blue Crane were predominantly recorded on a portion of transect well off

the Bayview Wind Farm site on the Sundays River plains, on dairy pastures. This data is therefore not directly relevant to the avifaunal community on the site itself.

- A large number (300-400) of Greater and Lesser Flamingos were present on the Cerebos salt works 6km east of the site in all seasons. Although this is important to be aware of, in our opinion the likelihood of these birds flying over the Bayview Wind Farm site is low.
- Seventeen target bird species were recorded flying on the site itself. Of these the species we consider most at risk of collision with turbines if built are Martial Eagle and Blue Crane based on their conservation status, frequency, duration and height above ground at which they were recorded flying. Martial Eagle had the longest flight duration of all recorded species, most of which was at rotor height. Blue Crane flew less frequently but as a gregarious species the recorded flights often included multiple birds, and most flight was at rotor height.
- Overall the bird flight activity recorded on site was relatively low. An area of higher collision risk has been identified based on recorded flight data. This is an area in the far west of site.
- A medium sensitivity spatial category has been identified on site based on pans, drainage lines and bird collision risk index. It is recommended that overhead power lines and turbines are not built in this area.

As the result of the above avifaunal findings, the potential impacts on avifauna of the proposed project have been assessed as follows:

- Construction of the facility will result in a certain amount of destruction and removal of natural vegetation which was previously available to avifauna for use. This impact is anticipated to be of MODERATE NEGATIVE significance pre mitigation. The required mitigation is to adhere to the sensitivity map contained in this report. This will reduce the significance to LOW NEGATIVE.
- Disturbance of birds is rated as LOW NEGATIVE significance, on account of there being no known breeding sites of sensitive bird species on or near site. No specific mitigation is required.
- Once operational the facility could displace certain birds from the area, or cause them to fly further to get around the facility. Displacement of birds is judged to be of LOW NEGATIVE significance pre mitigation. No specific mitigation is required.
- Birds in flight on the site could collide with operational turbine blades, thereby being killed or seriously injured. Collision of birds with turbines is judged to be of MODERATE NEGATIVE significance pre mitigation. The significance of this impact can be reduced to LOW NEGATIVE significance by adhering to the sensitivity map in Section 6, and by providing a contingency mitigation budget for the operational phase of the wind farm to allow adaptive management of impacts that arise.
- Birds could perch on the pylons/towers of the overhead grid connection power line and be at risk of electrocution if the design is not bird friendly. Birds in flight could collide with the overhead cables, particularly the earth wire. Collision and electrocution of birds on overhead power lines on site is anticipated to be of HIGH NEGATIVE significance. Both of these impacts can be mitigated successfully in our opinion to reduce the significance to LOW NEGATIVE. To mitigate for collision of

the relevant species, it is recommended that the overhead cables be fitted with the best available (at the time of construction) Eskom approved anti bird collision line marking device. In the case of bird electrocution, the power line must be built on an Eskom approved bird-friendly pole structure which provides ample clearance between phases and phase-earth to allow large birds (such as eagles) to perch on them in safety.

- Overall, taking the above 5 impacts into account we conclude that the cumulative impact of wind farms on birds in the study area will be of Low to Moderate significance. The contribution of Bayview Wind Farm (up to 45 turbines out of a possible total of 47) is Moderate.
- Post construction or operational phase bird monitoring should be conducted according to the framework outlined in this report, but updated to consider best practice guidelines available at the time. This monitoring should be used to detect any significant impacts on birds which may require adaptive management during the lifespan of the facility. This monitoring should be done for at least the first two years of operations, or longer if any significant issues are identified. Thereafter monitoring should be repeated in years 5, 10, 15, 20, and 25.

We recommend that this wind farm can be developed with acceptable levels of risk to birds.

SPECIALIST DETAILS

Professional registration & experience

The Natural Scientific Professions Act of 2003 aims to "Provide for the establishment of the South African Council of Natural Scientific Professions (SACNASP) and for the registration of professional, candidate and certified natural scientists; and to provide for matters connected therewith." "Only a registered person may practice in a consulting capacity" – Natural Scientific Professions Act of 2003 (20(1)-pg 14)

Investigator:	Jon Smallie (Pr. Sci. Nat.)
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Declaration of independence

The specialist investigators declare that:

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

- We undertake to disclose to the relevant authorities any information that has or may have the potential to influence its decision or the objectivity of any report, plan, or document required in terms of the Environmental Impact Assessment Regulations, 2006.

Terms & Liabilities

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

Signed in July 2018 by Jon Smallie in his capacity as specialist investigator.

Contents

1. INTRODUCTION

1.1. Background

Bayview Wind Power (Pty) Ltd (hereafter referred to as the applicant) is a special purpose vehicle (SPV) established for the sole purpose of developing, owning and operating the proposed Bayview Wind Farm. The applicant intends to develop, construct and operate a Wind Energy Facility (WEF), the Bayview Wind Farm approximately thirty kilometres (30 km) north of Port Elizabeth in the Eastern Cape Province (Figure 1). The study area is situated in the Nelson Mandela Bay Municipality and will have an anticipated life span of 20 – 25 years. The three (3) affected properties, with a total extent of 2 636 ha are: Oliphants Kop 201, Remaining Extent (1 078ha); Steins Valley 202, Portion 4 (900ha); and Ebb and Vloed 230, Remaining Extent of Portion 8 (835ha).

Depending on the grid connection option negotiated and agreed with Eskom post preferred bidder status, the following infrastructure may be constructed. Forty-seven (47) turbine locations are being assessed for the proposed Bayview Wind Farm, however it is anticipated that only a maximum of forty-five (45) wind turbines will be constructed with an output capacity of between 3 MW and 4.5 MW per turbine. The total output of the proposed Bayview Wind Farm will be a maximum of 140 MW net generating capacity, which will be dependent on the number of turbines and their output capacity. Infrastructure required for the Bayview Wind Farm includes operational and maintenance buildings, internal roads, underground electrical cabling linking turbines, an on-site switching station, and an overhead line (132 kV) to an Eskom substation.

EOH-Coastal and Environmental Services (EOH-CES) was appointed to conduct the necessary environmental impact assessments for the proposed project and subsequently appointed WildSkies Ecological Services to conduct the avifaunal impact assessment. WildSkies has previously conducted four seasons of pre-construction bird monitoring on site in accordance with the best practice guidelines in this regard (Jenkins *et al,* 2015) under contract to VentuSA Energy (Pty) Ltd in 2014-2015 (Strugnell & Smallie 2016).

The site is located at an altitude of between approximately 70 and 180m metres above sea level. The vegetation consists of either thicket in the lower lying area or more open grassland/bontveld on the higher ground.

1.2. Project description

The following steps are generally followed during the construction phase of the activity:

- Vegetation clearance and gate erection;

- Establishment of access roads;
- Establishment of buildings such as site office area, control building, warehousing and workshops, gatehouse and concrete batching plant;
- Establishment of temporary construction hardstand area (assembly area, storage area of approximately 15 ha) and pegging of structures;
- Temporary construction laydown area establishment (approximately 6 ha);
- Construction of turbine hardstands and platforms;
- Undertake detailed geotechnical studies and foundation works for the turbines;
- Establishment of foundations;
- Assembly and erection of structures;
- Undertake civil works for the substation and construct the substation;
- Stringing of conductors to the substation;
- Connection of the substation to the main grid; and
- Rehabilitation of disturbed areas (where applicable).

Construction is anticipated to last between 18 and 24 months. Each of the ancillary infrastructure required for the Bayview Wind Farm has been discussed in more detail below.

Control buildings & initial hardstand areas

Initially, a 15 ha temporary hardstand area will be required. This area will serve as an assembly point, storage area (turbine main components) and will accommodate the erection of the crane boom. In addition, a 6 ha laydown area will be required (OHL and office components storage), which will be rehabilitated once construction is complete. Other infrastructure required will include:

- A gate house with security – approximately 36 m^2 (0.0036 ha)
- Operational and Maintenance buildings such as a Control centre, Offices, Warehouse, Workshop, Canteen, Visitors centre and Staff lockers – approximately 1 ha
- Concrete batching plant – approximately 5000 m^2 (0.5 ha)

Access roads

Existing roads will be used to gain access during the construction and operational phase (maintenance purposes) of the project. Additional access roads may need to be created / upgraded, which may include the following:

- A main access road of approximately 10 m in width consisting of gravel. The length of this road at this stage is estimated to be 11 km
- Internal access roads approximately 25 – 30 km in length and 6 – 8 m in width

- Jeep tracks which will be used for routine maintenance of overhead powerlines during the operational phase.

The new internal roads created will remain a permanent feature as these will be used for routine maintenance and access to the turbines.

Servitude, Powerline and Substation

Underground cabling will be required to connect the various turbines to an onsite (facility) substation at medium voltage (MV) level. This cabling will be adjacent to roads at all times. At the onsite substation it will be stepped up to a high voltage (HV) level of 132 kV via the main power transformer, and then evacuated via overhead line (OHL) into the designated Eskom Point of Connection (POC). This line will be approximately 22 m above ground level and will be supported either on monopole or lattice tower structures. There are four options for the grid connection:

- A loop-in loop-out (LILO) on the Grassridge/Nooitgedacht 132 kV OHL
- A new 132 kV OHL direct to Dedisa Substation.
- A new 132 kV OHL direct to Grassridge Substation
- A new 132 kV OHL direct to Dedisa (CDC corridor)

The servitude width required for the 132 kV OHL will be approximately 31 – 36 m in width. An 8 m wide strip is generally required to be cleared (trees and shrubs) down the centre of the distribution power line servitude for stringing purposes only. For the purposes of assessing the best location of the line within the servitude, a 300 m corridor (150 m each side) around each overhead line will be assessed. Should the preferred distribution line corridor receive environmental authorisation from DEA, the optimal tower sizes and positions will be identified and verified through a comprehensive ground survey of the preferred route.

An onsite substation will be required of approximately 1 ha in size, where all the turbines will connect to via underground MV cabling.

Turbines and turbine hardstands

A maximum of 45 turbines are proposed for the Bayview Wind Farm, with the turbine capacity ranging between 3 MW and 4.5 MW. Each turbine foundation will be approximately 400 m^2 and will be approximately 3 m deep. Assuming the maximum amount of turbines is constructed this will equate to a total area of approximately 18 000 m^2 (1.8 ha) of vegetation clearance required for the turbines. Each crane hardstand area is anticipated to be approximately 1800 m^2 in extent, totalling approximately 81 000 m^2 (8.1 ha) for all 45 turbines. The crane hardstands will not be entirely rehabilitated, and part of each designated area will need to be left intact for unplanned maintenance/ replacement of the blades or nacelle.

Approximately 500 – 1000 m^3 of spoil substrate would need to be excavated for each turbine, depending on the quality of soil and turbine specification. These excavated areas are then filled with steel-reinforced concrete. Spoil heaps will be temporary and disposed of where excavated material cannot be recycled for use during construction of access roads or foundations.

Dimensions of the turbines components will be dependent on the technology used. It is anticipated that the hub height for each turbine will not exceed 150 m (worst case scenario). The rotor diameter is anticipated to be a maximum of 150 m (worst case scenario). The blade length of each turbine is anticipated to be approximately 75 m in length.

Water Requirements

For the construction period, water will be required for the purpose of concrete production (batching plant), roads and earthworks, and other ancillary requirements. The project will use about 100 kl of water per day (10 x 10 000 litre trucks) during construction and should not exceed a total amount of approximately 100 000 kl. A detailed breakdown will be provided at a later stage of the process.

Water required during operational phase will be minimal and will be primarily be for drinking and sanitation purposes.

Four (4) options are currently being investigated for water sourcing:

- Abstraction from the Nooitgedaght pipeline that crosses the study area;
- Supply from the Local Municipality (LM) - i.e. Nelson Mandela Bay Metropolitan Municipality (NMBM);
- Abstraction from an existing borehole within the study area (subject to NWA requirements);
- Drilling and use of a new borehole within the study area (subject to NWA requirements); and/or
- The use of treated effluent collected from Fishwater Flats WWTW or any other appropriate wastewater treatment works at which disposal facilities exist (for the use of construction other than concrete work, as required by the NMBM By-Law).

Should water be sourced from an external source, it will be trucked to the site. Should it be sourced from either the Nooitgedaght pipeline or the on-site borehole, it will most likely be piped via a temporary HDPE pipe which will be in agreement with the landowners. Should these same sources be utilised during the operational phase, these pipes will most likely be buried.

Waste requirements

Solid waste

Solid waste during the construction phase will mainly be in the form of construction material, excavated substrate and domestic solid waste. All waste will be disposed of in scavenger proof bins and temporarily placed in a central location for removal by the contractor. Any other waste and excess material will be removed once construction is complete and disposed of at a registered waste facility.

Solid waste during the operation phase will mainly be in the form of domestic waste such as food packaging, water bottles etc. Solid waste during the operational phase should be stored in a central location for regular removal.

Sewerage

During the construction phase, chemical ablution facilities will be utilised. These ablution facilities will be maintained, serviced and emptied by an appointed contractor, who will dispose of the effluent at a licensed facility off site. Once construction is complete, the chemical ablution facilities will be removed from the study area.

During the operational phase, effluent will be collected in waterproof conservancy sumps/tanks and will be regularly emptied, typically with Honey-sucker trucks by a service provider. The effluent will be transported and disposed of at a registered Municipal Sewerage Treatment Facility in Nelson Mandela Bay Metropolitan Municipality (presumably the FWF WWTW).

Hazardous substances

During the construction phase use of the following hazardous substances are anticipated:

- Cement powder associated with the batching plant;
- Petrol for trucks/ cranes/ bulldozers;
- Transformer oils.

Quantities of these will be confirmed at a later stage.

Hazardous substances used during the operational phase will mainly consist of lubricating oils and hydraulic and insulating fluids. These would be stored in the onsite workshop, in lockable containers. Quantities of these will be confirmed at a later stage.

Decommissioning

The Bayview Wind Farm will have an anticipated life span of 20 -25 years. Should the Wind Farm be decommissioned and not upgraded at the end of life, decommissioning will be as follows:

- Dismantle all wind turbines and foundations in line with all relevant legislation;
- Some foundations may be left and covered with soil;
- Recycle as much of the decommissioned project components as possible;
- Rehabilitate where required.

Figure 1 shows the position of the proposed site in the broader landscape.

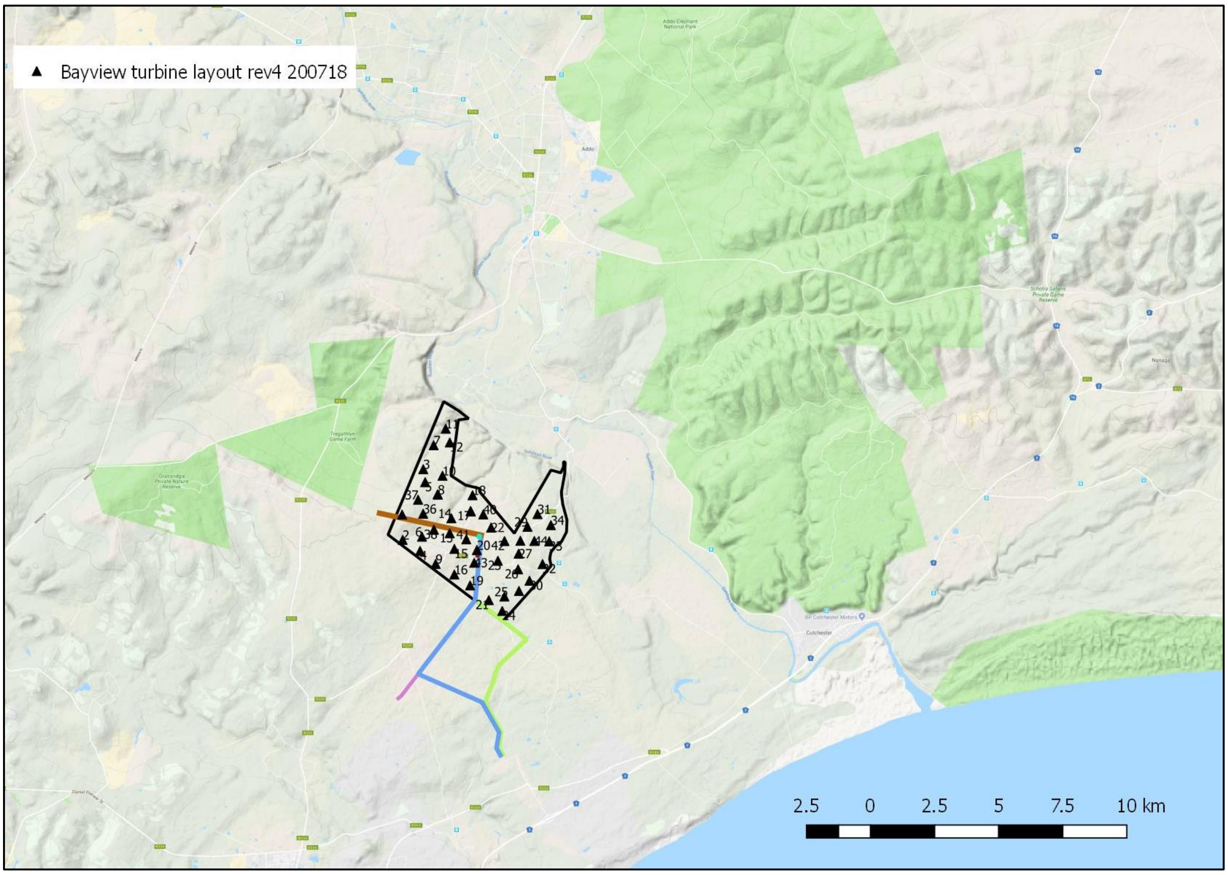

Figure 1. The proposed Bayview Wind Farm.

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: collisions – which is a direct mortality factor; disturbance – particularly whilst breeding; habitat alteration or destruction (less direct); and displacement and 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 the displacement and barrier effects are unique to wind energy.

Associated infrastructure such as the grid connection power line also has the potential to impact on birds.

1.2.1 Collision of birds with turbine blades

Without doubt the impact of collision 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/turbine/year compared to the 1.6 for North America. These figures include adjustment for detection (the efficiency with which monitors detect carcasses in different conditions) and scavenger bias (the rate at which birds are removed by scavengers between searches). These are important biases which must be accounted for in any study of mortality.

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), Martial Eagle *Polemaetus bellicosus* (2), Black Harrier *Circus maurus* (5), and Blue Crane *Anthropoides paradiseus* (3). Although not regionally Red Listed, a large number of Jackal Buzzard *Buteo rufofuscus* fatalities (24) were also reported.

1.2.2 Loss or alteration of habitat during construction

The area of land directly affected by a wind farm and associated infrastructure is relatively small. As a result in most cases, habitat destruction or alteration in its simplest form (removal of natural vegetation) is unlikely to be of much significance. However fragmentation of habitat can be an important factor for some smaller bird species. Construction and operation of a wind farm results in an influx of human activity to areas often previously relatively uninhabited (Kuvlesky *et al* 2007). This disturbance could cause certain birds to avoid the entire site, thereby losing a significant amount of habitat (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 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.

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 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. 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 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, although monitoring of power lines has been much less frequent (quarterly) than at turbines (weekly).

1.2.6. Mitigation

Realistic possible mitigation measures for 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, impractical or unlikely to be implemented by the operator post construction unless sufficient budget has been provided for during the planning phase. This report strongly recommends that the operator make provision for a mitigation contingency budget.

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. 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 bird species are already struggling to maintain sustainable populations, we should be striving to avoid all additional, new and preventable impacts on these species, and not permitting these impacts simply because they are smaller than those anthropogenic impacts already in existence.

1.3. Relevant legislation

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

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

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

The Convention on the Conservation of Migratory Species of Wild Animals (also known as CMS or Bonn Convention) aims to conserve terrestrial, aquatic and avian migratory species throughout their range. It is an intergovernmental treaty, concluded under the aegis of the United Nations Environment

Programme, concerned with the conservation of wildlife and habitats on a global scale. Since the Convention's entry into force, its membership has grown steadily to include 117 (as of 1 June 2012) Parties from Africa, Central and South America, Asia, Europe and Oceania. South Africa is a signatory to this convention.

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

The National Environmental Management – Biodiversity Act - Threatened Or Protected Species list (TOPS). Species on this list are shown in Table 7.

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’s regulations are relevant to the issue of lighting of wind energy facilities, and to painting turbine blades, both of which are relevant to bird collisions with turbine blades.

2. METHODS

2.1. Terms of reference

The avifaunal specialist has conducted this assessment according to the terms of reference provided by EOH-CES for a study of this nature. The terms of reference are as follows:

- The existing environment must be described and the bird communities most likely to be impacted will be identified. Different bird micro-habitats must be described as well as the species associated with those habitats.
- Typical impacts that could be expected from the developments must be listed as well as the expected impact on the bird communities. Impacts must be quantified (if possible) and a full description of predicted impacts (direct and indirect) must be provided.
- Gaps in baseline data must be highlighted and discussed. An indication of the confidence levels must be given. The best available data sources must be used to predict the impacts including the results of the pre-construction monitoring and specialist studies that have been completed for previous EIA studies (if any) conducted at the site (or similar sites), and extensive use must be made of local knowledge, if available.
- The potential impact on the birds must be assessed and evaluated according to the requirements prescribed by the Environmental Assessment Practitioner.
- Practical mitigation measures must be recommended and discussed, including a post construction monitoring programme.
- Bird sensitive areas must be mapped in a sensitivity map for easy reference. Any no-go areas must be clearly indicated.

The Avifaunal Impact Assessment was available for a thirty (30) day Public Review period, as part of the Public Participation Process (PPP) on the Draft Environmental Impact Report (EIR), from the 20th of August 2018 until the 20th of September 2018. The comments, which were received, relating to the avifauna of the proposed site have been included in the Issues and Response Trail (IRT) in the Final EIR and, where necessary, responses were provided by the relevant specialist.

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 2014.
- 12 months (4 seasons) of pre-construction bird monitoring was conducted on site during 2014-2015. This consisted of four seasonal site visits of approximately ten days each by a team of two skilled observers, to record data on bird species and abundance on and near site. During this period several additional short visits were made by the specialist.
- The data collected was analysed and written up in a final pre-construction bird monitoring report (Strugnell & Smallie, 2016).
- During 2017 the specialist was appointed by EOH-CES to conduct this avifaunal impact assessment. A brief site visit was conducted in October 2017 to determine whether any significant changes to the habitat or avifaunal community on site had taken place subsequent to the above monitoring. Particular emphasis was placed on detecting any new nests of significant bird species on or near site.
- This avifaunal impact assessment was compiled using the above described data for the site.

2.3. Data sources consulted for this study

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

- The pre-construction bird monitoring final report and associated data (Strugnell & Smallie 2016).
- 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).
- The conservation status of all relevant bird species was determined using Taylor *et al* (2015) & IUCN 2017.
- The latest 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).
- Best-practice Guidelines for assessing and monitoring the impact of wind energy facilities on birds in Southern-Africa, third edition (Jenkins *et al,* 2015).
- Google Earth was used extensively to examine the study area on a desktop basis.
- 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 two years of work at the nearby operational Grassridge Wind Farm, and the proposed Dassiesridge and Scarlet Ibis wind farms and other older projects we have worked on in the area.
- 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 in prep) was consulted extensively.

2.4. Data collection activities

The following sections describe the data collection activities on site.

2.4.1. Sample counts of small terrestrial species

Although not traditionally the focus of wind farm–bird studies and literature, small terrestrial birds are an important component of this programme. Due to the rarity of many of our threatened bird species, it is anticipated that statistically significant trends in abundance and density may be difficult to observe in 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 wind farms, these smaller species may also be particularly vulnerable to displacement and habitat level effects. Sampling these species aims to establish abundance estimates for the small terrestrial birds in the study area. Since the aim is to count as close as possible to all of the birds in a given sample area, these counts were conducted when conditions were optimal. In this case this means the times when birds are most active and vocal, i.e. early mornings. A total of 12 walked transects (WT) of 14.3 km in total were established and conducted starting at first light. These WT's were positioned to represent and sample the bird micro habitats available (Figure 4). During these transects, all bird species seen or heard, and their position relative to the transect line were recorded. Small terrestrial bird species abundance has been calculated into a simple 'bird per km of transect walked' index.

2.4.2. Counts of large terrestrial species & raptors

This is a very similar data collection technique to that above, the aim being to determine as close as possible to how many individuals of each species are present in a given area. Large terrestrial and raptor bird species are relatively easily detected from a vehicle hence 'drive transects' were conducted in order to determine the number of birds of relevant species in the study area. Detection of these large species is less dependent on their activity levels and calls, so these counts can be done later in the day. A total of 6 transects were established totalling 43.2km (Figure 4).

2.4.3. Focal site surveys & monitoring

Two Focal sites were established for this project (Figure 4). Focal Site 1 was the Cerebos salt works approximately 6km east of the site, and held a large number of water birds (Figure 2). Focal Site 2 was a section of the Sundays River valley at the north of the site (Figure 3). The salt works are probably too far from the Bayview site for the avifauna there to be directly relevant. However since there is so little surface water in the broader area, and no other sensitive avifaunal features evident, these salt works were identified as the most relevant focal sites.

Figure 2. The Cerebos salt works at Focal Site 1.

Figure 3. The Sundays River system at Focal Site 2.

2.4.4. Incidental observations

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

2.4.5. Direct observation of bird movements

The above efforts in 2.4.1 to 2.4.4 allow us to arrive at an estimate of the abundance or density of the relevant species on site. This allows the identification of any displacement and disturbance effects on these species post construction. However in evaluating the likelihood of these species colliding with turbine blades, their abundance is not sufficient. We also need to understand their flight behaviour. It is the flight behaviour which determines their exposure to collision risk. A bird which seldom flies, or typically flies lower than blade height is at lower risk than a frequent flier that typically flies at blade height. In order to gather baseline data on this aspect, direct observations of bird flight behaviour are required. This is the most time consuming and possibly the most important activity to be conducted on site, and is elaborated on below.

Data collection methods

The aim of direct observation of flying birds is to quantify bird usage of the study area over time; and to record bird behaviour which may help explain any future interactions between birds and the facility. Direct observation was conducted through counts at four vantage points (VP) in the study area (Figure 4), which provide coverage of a reasonable and representative proportion of the entire study area. Vantage Points were identified using GIS (Geographic Information Systems), and then fine-tuned during the project setup, based on access and other information. Since these VP's aim at capturing both usage and behavioural data, they were positioned mostly on high ground to maximise visibility. The survey radius for VP counts was 2 kilometres. Vantage Point counts were conducted by two observers. Birds were recorded in a 360 degree arc of the observers. Data on bird flight should ideally be collected during representative conditions, so the sessions have been spread throughout the day, with each VP being counted over early to mid-morning, mid to late morning, early to mid -afternoon, and mid-afternoon to evening. Each session was 3hrs long, resulting in a total of 12hrs of observation being conducted at each vantage point on each site visit. Three hours is believed to be towards the upper limit of observer concentration span, whilst also maximising duration of data capture relative to travel time required in order to get to the VP's. A maximum of two VP sessions were conducted per day, to avoid observer fatigue compromising data quality.

One of the most important attributes of any bird flight event is its height above ground. 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 has been 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 flight data to classes later on depending on final turbine specifications.

Data analysis

The spatial analysis of data was conducted as follows: The recorded flight paths were digitised, creating vectorized lines for each flight record. A 50x50metre grid was created of the study area, which covers a two kilometre radius from the observation point. The number of times a flight path intersected a grid cell was calculated. The number of observations per grid cell was categorised by the actual number of observations per grid cell, with more than 5 observations per grid cell being grouped together. A Viewshed Analysis of the 2 kilometre radius around each Vantage Point was undertaken to identify the areas that can actually be seen by the observers from the Vantage Point. This was done by using 5 metre contours to create a Triangular Irregular Network.

2.4.6. Control site

A suitable control site was monitored approximately 6 kilometres south-east of the main site. This site was chosen as it is one of the few areas that has similar habitat that will not be developed into a wind energy facility in the future to our knowledge. One vantage point, one drive transect and three walked transects were established on the control site. For a full explanation of the data capture methods above, see Jenkins *et al,* 2015. The layout of the above activities is shown in Figure 4 below. The data collected on the control site is not relevant to this impact assessment and is not discussed further.

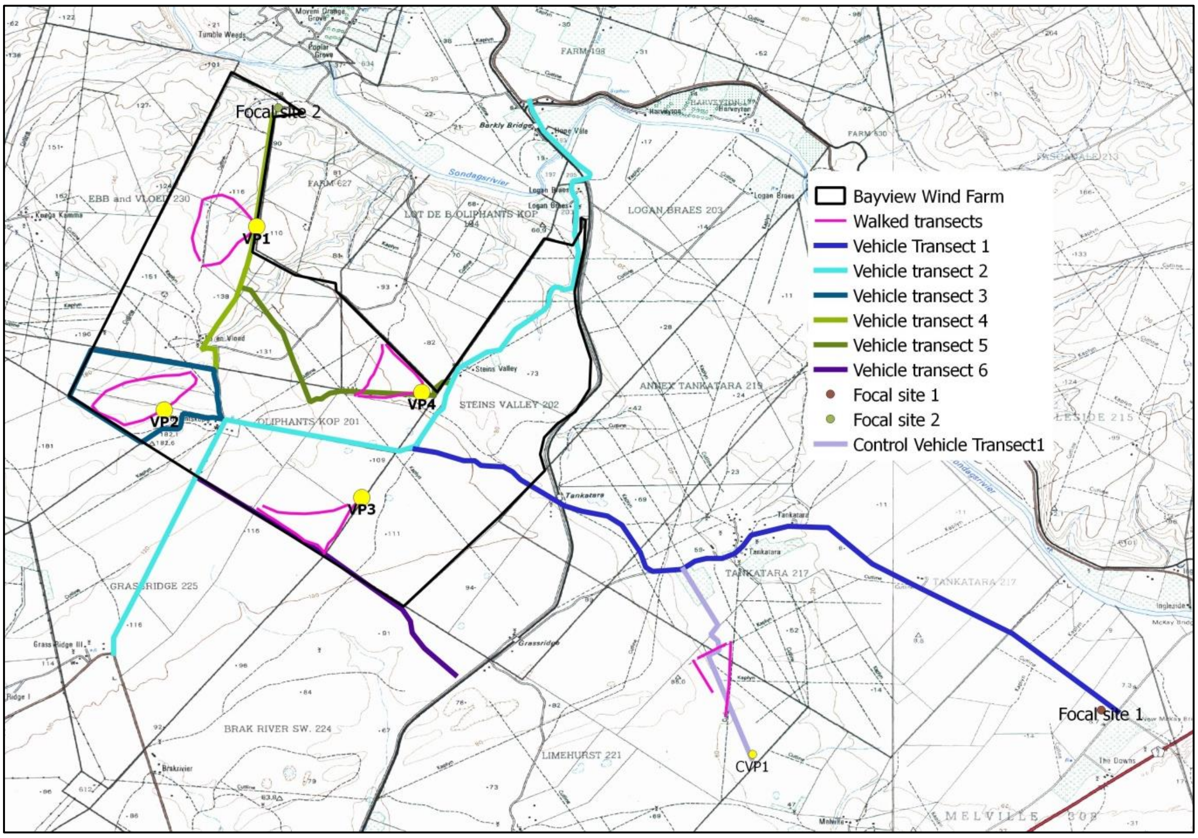

Figure 4. The layout of the pre-construction bird monitoring activities on the Bayview Wind Farm.

3. AVIFAUNAL COMMUNITY ON SITE - RESULTS & DISCUSSION

3.1. Description of study area

The study site is comprised of two main vegetation types (Mucina & Rutherford, 2006): 'Sundays Thicket' and 'Coega Bontveld'. A map of these vegetation types can be seen below in Figure 5. The Sundays Thicket distribution is as follows: "Eastern Cape Province: From the surrounds of Uitenhage and the northern edge of Port Elizabeth into the lower Sundays River Valley to east of Colchester and northwards to the base of the Zuurberg Mountains and stretching westwards north of the Groot Winterhoek Mountains to roughly the Kleinpoort longitude. Also an extensive area north of the Klein Winterhoek Mountains including much of the Jansenville District and parts of the far-southern Pearston District and far-western Somerset East District. Altitude 0–800 m." (Mucina & Rutherford, 2006). The Coega Bontveld is a regionally endemic or restricted range vegetation type and is distributed as follows: "Eastern Cape Province: Northeast of Port Elizabeth just inland of Algoa Bay; mainly around Coega, but also in small patches in Addo. Altitude 0–400 m".

The relevance of this vegetation type description to avifauna is that two main micro habitats are available for avifauna. There are two dominant habitats: thicket and shorter open shrubland. Figure 6 shows examples of these micro habitats. The shorter more open vegetation exists mostly in the west of site (see Figure 7). In addition there are several small pans on site (see Figure 8). These did not hold water during this monitoring programme, but are an important micro habitat nonetheless since they offer shorter vegetation and more open areas in between thicket.

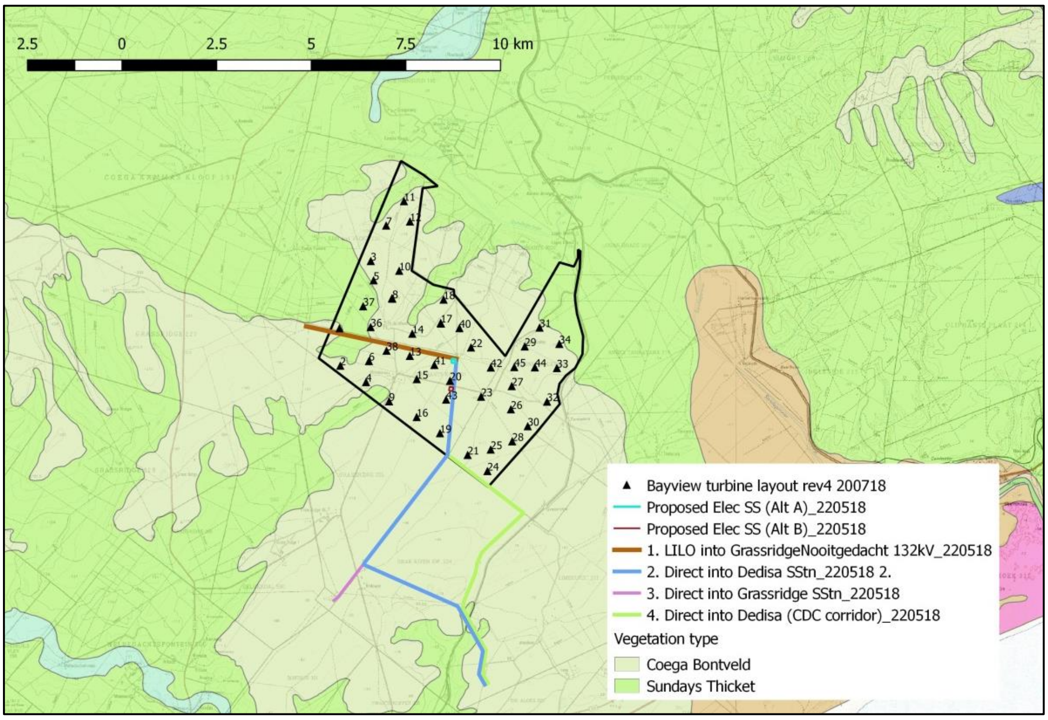

Figure 5. The vegetation classification for the Bayview Wind Farm site (Mucina & Rutherford, 2006).

Figure 6. Typical micro-habitats available to birds in the Bayview Wind Farm study area.

Figure 7. The open shorter vegetation in the west of the Bayview Wind Farm site. Note that one operational turbine from the neighbouring Grassridge Wind Farm can be seen in the far west.

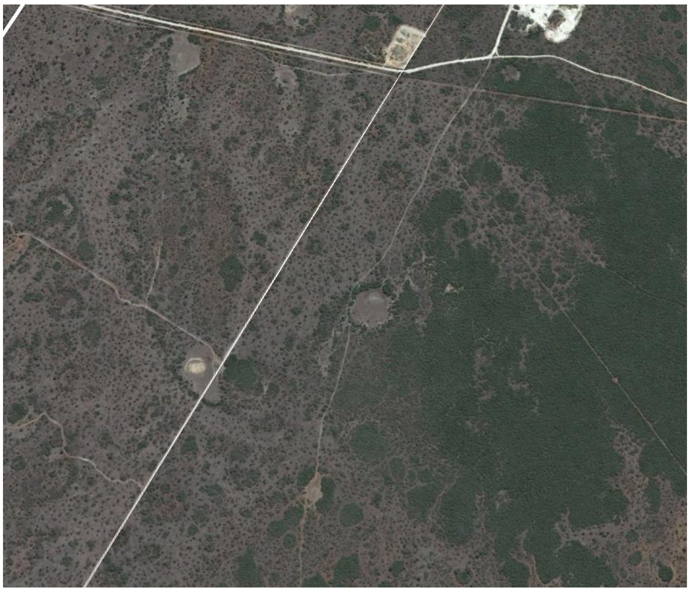

Figure 8. An example of the small pans on site visible as small light patches.

3.2. Target bird species

The national list of priority species compiled for the sensitivity map (described above – Retief *et al*, 2011, 2014) comprises 210 species, 33 of which could possibly occur on the Bayview site (Harrison *et al*, 1997; www.sabap2.adu.org.za). Table 1 below lists these species with their conservation status, preferred micro-habitats, uses of site, importance of site and likely interactions on site. An indication of whether the species was recorded on site during this monitoring was also provided. Of the 42 species, 22 were recorded on site, 9 of which are regionally Red Listed species. These are therefore the target species for this site.

Table 1. Summary of target bird species for this study and description of their likely interaction with the planned Bayview Wind Farm.

Common name	*Species name*	Regional Red List (Taylor *et al* 2015)	Preferred micro habitat	Confirmed on site during monitoring	Likely uses of site	Importance of site for species	Possible interactions with planned facility
African Marsh Harrier	*Circus ranivorus*	EN	Large wetlands and adjacent open country	Yes	Foraging	Low to medium	Collision with turbines & power lines
African Fish-Eagle	*Haliaeetus vocifer*		Water bodies	Yes	Foraging	Medium to high	Collision with turbines & power lines
African Harrier-Hawk	*Polyboroides typus*		Generalist	Yes	Foraging	Medium	Collision with turbines & power lines
Amur Falcon	*Falco amurensis*		Grassland	-	-	-	-
Black Sparrowhawk	*Accipiter melanoleucus*		Tall woodlands	Yes	Foraging	Low	Collision with turbines & power lines
Black Stork	*Ciconia nigra*	VU	Water bodies	-	-	-	-
Black Harrier	*Circus maurus*	EN	Open habitat	Yes	Foraging	Low	Collision with turbines & power lines
Black-shouldered Kite	*Elanus caeruleus*		Generalist	Yes	Foraging	Low	Collision with turbines & power lines
Black-winged Lapwing	*Vanellus melanopterus*		Short grassland	Yes	Foraging, breeding	Low	Collision with turbines & power lines
Blue Crane	*Anthropoides paradiseus*	NT	Grassland, wetland, dams, arable lands	Yes	Foraging	Low to Medium	Collision with turbines & power lines Disturbance if breeding Habitat destruction
Booted Eagle	*Aquila pennatus*		Generalist	Yes	Foraging	Low	Collision with turbines & power lines
Caspian Tern	*Sterna caspia*	VU	Water bodies	Yes	Foraging	Low	Collision with turbines & power lines
Chestnut-banded Plover	*Charadrius pallidus*	NT	Salt pans and water bodies	-	-	-	-
Denham's Bustard	*Neotis denhami*	VU	Grassland, arable lands	Yes	Foraging	Low to medium	Collision with turbines & power lines Disturbance if breeding Habitat destruction
Greater Flamingo	*Phoenicopterus ruber*	NT	Water bodies	Recorded off site	-	-	-
Grey-winged Francolin	*Scleroptila africanus*		Grassland	-	-	-	-
Jackal Buzzard	*Buteo rufofuscus*		Generalist	Yes	Foraging	Medium	Collision with turbines & power lines

Common name	*Species name*	Regional Red List (Taylor *et al* 2015)	Preferred micro habitat	Confirmed on site during monitoring	Likely uses of site	Importance of site for species	Possible interactions with planned facility
							Disturbance if breeding Habitat destruction
Lanner Falcon	*Falco biarmicus*	VU	Generalist	Yes	Foraging	Medium	Collision with turbines & power lines Disturbance if breeding Habitat destruction
Lesser Kestrel	*Falco naumanni*		Open country		-	-	-
Lesser Flamingo	*Phoenicopterus minor*	NT	Water bodies	Recorded off site	-	-	-
Long-crested Eagle	*Lophaetus occipitalis*		Woodlands and forest	-	-	-	-
Marsh Owl	*Asio capensis*		Marshes and damp ground	-	-	-	-
Martial Eagle	*Polemaetus bellicosus*	EN	Generalist	Yes	Foraging	Medium	Collision with turbines & power lines Disturbance if breeding Habitat destruction
Peregrine Falcon	*Falco peregrinus*		Cliffs	Yes	Foraging	Low	
Rufous-breasted Sparrowhawk	*Accipiter rufiventris*		Forests and plantations	-	-	-	-
Secretarybird	*Sagittarius serpentarius*	VU	Open grassland and open thicket	Yes	Foraging	Medium to high	Collision with turbines & power lines Disturbance if breeding Habitat destruction
Southern Black Korhaan	*Afrotis afra*	VU	Fynbos and karoo scrub	Yes	Foraging	Low	Collision with turbines & power lines Disturbance if breeding Habitat destruction
Pale Chanting Goshawk	*Melierax canorus*		Generalist	Yes	Foraging	Medium	Collision with turbines & power lines Disturbance if breeding Habitat destruction
Spotted Eagle-Owl	*Bubo africanus*		Generalist	Yes	Foraging	Low	Collision with turbines & power lines Disturbance if breeding Habitat destruction
Steppe Buzzard	*Buteo vulpinus*		Generalist	Yes	Foraging	Low	Collision with turbines & power lines

Common name	*Species name*	Regional Red List (Taylor *et al* 2015)	Preferred micro habitat	Confirmed on site during monitoring	Likely uses of site	Importance of site for species	Possible interactions with planned facility
Verreaux's Eagle	*Aquila verreauxii*	VU	Grassland and thicket, close to mountainous areas	Yes	Foraging	Low	Collision with turbines & power lines
White Stork	*Ciconia ciconia*		Arable land, wetland	-	-	-	-
Yellow-billed Stork	*Mycteria ibis*	EN	Water bodies	-	-	-	-

CR=Critically Endangered; EN= Endangered; VU = Vulnerable; NT = near-threatened (Taylor *et al*, 2015).

Certain of the species in Table 1 above have been included in spite of being relatively common, non-threatened species in South Africa. These include White Stork *Ciconia ciconia*, Pale Chanting Goshawk *Melierax canorus*, Jackal Buzzard *Buteo rufofuscus*, and others. They are included as their behaviour and/or morphology makes them likely candidates for interaction with wind energy facilities (see Retief *et al*, 2011, 2014). Other species such as Blue Crane, Denham's Bustard *Neotis denhami* are included since we believe them to be likely to interact with the facility, and they are already Red List species (Taylor *et al*, 2015) facing conservation challenges. Species such as these can ill afford additional mortality factors.

These species are described in more detail later in this report.

3.3. Sample counts of small bird species

A total of 80 small (i.e. not large terrestrial or raptor) bird species were recorded on the 12 Walked Transects conducted. This includes 4 049 individual birds from 2 735 records (see Appendix 2). Figure 9 shows the data for those species for which 50 or more individuals were recorded (since the full data set is too large to include in the main report). 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. Of the species recorded, two are regionally Red Listed (Taylor *et al*, 2015). These are the Caspian Tern *Hydroprogne caspia*, which is 'Vulnerable' and the Knysna Woodpecker *Campethera notata*, which is 'Near-threatened'. In addition to the two red listed species some of the remaining species are considered endemic or near-endemic species (see Table 2). The most abundant species recorded on site were Sombre Greenbul *Andropadus importunus*, Bar-throated Apalis *Apalis thoracica* and Southern Double-collared Sunbird *Cynniris chalybeus*. Figure 10 presents this data on a seasonal basis. As is to be expected most species were slightly more abundant in the summer and spring seasons than in autumn and winter. Almost all of these species (for which 50 or more individuals were recorded) were recorded across all four seasons on site. One notable exception is the Barn Swallow *Hirundo rustica*, which was recorded only in summer since it is a summer migrant to South Africa.

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.

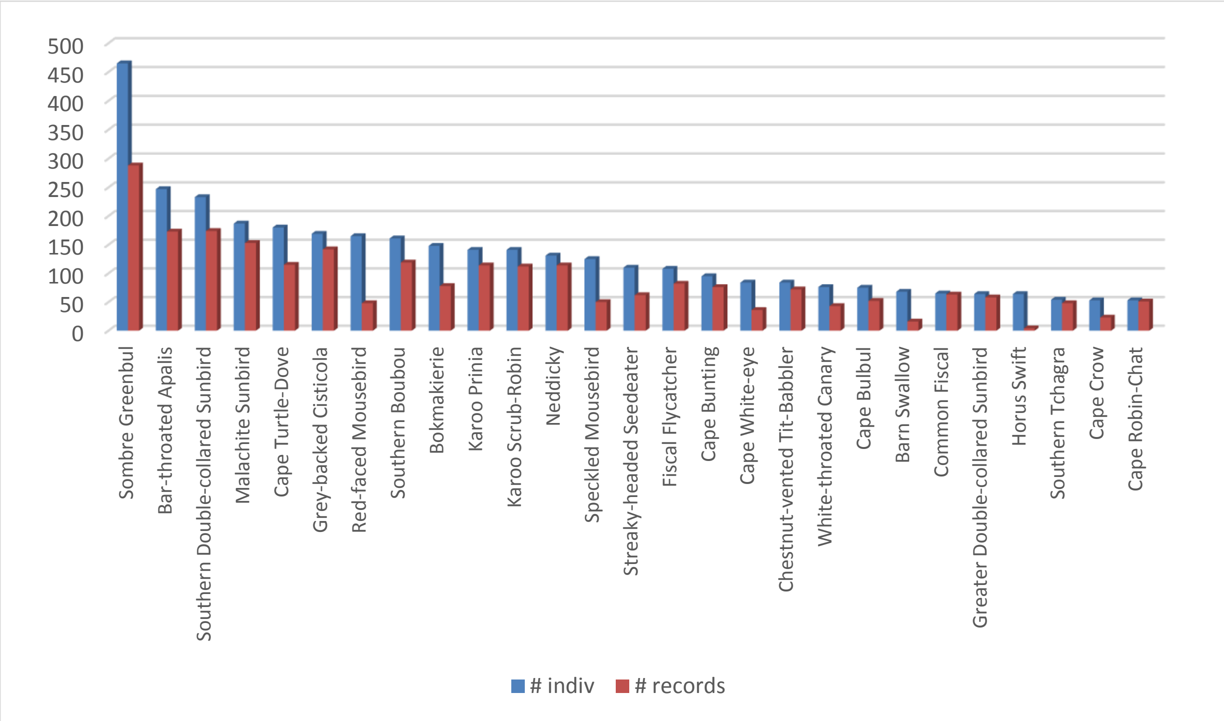

Figure 9. Summary of those small passerine bird species for which 50 or more individuals were recorded by the Walked Transects at Bayview Wind Farm. The full species list can be seen in Appendix 2.

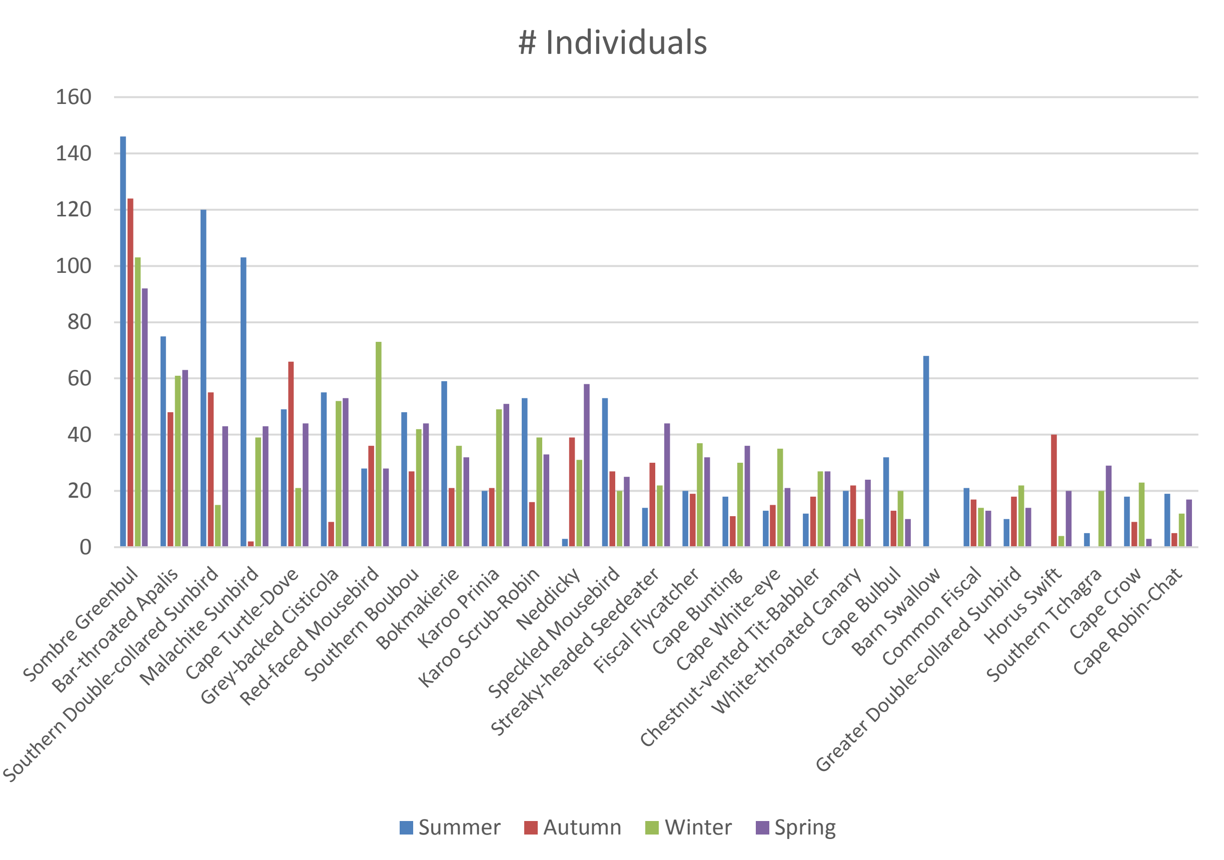

Figure 10. Seasonal summary of those small passerine bird species for which 50 or more individuals were recorded by the Walked Transects at the Bayview Wind Farm site. The full species list can be seen in Appendix 2.

Table 2. Endemic & Near-endemic small passerine bird species recorded on walk transects during pre-construction bird monitoring at Bayview Wind Farm.

				Total	
Species			**# indiv**	**# records**	**# birds/km**
Transect Length				**57.2km**	
Total # species	***Taxonomic name***	**Endemism**		**80**	
Common Name					
Acacia Pied Barbet	*Tricholaema leucomelas*	Endemic	32	31	0.56
Cape Batis	*Batis capensis*	Endemic	19	14	0.33
Cape Bulbul	*Pycnonotus capensis*	Endemic	75	52	1.31
Cape Canary	*Serinus canicollis*	Endemic	1	1	0.02
Cape Clapper Lark	*Mirafra apiata*	Endemic	42	33	0.73
Cape Longclaw	*Macronyx capensis*	Endemic	6	3	0.11
Cape Weaver	*Ploceus capensis*	Endemic	2	2	0.05
Cape White-eye	*Zosterops capensis*	Endemic	84	36	1.47
Eastern Long-billed Lark	*Certhilauda semitorquata*	Endemic	1	1	0.02
Fiscal Flycatcher	*Sigelus silens*	Endemic	108	82	1.89
Forest Canary	*Serinus scotops*	Endemic	1	1	0.02
Greater Double-collared Sun-	*Cinnyris afer*	Endemic	64	58	1.12

bird					
Karoo Prinia	*Prinia maculosa*	Endemic	141	114	2.47
Karoo Scrub-Robin	*Cercotrichas coryphoeus*	Endemic	141	112	2.47
Knysna Woodpecker	*Campethera notata*	Endemic	1	1	0.02
Southern Boubou	*Laniarius ferrugineus*	Endemic	161	119	2.82
Southern Double-collared Sunbird	*Cinnyris chalybeus*	Endemic	233	174	4.07
Southern Tchagra	*Tchagra tchagra*	Endemic	54	48	0.94
Bokmakierie	*Telophorus zeylonus*	Near-endemic	148	78	2.59
Cape Penduline Tit	*Anthoscopus minutus*	Near-endemic	6	3	0.11
Cape Sparrow	*Passer melanurus*	Near-endemic	6	3	0.11
Chestnut-vented Tit-Babbler	*Sylvia subcaeruleum*	Near-endemic	84	72	1.47
Eastern Clapper Lark	*Mirafra fasciolata*	Near-endemic	13	4	0.23
Grey-backed Cisticola	*Cisticola subruficapilla*	Near-endemic	169	142	2.96
Olive Bush-Shrike	*Telophorus olivaceus*	Near-endemic	16	15	0.28
White-throated Canary	*Crithagra albogularis*	Near-endemic	76	43	1.33
Yellow Canary	*Crithagra flaviventris*	Near-endemic	25	18	0.44

3.4. Counts of large terrestrial species & raptors

A total of 11 relevant bird species were recorded across the 6 drive transects totalling 172.8 kilometres for the year. This included 54 individual birds from 32 records. These data are shown in Figure 11 and Table 3. In each case the species' Red List status and endemism is shown. Figure 12 presents a seasonal summary of this data. The most abundant species were Denham's Bustard, Rock Kestrel *Falco rupicolus* and Blue Crane. Only two species were recorded across all four seasons, the Rock Kestrel *Falco rupicolus* and Jackal Buzzard. Southern Black Korhaan *Afrotis afra* and Denham's Bustard were recorded in three seasons, and the remaining species only in one season each. This data needs to be used cautiously, since the drive transects extend beyond the site boundary, as they aimed to measure abundance of these species in the broader area. Transect 4 in particular traverses the Sundays River floodplain to the east of the Bayview site, which is currently used for dairy pastures. This area represents a very attractive micro habitat for large terrestrial bird species including Blue Crane, Denham's Bustard and Southern Black Korhaan. Most (all Denham's Bustards, all Southern Black Korhaans and 7 of the 9 Blue Cranes) of the records of these species presented in Figure 11 and Table 3 are from this area. Since this a very different habitat to that on the Bayview site itself, these abundances of these species are not necessarily relevant to the site. The extent to which these species may move onto the Bayview site at some point in future is unknown, but based on this monitoring programme we conclude that the abundance of these species on site is far lower than in this floodplain area.

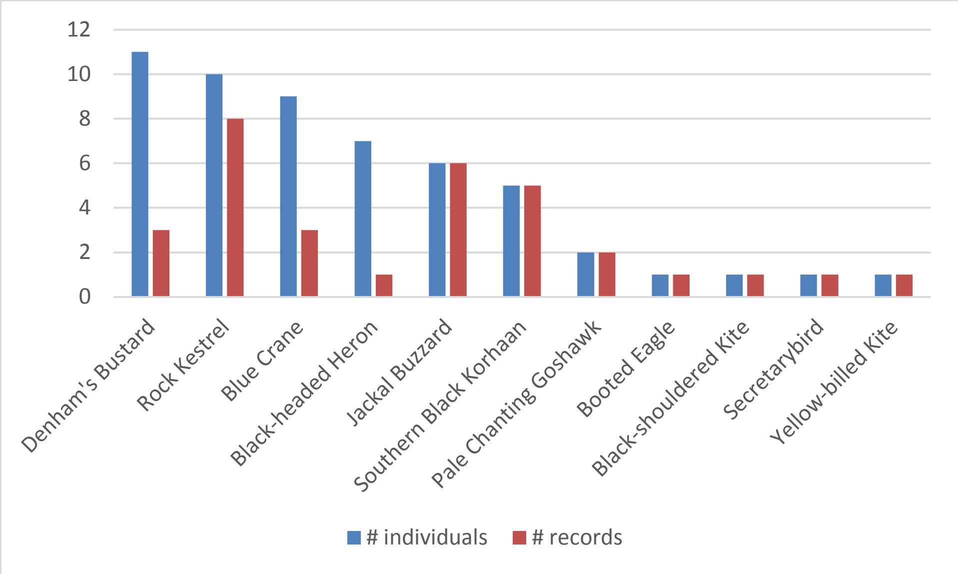

Figure 11. Summary of the large terrestrial and raptor bird species recorded during the vehicle based transects at the Bayview Wind Farm.

Table 3. Large terrestrial and raptor species recorded on the drive transects at Bayview Wind Farm.

Species					**All year**	
Total species					**10**	
Length of Transect					**172.8**	
Common name	**Species Name**	**Cons Stat**	**Ende-mism**	**# individ-uals**	**# rec-ords**	**# birds/km**
Denham's Bustard	*Neotis denhami*	VU		11	3	0.06
Rock Kestrel	*Falco rupicolus*			10	8	0.06
Blue Crane	*Anthropoides paradiseus*	NT	Endemic	9	3	0.05
Black-headed Heron	*Ardea melanocephala*			7	1	0.04
Jackal Buzzard	*Buteo rufofuscus*		Endemic	6	6	0.04
Southern Black Korhaan	*Afrotis afra*	VU	Endemic	5	5	0.03
Pale Chanting Goshawk	*Melierax canorus*		Near-endemic	2	2	0.01
Booted Eagle	*Aquila pennatus*			1	1	0.01
Black-shouldered Kite	*Elanus caeruleus*			1	1	0.01
Secretarybird	*Sagittarius serpentarius*	VU		1	1	0.01
Yellow-billed Kite	*Milvus parasitus*			1	1	0.01

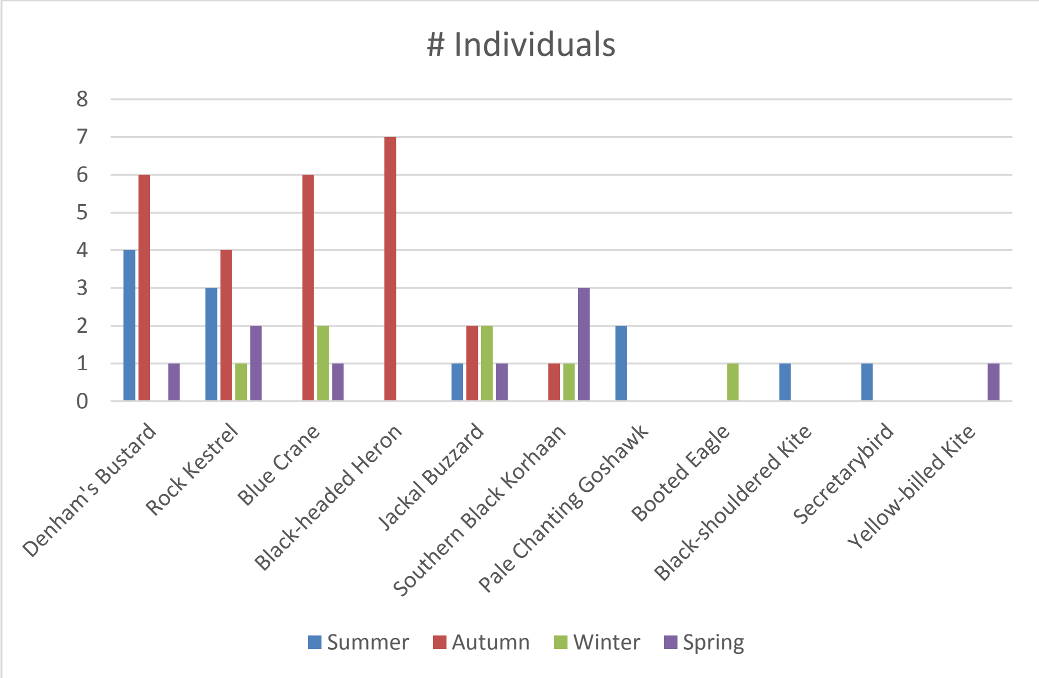

Figure 12. Seasonal summary of the large terrestrial and raptor bird species recorded during the vehicle based transects at the Bayview Wind Farm.

3.5. Focal Site surveys

A summary graph was produced showing the total number of species at both focal sites for the full year of monitoring (Figure 13 below). Most birds were Greater *Phoenicopterus roseus* and Lesser Flamingos *Phoeniconaias minor*. These were very difficult to count as the count was done from a large distance and as such some inaccuracies exist between the two species. This does not materially affect these findings though. The next most common species was the Black-necked Grebe *Podiceps nigricollis* followed by Ruff *Philomachus pugnax* and Pied Avocet *Recurvirostra avosetta*. The vast majority of birds were recorded at Focal Site 1 (6km from site), with only Cattle Egrets *Bubulbus Ibis* recorded at Focal Site 2, the Sundays River valley.

Focal Site 1 (Cerebos salt works) is approximately 6km from the proposed facility. As such the avifauna present at this site are of lower relevance to the project, but were counted in order to be thorough and since no other significant surface water sources are present closer to the facility site. Both the flamingo species are classified as Near-threatened (Taylor *et al,* 2015) and therefore of conservation concern. The likelihood of the flamingos in particular flying over the proposed site is low in our view. Most other water sources for them to commute to and from are closer to and along the coast (Sundays River estuary, Coega Saltworks etc) and would not require them to fly inland towards the Bayview site. Flamingos are known to fly off course at times, particularly in bad weather, so we cannot entirely exclude the chance of collision fatalities at Bayview once turbines are built. The risk thereof is however very low and does not require any management in our view.

In addition to these Focal Sites, sensitive species breeding sites often form focal sites. We spent several additional days searching for any large eagle or raptor nests but did not locate any. It is possible that the eagles we recorded on site are breeding in Addo National Park and commuting to the site to forage. We believe that at least one pair of African Fish-Eagle *Haliaeetus vocifer* must breed along the Sundays River within approximately 10km of the Bayview site. There are however so many potential trees, and land access from the northern banks is complex so we did not search further afield than Focal Site 2 for this nest.

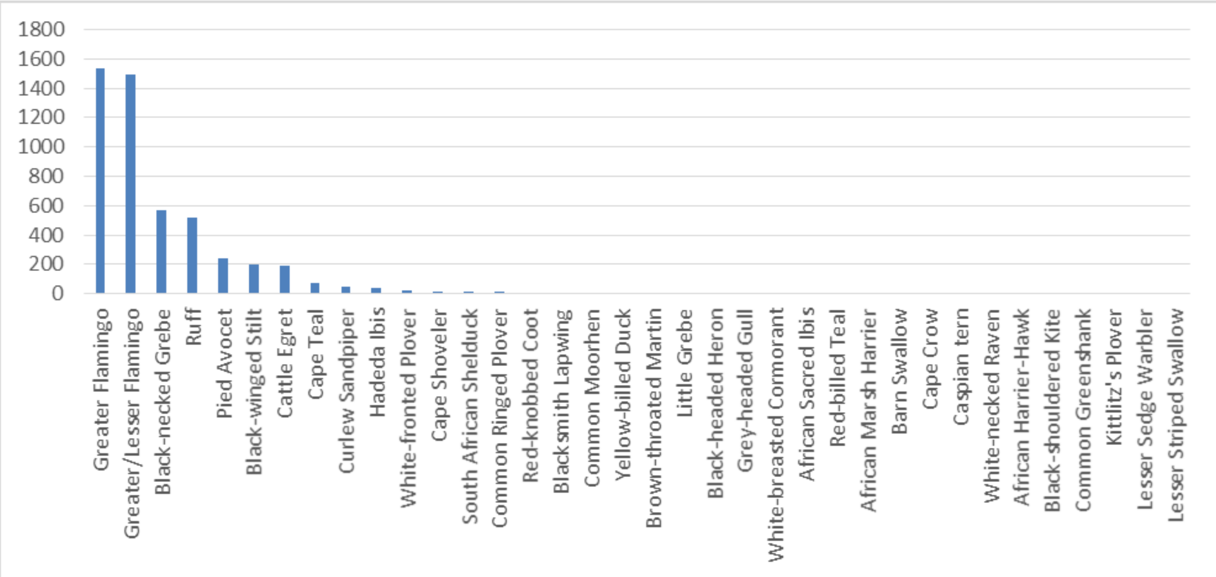

Figure 13. Total numbers of birds recorded at the two focal sites at Bayview Wind Farm.

3.6. Incidental Observations

A total of 79 separate records of target species were made, totalling 101 individual birds. The species recorded with the most individuals on site included Blue Crane, Pale Chanting Goshawk, Southern Black Korhaan, Jackal Buzzard and Denham's Bustard as can be seen in Figure 14 below. Table 4 presents the species recorded by this method. Each species' Red List and endemic status is also presented. As can be seen Martial Eagle is an endangered species (recorded once), while Southern Black Korhaan; Denham's Bustard and Secretarybird are all vulnerable species recorded fairly frequently on site. In addition Blue Crane is a near-threatened species. This data is presented on a seasonal basis in Figure 15. Species with strong seasonality are Blue Crane and Southern Black Korhaan, both recorded more in spring. Since this incidental data is not the product of a systematic data collection method it is used cautiously. In addition, as with the vehicle transects described in Section 3.2.2, many of the records presented here were made well off the Bayview site itself. This data is therefore not discussed in depth here.

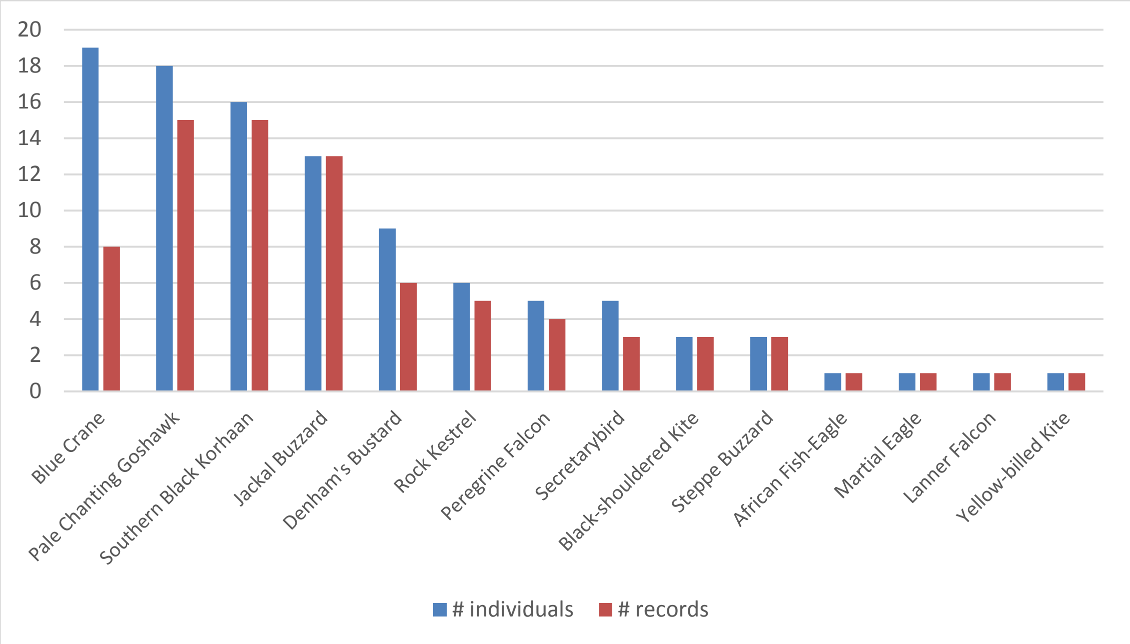

Figure 14. Summary of Incidental Observation data for target species on the site.

Table 4. Red List, endemic and near-endemic target bird species recorded as Incidental Observations.

				All year	
Total species				**14**	
Common name	**Species Name**	**Conservation Status**	**Endemism**	**# individuals**	**# records**
Blue Crane	*Anthropoides paradiseus*	NT	Endemic	19	8
Pale Chanting Goshawk	*Melierax canorus*		Near-endemic	18	15
Southern Black Korhaan	*Afrotis afra*	VU	Endemic	16	15
Jackal Buzzard	*Buteo rufofuscus*		Endemic	13	13
Denham's Bustard	*Neotis denhami*	VU		9	6
Rock Kestrel	*Falco rupicolus*			6	5
Peregrine Falcon	*Falco peregrinus*			5	4
Secretarybird	*Sagittarius serpentarius*	VU		5	3
Black-shouldered Kite	*Elanus caeruleus*			3	3
Steppe Buzzard	*Buteo vulpinus*			3	3
African Fish-Eagle	*Haliaeetus vocifer*			1	1
Martial Eagle	*Polemaetus bellicosus*	EN		1	1
Lanner Falcon	*Falco biarmicus*			1	1
Yellow-billed Kite	*Milvus parasitus*			1	1

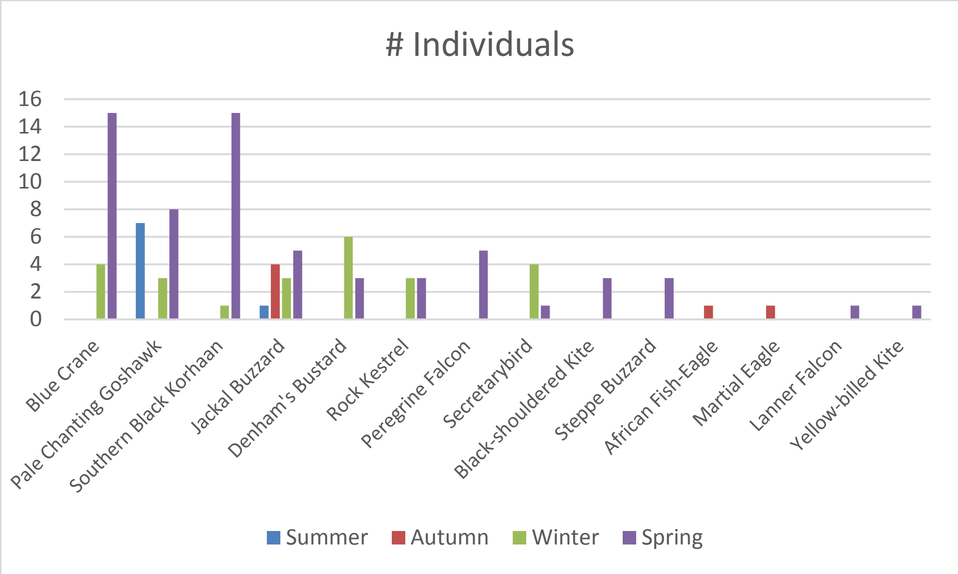

Figure 15. Seasonal summary of Incidental Observations data at Bayview Wind Farm.

A total of 169 bird species were recorded on site during the year using all methods, with a peak in species richness in autumn (125), followed by summer (118), spring (114) and winter (84).

3.7. Bird flight activity on site

A total of 64 sessions of bird flight observation were completed, of 3 hours each, totalling 192 hours of observation at Vantage Points. In total, 17 bird species were recorded flying on the site during the 288 hours of observation. These data are shown in Table 5.

Table 5 below shows the species recorded during the vantage point surveys as well as the total and average flight time and passage rates for these species. In total, 17 species were recorded flying. In terms of total flight duration, the species recorded flying for the longest on the site was Martial Eagle with a total flight time of 2:47:32 and a mean flight duration of 07:37. This was followed by Rock Kestrel with a total flight time of 41:55 and a mean flight time of 03:00. Jackal Buzzard was recorded flying for 41:53 with a mean flight time of 03:13. Secretarybird was recorded flying for 38:22 with a mean flight duration of 03:29. Black Shouldered Kite *Elanus caeruleus* was recorded flying for 27:09 with a mean flight duration of 02:16. Blue Crane was recorded flying for 24:26 with a mean flight duration of 01:13.

Generally speaking we expect those species which fly more often to be more susceptible to turbine collision. We consider those species with passage rates greater than 0.05 birds/hour to be the most frequent fliers and hence at most risk at this site. These include: African Fish-Eagle; Blue Crane; Black-shouldered Kite; Jackal Buzzard; Martial Eagle; Rock Kestrel; Secretarybird; and Pale Chanting Goshawk.

Table 5. Target bird species recorded during vantage point counts at Bayview Wind Farm.

Species	# birds	# rec-ords	Total flight duration	Mean flight duration	Passage rates-# bird/hour
African Fish-Eagle	17	17	00:23:48	00:01:24	0.089
African Harrier-Hawk	1	1	00:01:35	00:01:35	0.005
African Marsh-Harrier	1	1	00:12:10	00:12:10	0.005
Black Harrier	3	3	00:04:08	00:01:23	0.016
Black-shouldered Kite	12	12	00:27:09	00:02:16	0.063
Blue Crane	50	20	00:24:26	00:01:13	0.260
Booted Eagle	3	3	00:05:55	00:01:58	0.016
Jackal Buzzard	13	13	00:41:53	00:03:13	0.068
Lanner Falcon	5	5	00:05:22	00:01:04	0.026
Martial Eagle	25	22	02:47:32	00:07:37	0.130
Peregrine Falcon	4	4	00:12:41	00:03:10	0.021
Rock Kestrel	14	14	00:41:55	00:03:00	0.073
Secretarybird	17	11	00:38:22	00:03:29	0.089
Pale Chanting Goshawk	14	11	00:12:27	00:01:08	0.073
Steppe Buzzard	4	4	00:20:30	00:05:08	0.021
Verreaux's Eagle	3	3	00:08:20	00:02:47	0.016
Yellow-billed Kite	4	4	00:09:26	00:02:22	0.021

Figure 16 shows the seasonal summary of this flight data. Both Blue Crane and African Fish-Eagle were recorded flying far more in summer than other seasons. The remaining species shows less seasonality in their flight activity. Martial Eagle, Secretarybird and Rock Kestrel showed more flight activity in autumn and winter than the warmer seasons.

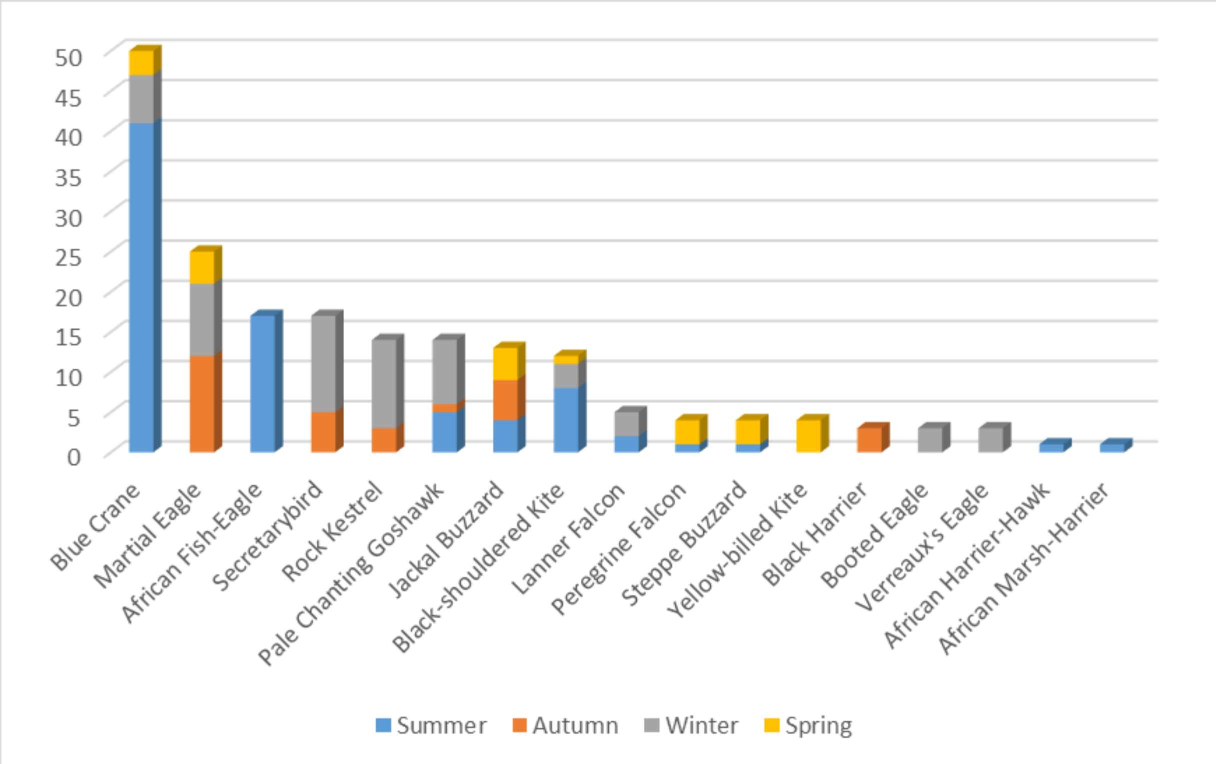

Figure 16. Seasonal numbers of bird flights recorded for each species at Bayview Wind Farm.

A summary of the target bird species flight height data is presented in Table 6 and in pie charts in Figure 17. Table 6 presents the percentage of flight time spent below, within and above the rotor impact zone

The following species spent 100% of their flight time below the rotor impact zone: African Harrier-Hawk, African Marsh-Harrier, Black Harrier, Lanner Falcon and Yellow-billed Kite. This is expected in the case of the harriers, which we know to typically fly low over the ground when foraging (which makes up most of their flight time). The following species spent the majority of their time below the rotor swept zone: Black-shouldered Kite, Booted Eagle, Peregrine Falcon, Rock Kestrel and Secretarybird.

The following birds spent the majority of their time within the rotor swept zone: African Fish Eagle, Blue Crane, Jackal Buzzard, Martial Eagle, Steppe Buzzard and Verreaux's Eagle. This is of concern as these species are believed likely to be susceptible to turbine collision based on their susceptibility to collision with other infrastructure such as power lines. It is also expected that species that spend more flight time at rotor height could be more at risk of collision with turbine blades. Data collected on operational wind farms shows that these species are sensitive to collisions with wind turbines (Ralston-Paton *et al,* 2017; & pers. obs). These species will be discussed in more detail later in this report

Very few flights were recorded above the rotor swept zone across all species.

The most sensitive species recorded from a conservation perspective are those with a regional Red List status (Table 6) and recorded flying frequently at rotor height. These include Blue Crane (Near-threatened) and Martial Eagle (Endangered).

Table 6. Summary of target bird species flight height data recorded during direct observation of bird flight at Bayview Wind Farm.

Species	# birds	# records	Total flight duration	Mean flight duration	Passage rates	% of flight duration below rotor	% of flight duration within rotor	% flight duration above rotor
African Fish-Eagle	17	17	00:23:48	00:01:24	0.089	15	**85**	
African Harrier-Hawk	1	1	00:01:35	00:01:35	0.005	100		
African Marsh-Harrier	1	1	00:12:10	00:12:10	0.005	100		
Black Harrier	3	3	00:04:08	00:01:23	0.016	100		
Black-shouldered Kite	12	12	00:27:09	00:02:16	0.063	85	**15**	
Blue Crane	50	20	00:24:26	00:01:13	0.260	39	**61**	
Booted Eagle	3	3	00:05:55	00:01:58	0.016	82	**18**	
Jackal Buzzard	13	13	00:41:53	00:03:13	0.068	43	**57**	
Lanner Falcon	5	5	00:05:22	00:01:04	0.026	100		
Martial Eagle	25	22	02:47:32	00:07:37	0.130	38	**54**	8
Peregrine Falcon	4	4	00:12:41	00:03:10	0.021	76	**24**	
Rock Kestrel	14	14	00:41:55	00:03:00	0.073	97	**3**	
Secretarybird	17	11	00:38:22	00:03:29	0.089	50	**42**	8
Pale Chanting Goshawk	14	11	00:12:27	00:01:08	0.073	50	**50**	
Steppe Buzzard	4	4	00:20:30	00:05:08	0.021	5	**95**	
Verreaux's Eagle	3	3	00:08:20	00:02:47	0.016	20	**80**	
Yellow-billed Kite	4	4	00:09:26	00:02:22	0.021	100		

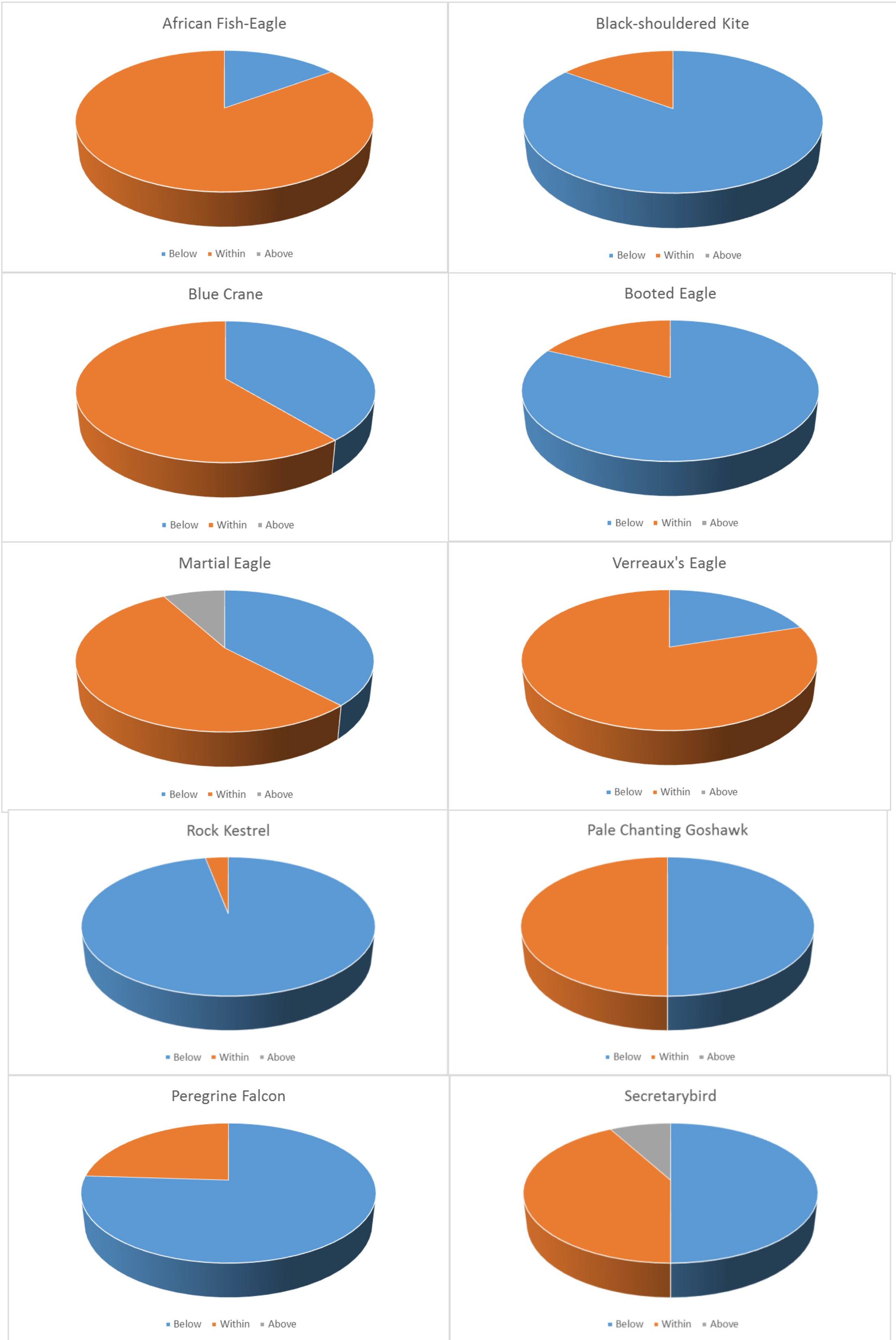

Figure 17. Flight height zones of target species that were recorded flying at at-least two different height classes.

The spatial patterns of bird flight activity can be seen below in Figure 18. Certain patterns in flight movement are evident, and are discussed in more detail below.

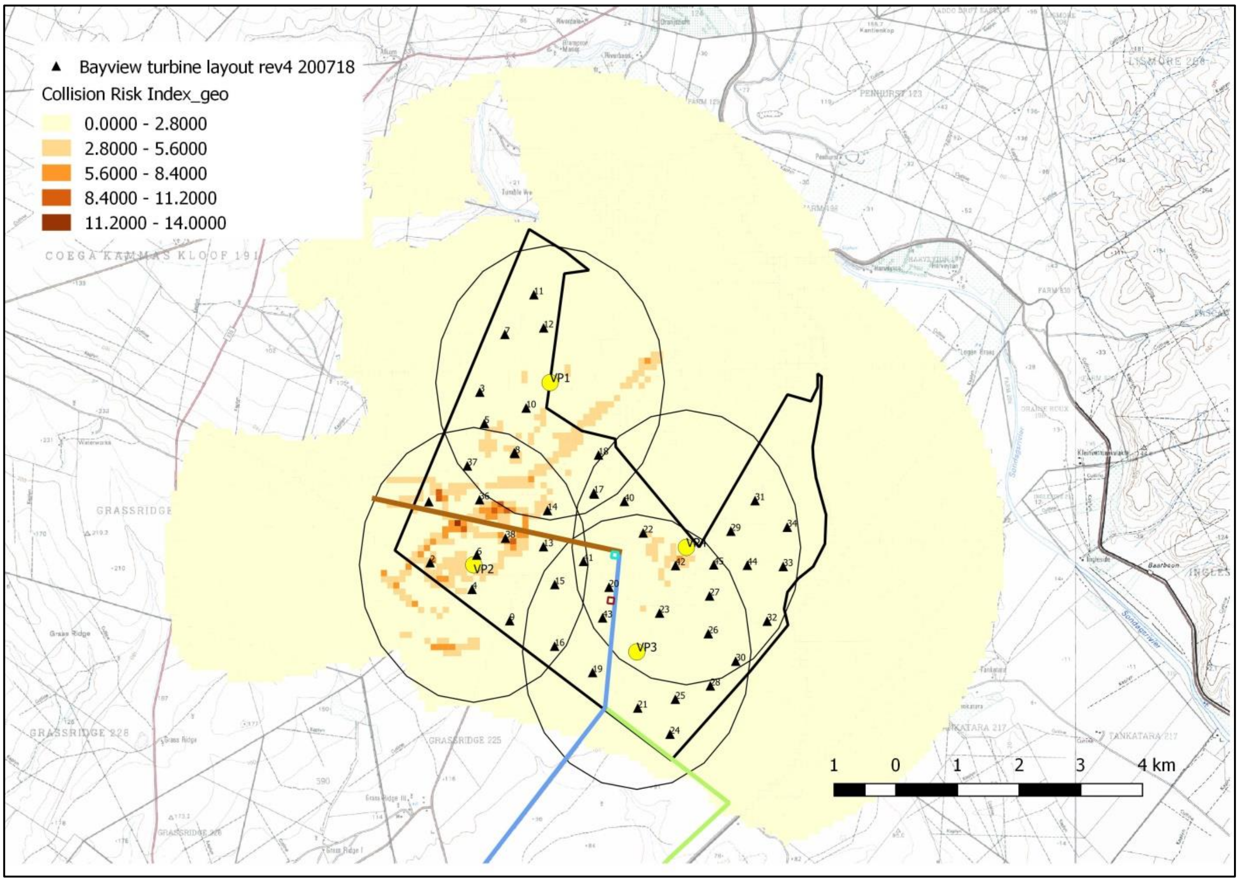

Figure 18. The individual Vantage Points and the raster display of bird usage patterns and flight paths.

Vantage Point 1: This vantage point is the most northerly vantage point on the project site. Very little flight activity was recorded at this VP.

Vantage Point 2: This vantage point is positioned in the west of the site in the shorter more open vegetation. This was the busiest area of the site in terms of target bird species flight activity. A slight flight path pattern can be identified running approximately south-west to north-east. This is over a small drainage line. The relevance of this aspect to the final facility layout has been discussed in more detail in Section 4.

Vantage Point 3: This is located in the south-east of the site, and recorded very little target bird species flight activity.

Vantage Point 4: This is located in the north-east of the site, and likewise recorded very little target bird species flight activity.

In general there was very little flight data recorded during the avifaunal monitoring program. The above maps show areas that had more flight activity than others, but overall the flight activity was relatively low.

3. SUMMARY OF RISK POSED TO AVIFAUNA

Table 6 presents a qualitative assessment of the risk of each type of impact occurring for each of the key target species (those species in Table 1) 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.

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. Overall, we judge that disturbance and displacement will be of low risk across all species. We have not found any breeding sites of sensitive species on or near site. The habitat on site is important for avifauna, particularly the bontveld, so we judge habitat destruction to be of medium risk. We judge bird collision with turbines to be of medium risk, and a high risk for collision/electrocution on power lines (particularly collision).

A discussion of those most important species follows Table 7:

Table 7. Qualitative assessment of risk for each target bird species at the Bayview Wind Farm site.

Common name	Regional, Global status	TOPS	Conse-quence of risk	Overall risk	Turbine collision risk	Power line colli-si-on/electrocutio n risk	Habitat destruction risk	Disturb-ance risk	Displacement risk
Harrier, Black	EN, EN		Low	Low	Low	Low	Low	Low	Low
Marsh-Harrier, African	EN, LC	PR	Low	Low	Low	Low	Low	Low	Low
Martial Eagle	EN, VU	VU	**High**	Medium	Medium	Medium	Low	Low	Low
Southern Black Korhaan	VU, VU		Low	Low	Low	Low	Low	Low	Low
Verreaux's Eagle	VU, LC		Low	Low	Low	Low	Low	Low	Low
Bustard, Denham's	VU, NT	PR	Low	Low	Low	Low	Low	Low	Low
Falcon, Lanner	VU, LC		Low	Low	Low	Low	Low	Low	Low
Secretarybird	VU, VU		**High**	Medium	Medium	Low	Low	Low	Low
Tern, Caspian	VU. LC		Low	Low	Low	Low	Low	Low	Low
Crane, Blue	NT, VU	EN	**High**	Medium	Medium	Medium	Low	Low	Low
Woodpecker, Knysna	NT, NT		Low	Low	Low	Low	Low	Low	Low
Rock Kestrel			Low	Medium	Medium	Low	Low	Low	Low
Booted Eagle			Low	Low	Low	Low	Low	Low	Low
Buzzard, Jackal			Low	Medium	Medium	Low	Low	Low	Low
Buzzard, Steppe			Low	Low	Low	Low	Low	Low	Low
Eagle, Long-crested			Low	Low	Low	Low	Low	Low	Low
Goshawk, Pale Chanting			Low	Medium	Medium	Low	Low	Low	Low
Harrier-Hawk, African			Low	Low	Low	Low	Low	Low	Low
Kite, Black-shouldered			Low	Medium	Medium	Low	Low	Low	Low
Stork, White			Low	Low	Low	Low	Low	Low	Low
African Fish-Eagle			Low	Medium	Medium	Medium	Low	Low	Low

Regional Status = Taylor et al, 2015; Global status = ICUN Red List 2-18. EN = Endangered; VU = Vulnerable; NT = Near-threatened; PR = Protected. TOPS = Threatened or Protected Species.

Martial Eagle *Polemaetus bellicosus*

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 in South Africa (Ralston-Paton, Smallie, Pearson & Ramalho, 2017) particularly in close association with nests (MacEwan & Smallie, 2016; Simmons & Martins, 2016).

This is a wide ranging species, which can best be protected from wind turbine collision risk close to its' breeding sites. We recorded Martial Eagle flying 22 times on site during pre-construction monitoring. This is a relatively high frequency and gave us cause to invest extra effort in searching for a nest in the wider area. We did not locate such a nest. A Martial Eagle nest was previously located approximately 3km south-east of the Bayview site by another study (Morant 2013, citing data from Paul Martin) on a power line tower. We visited this location and confirmed that the nest is no longer active. It has been partially pulled apart. We also surveyed approximately 20 towers (or 6-7km) of power line in the vicinity and confirmed that the nest had not moved to any of those. We have high confidence that no nest exists on the proposed site, however as distance from the site boundary increases our confidence in whether there could be a nest diminishes. There is certainly plenty of power line nesting substrate in the wider area and this species is well adapted to nesting on power lines. We have surveyed all power line possible in order to rule out that nests exist, but it is not possible to cover all of it, and new nests could be built subsequent to this report.

Based on its' presence in the broader area, conservation status, proven susceptibility to wind turbine collisions (and electrocution and collision on overhead power lines), we consider this a priority species for this assessment and judge that it will be at medium risk.

Secretarybird *Sagittarius serpentarius*

Secretarybird is classified as Vulnerable by Taylor *et al* (2015), having been upgraded from Near-threatened previously. This upgrade was as a result of having undergone more than 30% population reduction in the last ten years. The population in the region is estimated at less than 10 000 birds. Habitat loss is the biggest threat to this species. It is also very susceptible to collision with overhead power lines. We suspect it may be vulnerable to collision with wind turbines. According to Ralston-Paton et al (2017) no turbine fatalities have been recorded at wind farms in South Africa to date.

At the Bayview site, we have recorded the species flying fairly frequently on site. We judge this species to be at medium risk, primarily through collision risk. This is a difficult species to mitigate for as it is wide ranging and typically solitary or in pairs, so determining patterns of preferred areas or flight paths is not easy.

Black Harrier *Circus maurus*

The conservation status of the endemic Black Harrier has recently been re-appraised across its' limited world distribution and been reclassified as Endangered in both South Africa (Taylor *et al,* 2015). 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 (Ralston-Paton *et al*, 2017) in its tiny breeding range in South Africa mean that this species is now more threatened than ever.

This species was recorded flying 3 times on the Bayview Wind Farm site, in all cases solitary birds well below rotor height. Collision risk for this species appears to be strongly related to breeding activities during which the birds fly higher than typically recorded and hence into the rotor zone. If a pair of birds breed on or near a wind farm this results in high collision risk. We have not recorded any such breeding at Bayview Wind Farm. However if breeding occurs during the operation of the wind farm the operator will need to take the necessary mitigation measures to avoid fatalities. This could include: further research; habitat alteration; bird deterrence; and temporary shutdown of high risk turbines. This species cannot afford further fatalities.

Considering the habitat available and the various evidence at hand (including its' proven susceptibility to turbine collision at other operational sites in SA), we consider this species to be at low risk at this site, predominantly through collision with turbines.

Blue Crane *Anthropoides paradiseus*

The Blue Crane is classed as Near-threatened by Taylor *et al* (2015). 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), but only about 2 600 of these birds exist in the 'eastern grasslands' sub population. The Bayview population probably represents a transitional population between Karoo and eastern grasslands.

This species is highly susceptible to collision with overhead power lines (e.g. Shaw, 2009), and more recently has been recorded colliding with turbines at three operational wind farms we are aware of (per sobs, and in Ralston-Paton *et al*, 2017).

We conclude that this species is at medium risk overall from the proposed facility.

Denham's Bustard *Neotis denhamii*

The Denham's Bustard is classified as Vulnerable by Taylor *et al* (2015) 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. 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 estimate. This species is typically seen in higher densities in transformed habitats towards the west of the country, rather than in the natural grassland more prevalent in the east of South Africa. In the Eastern Cape to our knowledge, it is common only in the Kouga area around Humansdorp and St Francis Bay.

In terms of collisions this species is well known to be vulnerable to collision with overhead power lines (amongst other sources, 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. Raab *et al* (2009) however state that up until their publication no known instance of collision of Great Bustard with wind turbine exists (2009), probably because they fly too low. According to Ralston-Paton *et al* (2017) no turbine fatalities had been recorded at the time of writing.

At an operational wind farm elsewhere in Denham's Bustard range, the number of displaying male bustards did not appear to decrease when comparing pre, during and post wind farm construction monitoring results (Smallie, 2016). There may have been a slight displacement of the bustard lek area further away from turbines after they were constructed, which may indicate a slight spatial displacement effect (Smallie, 2016).

At the Bayview Wind Farm site this species has not been recorded flying. We conclude that this species will be low risk overall if the facility is built.

Jackal Buzzard *Buteo rufofuscus*

The Jackal Buzzard is a fairly common species throughout South Africa and on this site where one pair probably resides in the broader area. It is a generalist in terms of habitat, although does favour shorter vegetation. It hunts mostly in flight, meaning that a large proportion of its time is spent flying, and thereby at some risk of collision with vertical obstacles. On this site this species has been recorded frequently by all data collection methods.

This species is likely to be susceptible to four possible impacts: habitat destruction, disturbance, displacement and collision with turbine blades and power lines. 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). Ralston-Paton *et al* (2017) report 24 Jackal Buzzards killed on the 8 relevant sites.

We conclude that this species is at medium 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.

Black-shouldered Kite *Elanus caeruleus*

Kites typically hover approximately 10 to 30 metres above the ground whilst hunting and swoop down onto prey. Importantly they do not appear to require moving air or wind to fly, being able to fly even in stationary air. This has implications for their wind turbine collision risk profile, as they can occur and hunt almost anywhere on a site, and in any conditions.

The Black-shouldered Kite is a relatively common species throughout most of South Africa. It can forage over most open habitat types and has also been recorded breeding on man-made structures, such as Eskom transmission lines. This species has been recorded flying frequently and for long durations on the Bayview site. Its flight behaviour, alternating hovering with soaring makes it theoretically highly susceptible to collision with turbines. It is considered likely to breed on or near the site, although no nests have been found so far.

This species is likely to be susceptible to four possible impacts: habitat destruction, disturbance, displacement and collision with turbine blades and power lines. 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,* in prep.). This is a difficult species to mitigate for as it can forage almost anywhere over the site.

We conclude that this species is at medium risk, although its' non-threatened status means there is no significant cause for concern.

African Fish-Eagle *Haliaeetus vocifer*

Although not Red Listed, this is a species to consider reasonably important for this assessment. It has proven susceptible to wind turbine collision elsewhere (Ralston-Paton *et al* 2017) and is likely to be resident and breeding somewhere along the Sundays River. We recorded this species flying 17 times on site during monitoring, indicating that it could be susceptible to collision with turbines. We judge this risk to be medium.

Rock Kestrel *Falco rupicolus*

Kestrels are a group of birds that distinguishable by their flight behaviour. They typically hover approximately 10 to 30 metres above the ground whilst hunting and swoop down onto prey. Importantly kestrels do not require moving air or wind to fly, being able to fly even in stationary air. This has implications for their wind turbine collision risk profile, as they can occur and hunt almost anywhere on a site, and in any conditions. The Rock Kestrel is a relatively common species throughout most of South Africa. It can forage over most open habitat types but breeds in cliff terrain, although it has also been recorded breeding on man-made structures, such as Eskom transmission lines. This species has been recorded flying frequently and for long durations on the Bayview site. Its flight behaviour, alternating hovering with soaring makes it theoretically highly susceptible to collision with turbines.

This species is likely to be susceptible to four possible impacts: habitat destruction, disturbance, displacement and collision with turbine blades and power lines. Early observations on constructed wind farms under monitoring indicate that this species is highly susceptible to collision with turbines (pers. Obs). This is a difficult species to mitigate for as it can forage almost anywhere over the site.

We conclude that this species is at medium risk.

4. IMPACT ASSESSMENT

The potential impacts of the proposed Bayview Wind Farm and associated infrastructure have been formally assessed and rated according to the criteria (supplied by EOH-CES and shown in Appendix 5).

4.1 Destruction of bird habitat during construction of the facility

Cause & comment

Construction of the facility will result in a certain amount of destruction and removal of natural vegetation which was previously available to avifauna for use. This impact is anticipated to be of MODERATE NEGATIVE significance pre mitigation, particularly in the bontveld (which is endemic to this region).

Mitigation measures

Adhere to the sensitivity map (Section 6). Ensure that all vegetation removal and alteration is kept to an absolute minimum. It is not acceptable to impact on a much wider area than necessary for earthworks and then plan to rehabilitate.

Significance statement

IMPACT 1: Habitat destruction					
IMPACT	EFFECT			RISK OR LIKELIHOOD	OVERALL SIGNIFICANCE
	TEMPORAL SCALE	SPATIAL SCALE	SEVERITY OF IMPACT		
Without Mitigation	Long Term	Study Area	Moderately severe	Definite	**MODERATE -**
With Mitigation	Long Term	Study Area	Slight -	Definite	**LOW -**
No-Go Alternative	Long Term	Study Area	Slight -	Definite	**LOW -**

4.2 Disturbance of birds

Cause & comment

This is rated as LOW NEGATIVE significance, on account of there being no known breeding sites of sensitive bird species on or near site.

Mitigation measures

Nothing specific required. Adhere to sensitivity map.

Significance statement

IMPACT 1: Disturbance of birds					
IMPACT	EFFECT			RISK OR LIKELIHOOD	OVERALL SIGNIFICANCE
	TEMPORAL SCALE	SPATIAL SCALE	SEVERITY OF IMPACT		
Without Mitigation	Short Term	Study Area	Moderately severe	Probable	**LOW -**
With Mitigation	Short Term	Study Area	Slight -	Probable	**LOW -**
No-Go Alternative	Short Term	Study Area	Slight -	Probable	**LOW -**

4.3 Displacement of birds from the site and barrier effects

Cause & comment

Once operational the facility could displace certain birds from the area, or cause them to fly further to get around the facility. Displacement of birds is judged to be of LOW NEGATIVE significance pre mitigation.

Mitigation measures

Nothing specific required. Adhere to sensitivity map.

Significance statement

IMPACT 1: Displacement of birds					
IMPACT	EFFECT			RISK OR LIKELIHOOD	OVERALL SIGNIFICANCE
	TEMPORAL SCALE	SPATIAL SCALE	SEVERITY OF IMPACT		
Without Mitigation	Long Term	Study Area	Slight -	Probable	**LOW -**
With Mitigation	Long Term	Study Area	Slight -	Probable	**LOW -**
No-Go Alternative	Long Term	Study Area	Slight -	Probable	**LOW -**

4.4 Collision of birds with turbine blades

Cause & comment

Birds in flight on the site could collide with operational turbine blades, thereby being killed or seriously injured. Collision of birds with turbines is judged to be of MODERATE NEGATIVE significance pre mitigation.

Mitigation measures

The significance of this impact can be reduced to LOW NEGATIVE significance by adhering to the sensitivity map in Section 6, and by providing a contingency mitigation budget in the operational phase to allow adaptive management of impacts that arise.

Significance statement

IMPACT 1: Collision of birds with turbine blades					
IMPACT	EFFECT			RISK OR LIKELIHOOD	OVERALL SIGNIFICANCE
	TEMPORAL SCALE	SPATIAL SCALE	SEVERITY OF IMPACT		
Without Mitigation	Long Term	Study Area	Moderately severe -	Possible	**MODERATE -**
With Mitigation	Long Term	Study Area	Slight -	Possible	**LOW -**
No-Go Alternative	Long Term	Study Area	Slight -	Possible	**LOW -**

4.5 Collision & electrocution on overhead power lines

Cause & comment

Birds could perch on the pylons/towers of the overhead grid connection power line and be at risk of electrocution if the design is not bird friendly. Birds in flight could collide with the overhead cables, particularly the earth wire. Collision and electrocution of birds on overhead power lines on site is anticipated to be of HIGH NEGATIVE significance.

Mitigation measures

Both of these impacts can be mitigated successfully in our opinion to reduce the significance to LOW NEGATIVE. In both cases the first and foremost approach to mitigation should be the selection of the shortest and most sensible possible length of new overhead grid connection power line to be constructed and the optimal route for this line (see Section 6.2). No overhead power line should be built connecting turbines within the site. Only the grid connection should be above ground. To mitigate for collision of the relevant species, it is recommended that the earth wires be fitted with the best available (at the time of construction) Eskom approved anti bird collision line marking device. This should preferably be a dynamic device, i.e. one that moves as it is believed that these are more effective in reducing collisions, especially for bustards (see Shaw 2013), which are one of the key species (Denham's Bustard) in this area. It is recommended that a durable device be used as this area is clearly prone to a lot of strong wind and dynamic devices may be susceptible to mechanical failure. It will be either Bayview Wind Farm or Eskom's responsibility to ensure that these line marking devices remain in working order for the full lifespan of the power line, as we cannot afford to have significant numbers of bird collisions on this new line. It is important that these devices are installed as soon as the conductors are strung, not only once the line is commissioned, as the conductors pose a collision risk as soon as they are strung. The devices should be installed alternating a light and a dark colour to provide contrast against dark and light backgrounds respectively. This will make the overhead cables more visible to birds flying in the area. Note that 100% of the length of each span needs to be marked (i.e. right up to each tower/pylon) and not the middle 60% as some guidelines recommend. This is based on a finding by Shaw (2013) that collisions still occur close to the towers or pylons. It is also recommended that the stay wires on the met masts on site be installed with these devices as soon as possible.

In the case of bird electrocution, the power line must be built on an Eskom approved bird-friendly pole structure which provides ample clearance between phases and phase-earth to allow large birds to perch on them in safety.

Significance statement

IMPACT 1: Collision & electrocution of birds on overhead power lines					
IMPACT	EFFECT			RISK OR LIKELIHOOD	OVERALL SIGNIFICANCE
	TEMPORAL SCALE	SPATIAL SCALE	SEVERITY OF IMPACT		
Without Mitigation	Long Term	Study Area	Severe -	Probable	**HIGH -**
With Mitigation	Long Term	Study Area	Slight -	Possible	**LOW -**
No-Go Alternative	Long Term	Study Area	Slight -	Probable	**LOW -**

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

The proposed Bayview Wind Farm is situated in an area of the country where several such projects are either under assessment or already authorised, and one site is operational. To our knowledge these sites (within a 30km radius of Bayview Wind Farm) are as follows:

- Dassiesridge Wind Energy Facility. Authorised – approximately 67 turbines
- Grassridge Wind Energy Facility. Operational – 20 turbines.
- Scarlet Ibis Wind Farm. Authorised. 9 turbines.
- Ukomeleza Wind Energy Facility. Approximately 8 turbines.
- Motherwell Wind Energy Facility. Approximately 22 turbines.
- Universal Wind Farm. Authorised – approximately 20 turbines.
- Coega Sonop Wind Farm. Approximately 36MW (assumed 20 turbines)

In such areas, where multiple facilities may be built, it is important to consider the overall or cumulative impact of these facilities on birds. Consideration of each project in isolation may not adequately judge the effect that projects will have on avifauna when combined. 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).

The cumulative impacts of wind energy on avifauna within a 30km radius of the proposed Bayview Wind Farm 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 Bayview Wind Farm project. *Sections 4.1 to 4.5 of this report.*
2. Identify and obtain details for all operational and authorised overhead power lines and wind farms (within 30km radius of Bayview Wind Farm). *Above*
3. Identify impacts of the proposed Bayview Wind Farm which are also likely or already exist at the other projects. *Section 4.1 to 4.5.*
4. Obtain avifaunal reports and data for other projects. *Done where possible*
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 Bayview Wind Farm 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.

The potential impacts identified at Bayview Wind Farm which are relevant to the cumulative assessment are as follows:

Destruction of bird habitat during construction

This impact was judged to be of medium negative significance for Bayview Wind Farm. Wind farms transform a relatively small proportion of the habitat on which they are built so at this level this impact is probably not of too much concern. However we do not yet fully understand the effects of habitat fragmentation which are less direct and tangible. It is this effect which is probably of most concern in terms of cumulative effects as more wind farms means more fragmentation over a wider area. We believe the significance of the cumulative effects of habitat destruction will be Moderate in this study area.

Disturbance of birds during construction and operations

This impact was judged to be of low negative significance for Bayview Wind Farm. The main basis for this impact being of low significance is that no disturbance of breeding sensitive species is anticipated since no such sites were found on or near site. This is also the case for the other projects for which we have obtained avifaunal reports (Dassiesridge, Scarlet Ibis, Ukomeleza, Grassridge). Overall we judge the cumulative effect of disturbance to be of Low significance.

Displacement of birds during operations

This impact was judged to be of low significance at Bayview Wind Farm. As with habitat fragmentation, this is an effect which likely will only become noticeable when multiple wind farms are built adjacent to each other as certain bird species may be left with nowhere to go and be displaced out of this study area entirely. Overall we judge this impact to be of Moderate significance on a precautionary basis.

Collisions of bird with turbines during operations

This impact was judged to be of moderate significance at Bayview Wind Farm. Given the low actual fatality rates recorded at the operational Grassridge Wind Farm (Smallie & MacEwan, 2017) we believe this cumulative impact will be of Moderate significance in the study area.

Collision and electrocution of birds on overhead power lines

This impact was assessed to be of High negative significance. We judge the cumulative effect of this impact in the study area to be of High significance. Fortunately this is easily mitigated as described in Section 4.5 of this report.

Overall, taking the above 5 impacts into account we conclude that the cumulative impact of wind farms on birds in the study area will be of Low to Moderate significance. The contribution of Bayview Wind Farm (45 turbines of a possible total of approximately 166 turbines) is Moderate.

5. MITIGATION OF THE IDENTIFIED RISKS TO AVIFAUNA

5.1. Spatial mitigation of avifaunal risk – avifaunal sensitivity mapping

The primary means of mitigating risk of wind energy facilities to birds is through spatial planning, both at the landscape level and the micro siting of turbines on site.

5.1.1. Landscape level sensitivity mapping

The "Avian Wind Farm Sensitivity map for South Africa" (Retief *et al,* 2011) was consulted to determine the sensitivity of the Bayview Wind Farm site in national terms. Figure 19 shows that the site falls between the 2nd and 3rd highest sensitivity category in terms of avifauna, 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 South African Important Bird Area (IBA) data was consulted and the site does not fall within any IBA's (Marnewick *et al*, 2015). The closest IBA's are 11km east (SA094-Alexandria Coastal belt) and 18km south west (SA096- Swartkops Estuary and Chatty Salt Pans). These were considered far enough away to not be discussed any further.

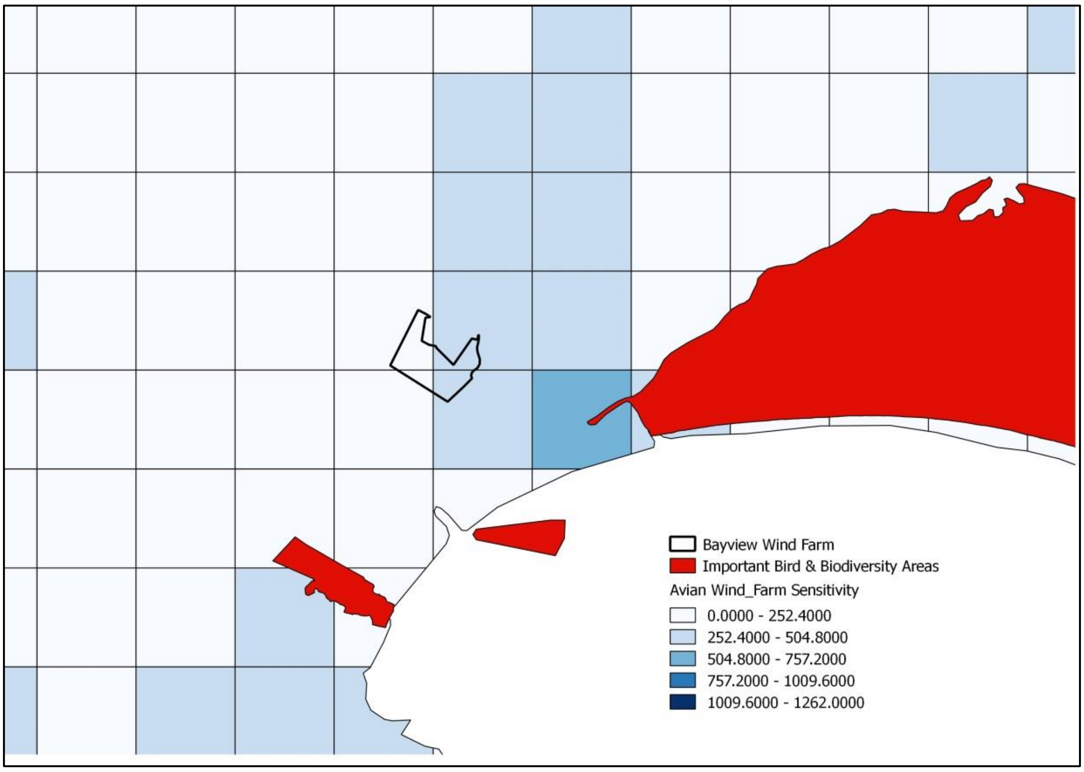

Figure 19. The position of the Bayview Wind Farm in the Avian wind farm sensitivity map and relative to Important Bird & Biodiversity Areas (Retief *et al*, 2011; Marnewick *et al*, 2015). Darker colours indicate higher avifaunal sensitivity.

5.1.2. On site avifaunal sensitivity

Three factors were considered relevant in the development of an avifaunal sensitivity map to inform the facility layout. These include: the collision risk index developed in Section 3.7; the position of small pans; and the position of a drainage line in the west of the site. Pans are considered attractive bird habitat as described elsewhere in this report, and have been provided with a 250m buffer around them to provide adequate spatial separation between birds utilising the pans and the nearest wind turbines. Drainage lines hold different vegetation and consequently different small bird species in addition to often representing flight paths for large birds commuting around the area. The drainage line in the west of the site has therefore been assigned a 250m buffer. Fortunately the high collision risk area identified in Section 3.7 is contained within the drainage line buffer. The resulting identified 'medium sensitivity areas are displayed in Figure 20. No overhead power lines or wind turbines should be placed in these medium sensitivity areas unless absolutely necessary and under approval of an ornithologist. The grid connection power line will traverse one drainage line. This is acceptable, and preferred to the alternative of a longer power line around the drainage line. To minimise impacts the power line should span the drainage line (i.e. no pylons in drainage itself). None of the current turbine positions are in medium sensitivity areas.

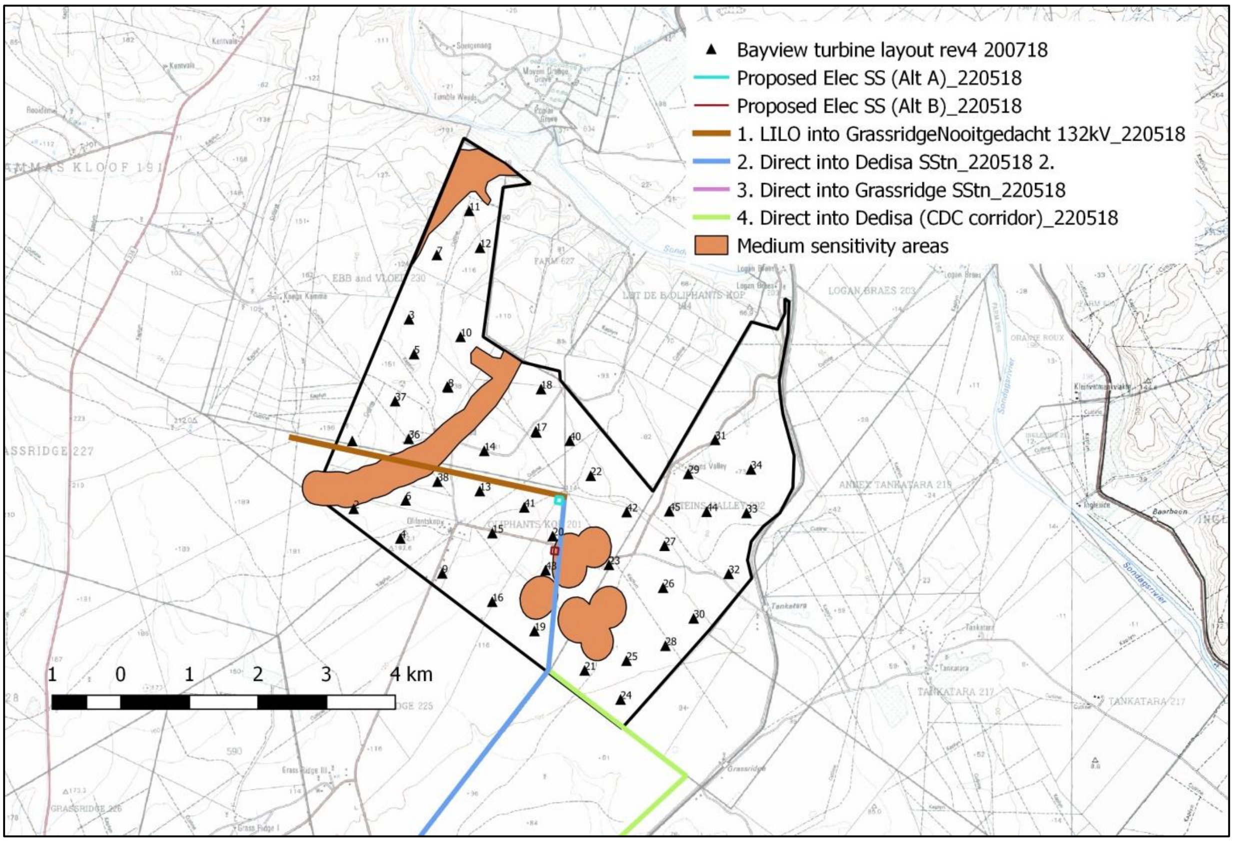

Figure 20. Avifaunal constraints map for the Bayview Wind Farm site.

5.2 Comparison of grid connection, substation & office building options

5.2.1. Power line options

Four options have been presented for the grid connection power line at Bayview Wind Farm. These also each have two sub-options dependent on which substation site is selected. These are described in Table 8 below and presented in Figure 21 (note that power line Options A and B overlap so that only A shows in the figure). The most important factor affecting the preference for options for avifauna is the length of the line. The less line needed the less the impacts in general. The most preferred option is therefore Option 1 into the Grassridge Nooitgedacht 132kv line.

Table 8. Grid connection power line options at Bayview Wind Farm.

Option	**Approximate length (Substation A)**	**Approximate length (Substation B)**	**Preference ranking**
1) LILO into Grassridge-Nooitgedacht 132kv	4.8km	5.6km	1
2)Direct into Dedisa Substation	12.1km	11.3km	4
3) Direct into Grassridge Substation	7.8km	7.0km	2
4) Direct into Dedisa (CDC corridor)	11.1km	10.3km	3

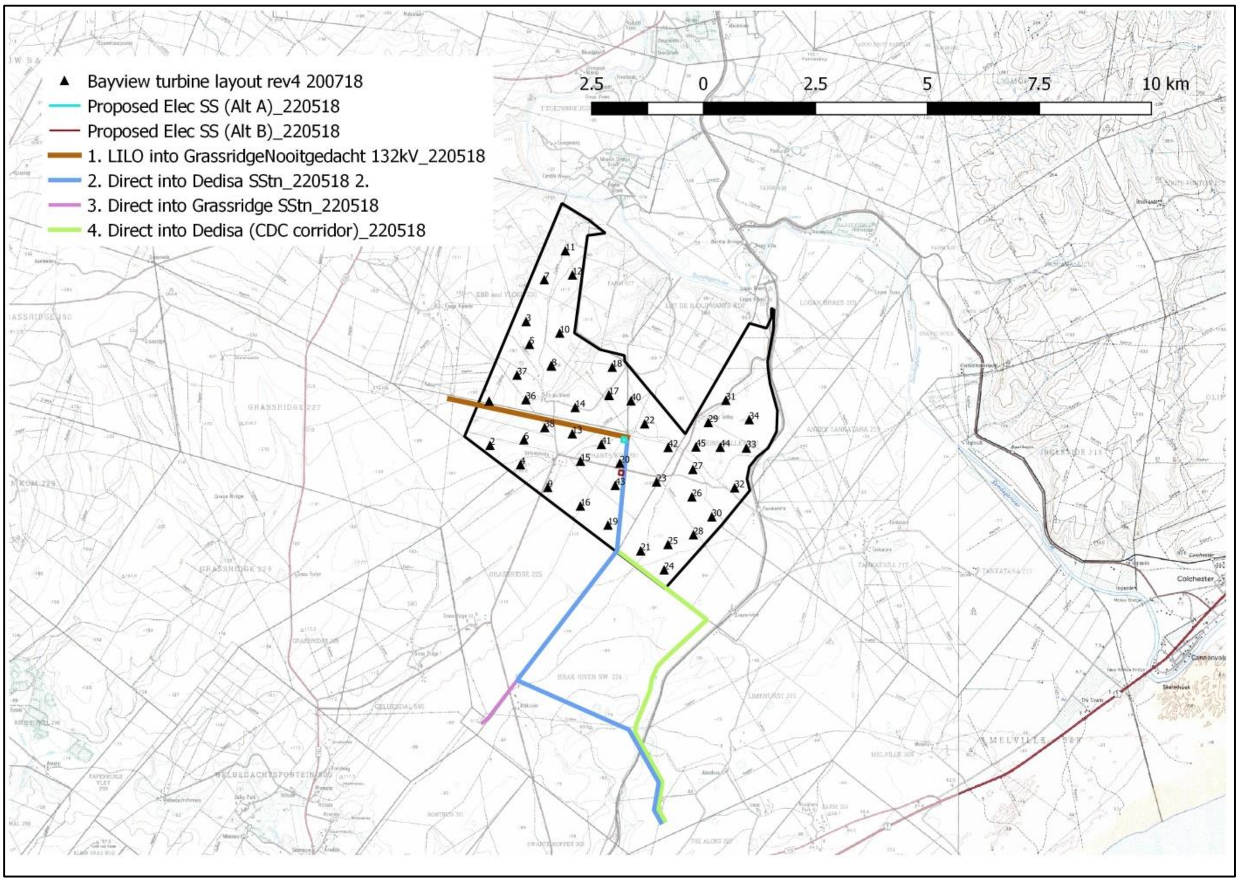

Figure 21. Grid connection power line options at Bayview Wind Farm.

5.2.2. Substation options

Two options for the placement of the on-site electrical substation are presented for assessment (Figure 22). These two are approximately 800m apart. There is little difference from an avifaunal perspective between the two sites. Substation A is preferred because it will result in a shorter power line being required (if Option 1 is selected for the power line).

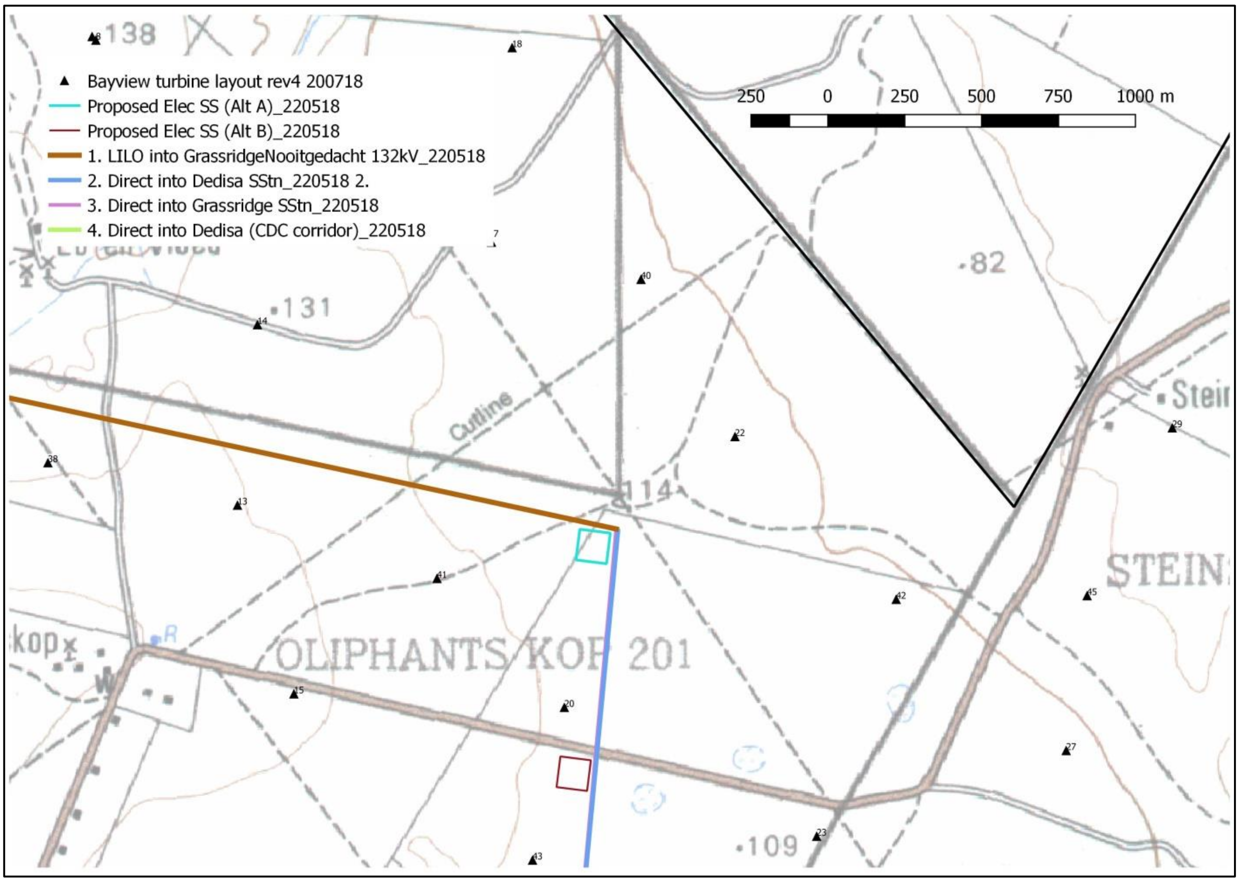

Figure 22. The two electrical substation options at Bayview Wind Farm.

6. POST CONSTRUCTION BIRD MONITORING PROGRAMME

The work done to date on the Bayview Wind Farm 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 Bayview Wind Farm if constructed.

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 construction 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.

6.1. Live bird monitoring

- The 12 walked transects of 1km each that have been done during pre-construction monitoring should be continued.
- The 6 vehicle based road count routes should be continued, and conducted once on each site visit.
- The two focal sites already established should be monitored. If any sensitive species are found breeding on site in future these nest sites should be defined as focal sites.
- 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 4 Vantage Points already established should be used to continue data collection post construction. The exact positioning of these may need to be refined based on the presence of new turbines and roads. A total of 12 hours of observation 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.
- The activities at the control site should be continued, i.e. 1 Vantage Point, 3 Walked Transects and 1 Vehicle Based transect.

6.2. 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.

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. The frequency at which these searches need to be conducted will be at least every 10 working days (or effective two weeks). 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.

A more detailed post construction monitoring programme can be designed once the full layout is finalised. The most up to date version of the best practice guidelines (Jenkins *et al* 2015) should inform the programme design at the time.

7. CONCLUSION & RECOMMENDATIONS

Key findings with respect to the avifaunal community on site are as follows:

- A total of 169 bird species were recorded on site. Species richness peaked in autumn, followed by summer, spring and winter.
- There are two dominant bird micro habitats available on site, the thicket, and open shorter vegetation. Several small pans and one drainage line are also present.
- Of the 42 bird species originally identified as target species for the site, 22 have been confirmed to occur on site. These include 9 regionally Red Listed bird species.
- Eighty small (i.e. not raptor or large terrestrial) bird species were recorded on site, of which 2 are regionally Red Listed species: Caspian Tern and Knysna Woodpecker. The most abundant small passerines species were Sombre Greenbul, Bar-throated Apalis and Southern Double-collared Sunbird. A large number of these 80 species are endemic (18) or near-endemic (9).
- Eleven target raptor or large terrestrial bird species were recorded on the drive transects on site. Most abundant of these were Denham's Bustard, Rock Kestrel and Blue Crane. However the Denham's Bustard and Blue Crane were predominantly recorded on a portion of transect well off the Bayview Wind Farm site on the Sundays River plains, on dairy pastures. This data is therefore not directly relevant to the avifaunal community on the site itself.
- A large number (300-400) of Greater and Lesser Flamingos were present on the Cerebos salt works 6km east of the site in all seasons. Although this is important to be aware of, in our opinion the likelihood of these birds flying over the Bayview Wind Farm site is low.
- Seventeen target bird species were recorded flying on the site itself. Of these, the species we consider most at risk of collision with turbines if built are Martial Eagle and Blue Crane based on the their conservation status, frequency, duration and height above ground at which they were recorded flying. Martial Eagle had the longest flight duration of all recorded species, most of which was at rotor height. Blue Crane flew less frequently but as a gregarious species the recorded flights often included multiple birds, and most flight was at rotor height.
- Overall the bird flight activity recorded on site was relatively low. An area of higher collision risk has been identified based on recorded flight data. This is an area in the far west of site.
- A medium sensitivity spatial category has been identified on site based on pans, drainage lines and bird collision risk index. It is recommended that overhead power lines and turbines are not built in this area. The grid connection power line preferred option currently traverses this medium sensitivity area. This is however acceptable provided that no pylons are placed in the drainage line.

As the result of the above avifaunal findings, the potential impacts on avifauna of the proposed project have been assessed as follows:

- Construction of the facility will result in a certain amount of destruction and removal of natural vegetation which was previously available to avifauna for use. This impact is anticipated to be of MODERATE NEGATIVE significance pre mitigation. The required mitigation is to adhere to the sensitivity map contained in this report. This will reduce the significance to LOW NEGATIVE.
- Disturbance of birds is rated as LOW NEGATIVE significance, on account of there being no known breeding sites of sensitive bird species on or near site. No specific mitigation is required.
- Once operational the facility could displace certain birds from the area, or cause them to fly further to get around the facility. Displacement of birds is judged to be of LOW NEGATIVE significance pre mitigation. No specific mitigation is required.
- Birds in flight on the site could collide with operational turbine blades, thereby being killed or seriously injured. Collision of birds with turbines is judged to be of MODERATE NEGATIVE significance pre mitigation. The significance of this impact can be reduced to LOW NEGATIVE significance by adhering to the sensitivity map in Section 6, and by providing a contingency mitigation budget for the operational phase of the wind farm to allow adaptive management of impacts that arise.
- Birds could perch on the pylons/towers of the overhead grid connection power line and be at risk of electrocution if the design is not bird friendly. Birds in flight could collide with the overhead cables, particularly the earth wire. Collision and electrocution of birds on overhead power lines on site is anticipated to be of HIGH NEGATIVE significance. Both of these impacts can be mitigated successfully in our opinion to reduce the significance to LOW NEGATIVE. To mitigate for collision of the relevant species, it is recommended that the overhead cables be fitted with the best available (at the time of construction) Eskom approved anti bird collision line marking device. In the case of bird electrocution, the power line must be built on an Eskom approved bird-friendly pole structure which provides ample clearance between phases and phase-earth to allow large birds (such as eagles) to perch on them in safety.
- Overall, taking the above 5 impacts into account we conclude that the cumulative impact of wind farms on birds in the study area will be of Low to Moderate significance. The contribution of Bayview Wind Farm (up to 45 turbines of a possible total of approximately 47 turbine location) is Moderate.
- Post construction or operational phase bird monitoring should be conducted according to the framework outlined in this report, but updated to consider best practice guidelines available at the time. This monitoring should be used to detect any significant impacts on birds which may require adaptive management during the lifespan of the facility. This monitoring should be done for at least the first two years of operations, or longer if any significant issues are identified. Thereafter monitoring should be repeated in years 5,10,15,20, and 25.

We recommend that this wind farm can be developed with acceptable levels of risk to birds.

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APPENDIX 1. BIRD SPECIES RECORDED ON THE BAYVIEW WIND FARM SITE.

"1" denotes presence, not abundance

	Winter	Spring	Summer	Autumn
Acacia Pied Barbet	1	1	1	1
African Black Swift			1	1
African Dusky Flycatcher		1		
African Fish-Eagle			1	1
African Goshawk		1		1
African Harrier-Hawk		1	1	1
African Hoopoe	1	1	1	1
African Marsh-Harrier			1	
African Pipit	1	1		1
African Sacred Ibis	1	1	1	1
African Spoonbill			1	1
African Stonechat	1	1	1	1
Alpine Swift			1	1
Amethyst Sunbird	1	1	1	1
Ant-eating Chat		1	1	1
Barn Swallow			1	
Bar-throated Apalis	1	1	1	1
Black Crake			1	
Black Harrier		1		1
Black Saw-wing		1	1	1
Black Sparrowhawk			1	
Black-bellied Starling	1		1	1
Black-collared Barbet	1	1		
Black-headed Heron	1	1	1	1
Black-headed Oriole	1	1	1	1
Black-necked Grebe		1		1
Black-shouldered Kite		1	1	
Blacksmith Lapwing	1	1	1	1
Black-winged Lapwing				1
Black-winged Stilt		1		1
Blue Crane		1	1	1
Bokmakierie	1	1	1	1
Booted Eagle		1		
Brimstone Canary	1	1	1	1
Brown-hooded Kingfisher		1	1	1
Brown-throated Martin		1	1	1
Bushveld Pipit			1	
Cape Batis	1	1	1	1
Cape Bulbul	1	1	1	1

Cape Bunting	1	1	1	1
Cape Canary	1	1	1	1
Cape Clapper Lark		1	1	1
Cape Crow	1	1	1	1
Cape Eagle-Owl			1	1
Cape Glossy Starling	1	1		
Cape Grassbird	1	1		
Cape Longclaw	1	1	1	1
Cape Penduline-Tit	1			1
Cape Robin-Chat	1	1	1	1
Cape Shoveler		1		
Cape Sparrow	1	1	1	1
Cape Spurfowl			1	
Cape Teal	1	1		
Cape Turtle-Dove	1	1	1	1
Cape Wagtail	1	1	1	1
Cape Weaver	1	1	1	1
Cape White-eye	1	1	1	1
Cardinal Woodpecker	1			
Cattle Egret	1	1	1	1
Chestnut-vented Tit-Babbler	1	1	1	1
Cinnamon-breasted Bunting				1
Common Fiscal		1	1	1
Common Greenshank			1	
Common Moorhen			1	1
Common Ringed Plover			1	1
Common Sandpiper				1
Common Starling		1	1	1
Common Swift			1	1
Common Waxbill		1	1	1
Crowned Lapwing	1			1
Dark-capped Bulbul	1		1	1
Denham's Bustard		1	1	1
Egyptian Goose	1	1	1	1
Emerald-spotted Wood-Dove	1	1		1
Familiar Chat			1	1
Fiscal Flycatcher	1	1	1	1
Fork-tailed Drongo	1		1	1
Greater Double-collared Sunbird	1	1	1	1
Greater Flamingo		1	1	1
Green Wood-Hoopoe			1	1
Green-backed Camaroptera			1	1
Grey Heron		1	1	1
Grey-backed Cisticola	1	1	1	1
Hadeda Ibis	1	1	1	1

Hamerkop		1	1	
Helmeted Guineafowl	1	1	1	1
Horus Swift	1	1	1	
Jackal Buzzard	1	1	1	1
Karoo Chat				1
Karoo Prinia	1	1	1	1
Karoo Scrub-Robin	1	1	1	1
Karoo Thrush			1	1
Kittlitz's Plover		1		
Knysna Woodpecker				1
Lanner Falcon		1	1	1
Large-billed Lark	1	1		
Lazy Cisticola				1
Lesser Flamingo			1	1
Lesser Striped Swallow			1	
Little Grebe		1	1	1
Little Swift	1	1	1	1
Long-billed Crombec			1	1
Long-billed Pipit			1	1
Malachite Sunbird	1	1	1	1
Martial Eagle		1		1
Neddicky	1	1	1	1
Olive Bush-Shrike	1	1		1
Olive Thrush	1			1
Orange-breasted Sunbird		1		
Peregrine Falcon			1	
Pied Avocet		1		
Pied Crow	1	1	1	1
Pied Kingfisher		1		
Pied Starling	1	1	1	1
Plain-backed Pipit	1			1
Red-billed Quelea	1			
Red-billed Teal		1		
Red-capped Lark	1	1		1
Red-eyed Dove	1	1	1	1
Red-faced Mousebird	1	1	1	1
Red-fronted Tinkerbird	1			
Red-knobbed Coot		1	1	1
Red-necked Spurfowl	1		1	1
Red-throated Wryneck	1	1		
Red-winged Starling	1	1	1	
Reed Cormorant		1	1	1
Rock Dove				1
Rock Kestrel		1	1	1
Rock Martin	1	1		1

Ruff		1	1	1
Secretarybird		1	1	1
Sombre Greenbul	1	1	1	1
South African Shelduck	1	1	1	1
Southern Black Korhaan	1			1
Southern Boubou	1	1	1	1
Southern Double-collared Sunbird	1	1	1	1
Southern Pale Chanting Goshawk	1	1	1	1
Southern Tchagra	1	1	1	1
Speckled Mousebird	1	1	1	1
Speckled Pigeon			1	1
Speckle-throated Woodpecker		1		
Spectacled Weaver	1	1	1	1
Spike-heeled Lark	1			
Spotted Eagle-Owl		1	1	1
Spotted Thick-knee	1	1	1	1
Spur-winged Goose	1	1	1	1
Steppe Buzzard			1	
Streaky-headed Seedeater				1
Tambourine Dove	1			1
Tawny-flanked Prinia		1		
Terrestrial Brownbul	1			
Three-banded Plover		1		1
Verreauxs' Eagle		1		
Wailing Cisticola		1		
Wattled Starling				1
White-breasted Cormorant		1	1	1
White-browed Scrub-Robin	1	1	1	1
White-faced Duck			1	
White-fronted Plover		1		
White-necked Raven	1	1	1	1
White-rumped Swift			1	
White-throated Canary	1	1	1	1
Yellow Bishop		1	1	
Yellow Canary	1	1	1	1
Yellow-billed Duck		1	1	1
Yellow-billed Egret	1	1		
Yellow-breasted Apalis			1	
Yellow-fronted Canary			1	1
Zitting Cisticola			1	

APPENDIX 2. SMALL PASSERINE BIRD SPECIES RECORDED ON THE BAYVIEW WIND FARM SITE.

			Total			Summer			Autumn			Winter			Spring		
Species			**# indiv**	**# rec-ords**	**# birds/km**	**# indiv**	**# rec-ords**	**# birds/km**	**# indiv**	**# rec-ords**	**# birds/km**	**# indiv**	**# rec-ords**	**# birds/km**	**# indiv**	**# rec-ords**	**# birds/km**
Transect Length				**57.2km**			**14.3km**			**14.3km**			**14.3km**			**14.3km**	
Total # species	***Taxonomic name***	**Endemism**		**80**			**48**			**43**			**50**			**62**	
Common Name			**# indiv**	**# rec-ords**													
Sombre Greenbul	*Andropadus importunus*		465	288	8.129	146	108	10.210	124	62	8.671	103	58	7.203	92	60	6.434
Bar-throated Apalis	*Apalis thoracica*		247	173	4.318	75	63	5.245	48	33	3.357	61	38	4.266	63	39	4.406
Southern Double-collared Sunbird	*Cinnyris chalybeus*	Endemic	233	174	4.073	120	86	8.392	55	40	3.846	15	12	1.049	43	36	3.007
Malachite Sunbird	*Nectarinia famosa*		187	153	3.269	103	83	7.203	2	2	0.140	39	33	2.727	43	35	3.007
Cape Turtle-Dove	*Streptopelia capicola*		180	115	3.147	49	33	3.427	66	41	4.615	21	17	1.469	44	24	3.077
Grey-backed Cisticola	*Cisticola subruficapilla*	Near-endemic	169	142	2.955	55	40	3.846	9	9	0.629	52	44	3.636	53	49	3.706
Red-faced Mousebird	*Urocolius indicus*		165	48	2.885	28	6	1.958	36	7	2.517	73	23	5.105	28	12	1.958
Southern Boubou	*Laniarius ferrugineus*	Endemic	161	119	2.815	48	45	3.357	27	22	1.888	42	25	2.937	44	27	3.077
Bokmakierie	*Telophorus zeylonus*	Near-endemic	148	78	2.587	59	31	4.126	21	11	1.469	36	19	2.517	32	17	2.238
Karoo Prinia	*Prinia maculosa*	Endemic	141	114	2.465	20	19	1.399	21	16	1.469	49	36	3.427	51	43	3.566
Karoo Scrub-Robin	*Cercotrichas coryphoe-us*	Endemic	141	112	2.465	53	44	3.706	16	11	1.119	39	31	2.727	33	26	2.308
Neddicky	*Cisticola fulvicapilla*		131	114	2.290	3	2	0.210	39	35	2.727	31	28	2.168	58	49	4.056
Speckled Mousebird	*Colius striatus*		125	50	2.185	53	20	3.706	27	11	1.888	20	6	1.399	25	13	1.748
Streaky-headed Seedeater	*Crithagra gularis*		110	62	1.923	14	10	0.979	30	12	2.098	22	16	1.538	44	24	3.077
Fiscal Flycatcher	*Sigelus silens*	Endemic	108	82	1.888	20	18	1.399	19	15	1.329	37	26	2.587	32	23	2.238

Cape Bunting	*Emberiza capensis*		95	76	1.661	18	16	1.259	11	9	0.769	30	24	2.098	36	27	2.517
Cape White-eye	*Zosterops capensis*	Endemic	84	36	1.469	13	8	0.909	15	6	1.049	35	8	2.448	21	14	1.469
Chestnut-vented Tit-Babbler	*Sylvia subcaeruleum*	Near-endemic	84	72	1.469	12	12	0.839	18	14	1.259	27	24	1.888	27	22	1.888
White-throated Canary	*Crithagra albogularis*	Near-endemic	76	43	1.329	20	8	1.399	22	10	1.538	10	7	0.699	24	18	1.678
Cape Bulbul	*Pycnonotus capensis*	Endemic	75	52	1.311	32	24	2.238	13	6	0.909	20	14	1.399	10	8	0.699
Barn Swallow	*Hirundo rustica*		68	16	1.189	68	16	4.755			0.000			0.000			0.000
Common Fiscal	*Lanius collaris*		65	63	1.136	21	20	1.469	17	16	1.189	14	14	0.979	13	13	0.909
Greater Double-collared Sunbird	*Cinnyris afer*	Endemic	64	58	1.119	10	9	0.699	18	16	1.259	22	19	1.538	14	14	0.979
Horus Swift	*Apus horus*		64	4	1.119			0.000	40	1	2.797	4	2	0.280	20	1	1.399
Southern Tchagra	*Tchagra tchagra*	Endemic	54	48	0.944	5	4	0.350			0.000	20	19	1.399	29	25	2.028
Cape Crow	*Corvus capensis*		53	23	0.927	18	8	1.259	9	4	0.629	23	9	1.608	3	2	0.210
Cape Robin-Chat	*Cossypha caffra*		53	51	0.927	19	18	1.329	5	5	0.350	12	12	0.839	17	16	1.189
White-browed Scrub-Robin	*Cercotrichas leucophrys*		47	44	0.822	13	13	0.909	3	3	0.210	16	14	1.119	15	14	1.049
Cape Clapper Lark	*Mirafra apiata*	Endemic	42	33	0.734	5	4	0.350	1	1	0.070			0.000	36	28	2.517
Common Waxbill	*Estrilda astrild*		37	14	0.647	1	1	0.070	7	2	0.490	3	2	0.210	26	9	1.818
Acacia Pied Barbet	*Tricholaema leucomelas*	Endemic	32	31	0.559	14	14	0.979	8	8	0.559	4	3	0.280	6	6	0.420
Spectacled Weaver	*Ploceus ocularis*		32	27	0.559	5	5	0.350	8	7	0.559	10	6	0.699	9	9	0.629
Yellow Canary	*Crithagra flaviventris*	Near-endemic	25	18	0.437	1	1	0.070	14	9	0.979	1	1	0.070	9	7	0.629
Dark-capped Bulbul	*Pycnonotus tricolor*		24	19	0.420	3	2	0.210	6	5	0.420			0.000	15	12	1.049
African Hoopoe	*Upupa africana*		22	12	0.385			0.000			0.000	13	3	0.909	9	9	0.629
Cape Batis	*Batis capensis*	Endemic	19	14	0.332	4	3	0.280	4	3	0.280	6	4	0.420	5	4	0.350
Olive Bush-Shrike	*Telophorus olivaceus*	Near-endemic	16	15	0.280			0.000	2	2	0.140			0.000	14	13	0.979
Amethyst Sunbird	*Chalcomitra amethys-tina*		14	11	0.245	7	6	0.490	6	4	0.420	1	1	0.070			0.000
Red-eyed Dove	*Streptopelia semitor-*		14	9	0.245			0.000	3	1	0.210	5	5	0.350	6	3	0.420

	quata																
Eastern Clapper Lark	*Mirafra fasciolata*	Near-endemic	13	4	0.227			0.000			0.000	13	4	0.909			0.000
Golden-breasted Bunting	*Emberiza flaviventris*		10	7	0.175			0.000			0.000			0.000	10	7	0.699
Cape Spurfowl	*Pternistis capensis*		8	5	0.140			0.000			0.000			0.000	8	5	0.559
Crowned Lapwing	*Vanellus coronatus*		8	5	0.140	2	2	0.140			0.000	2	1	0.140	4	2	0.280
Lesser-Striped Swallow	*Cecropis abyssinica*		8	5	0.140			0.000			0.000			0.000	8	5	0.559
Long-billed Crombec	*Sylvietta rufescens*		8	7	0.140			0.000	1	1	0.070			0.000	7	6	0.490
Wailing Cisticola	*Cisticola lais*		8	6	0.140			0.000			0.000	7	5	0.490	1	1	0.070
Yellow-fronted Canary	*Crithagra mozambica*		8	4	0.140	1	1	0.070	1	1	0.070			0.000	6	2	0.420
African Pipit	*Anthus cinnamomeus*		7	7	0.122			0.000	2	2	0.140			0.000	5	5	0.350
Brimstone Canary	*Crithagra sulphurata*		7	7	0.122	1	1	0.070			0.000			0.000	6	6	0.420
White-throated Swallow	*Hirundo albigularis*		7	2	0.122			0.000			0.000			0.000	7	2	0.490
Cape Longclaw	*Macronyx capensis*	Endemic	6	3	0.105			0.000			0.000	5	2	0.350	1	1	0.070
Cape Penduline Tit	*Anthoscopus minutus*	Near-endemic	6	3	0.105			0.000			0.000	3	1	0.210	3	2	0.210
Cape Sparrow	*Passer melanurus*	Near-endemic	6	3	0.105	1	1	0.070			0.000	2	1	0.140	3	1	0.210
Black Cuckoo	*Cuculus clamosus*		5	5	0.087			0.000			0.000			0.000	5	5	0.350
Common Starling	*Sturnus vulgaris*		5	1	0.087			0.000	5	1	0.350			0.000			0.000
Green Woodhoopoe	*Phoeniculus purpureus*		5	4	0.087			0.000			0.000	1	1	0.070	4	3	0.280
Pearl-breasted Swallow	*Hirundo dimidiata*		5	2	0.087			0.000			0.000			0.000	5	2	0.350
Tawny-flanked Prinia	*Prinia subflava*		5	3	0.087			0.000	2	1	0.140	1	1	0.070	2	1	0.140
Emerald-spotted Wood-Dove	*Turtur chalcospilos*		4	4	0.070			0.000	1	1	0.070	1	1	0.070	2	2	0.140
Greater Striped Swallow	*Cecropis cucullata*		4	2	0.070	4	2	0.280			0.000			0.000			0.000
Grey Sunbird	*Cyanmoitra veroxii*		4	4	0.070	4	4	0.280			0.000			0.000			0.000
Rufous- naped Lark	*Mirafra africana*		4	3	0.070			0.000			0.000	3	2	0.210	1	1	0.070

Black Saw-wing	*Psalidoprocne holome-laena*		3	1	0.052	3	1	0.210			0.000			0.000			0.000
Green-backed Cama-roptera	*Camaroptera brachyura*		3	3	0.052	3	3	0.210			0.000			0.000			0.000
Black-collared Barbet	*Lybius torquatus*		2	2	0.035			0.000			0.000	2	2	0.140			0.000
Cape Weaver	*Ploceus capensis*	Endemic	2	2	0.035	2	2	0.140			0.000			0.000			0.000
Cardinal Woodpecker	*Dendropicos fuscens*		2	2	0.035			0.000			0.000	1	1	0.070	1	1	0.070
Hadeda Ibis	*Bostrychia hagedash*		2	2	0.035	2	2	0.140			0.000			0.000			0.000
Olive Thrush	*Turdus olivaceus*		2	2	0.035			0.000			0.000	2	2	0.140			0.000
Yellow-breasted Apalis	*Apalis flavida*		2	2	0.035			0.000			0.000			0.000	2	2	0.140
Burchell's Coucal	*Centropus burchelli*		1	1	0.017			0.000			0.000			0.000	1	1	0.070
Brown-throated Martin	*Riparia paludicola*		1	1	0.017			0.000	1	1	0.070			0.000			0.000
Cape Canary	*Serinus canicollis*	Endemic	1	1	0.017			0.000			0.000			0.000	1	1	0.070
Caspian Tern	*Hydroprogne caspia*		1	1	0.017			0.000			0.000	1	1	0.070			0.000
Dark-backed Weaver	*Ploceus bicolo*		1	1	0.017	1	1	0.070			0.000			0.000			0.000
Eastern Long-billed Lark	*Certhilauda semitor-quata*	Endemic	1	1	0.017			0.000			0.000			0.000	1	1	0.070
Forest Canary	*Serinus scotops*	Endemic	1	1	0.017	1	1	0.070			0.000			0.000			0.000
Grey-headed Bush Shrike	*Malaconotus blanchoti*		1	1	0.017			0.000			0.000			0.000	1	1	0.070
Knysna Woodpecker	*Campethera notata*	Endemic	1	1	0.017			0.000			0.000	1	1	0.070			0.000
Spotted Thick-Knee	*Burhinus capensis*		1	1	0.017	1	1	0.070			0.000			0.000			0.000

APPENDIX 3. IMPACT ASSESSMENT CRITERIA (EOH-CES)

The following standard rating scales have been defined for assessing and quantifying the identified impacts. This is necessary since impacts have a number of parameters that need to be assessed. The identified impacts have been assessed against the following criteria:

- Temporal scale;
- Spatial scale;
- Risk or likelihood;
- Degree of confidence or certainty;
- Severity or benefits; and the
- Significance.

The relationship of the issue to the temporal scale, spatial scale and the severity are combined to describe the overall importance rating, namely the significance of the assessed impact.

Table 1.1: Significance Rating Table.

TEMPORAL SCALE *(THE DURATION OF THE IMPACT)*	
Short term	Less than 5 years (Many construction phase impacts are of a short duration).
Medium term	Between 5 and 20 years.
Long term	Between 20 and 40 years (From a human perspective almost permanent).
Permanent	Over 40 years or resulting in a permanent and lasting change that will always be there.
SPATIAL SCALE *(THE AREA IN WHICH ANY IMPACT WILL HAVE AN AFFECT)*	
Localised	Impacts affect a small area of a few hectares in extent. Often only a portion of the project area.
Study area	The proposed site and its immediate surroundings.
Municipal	Impacts affect the Nelson Mandela Bay Metropolitan Municipality, or any towns within the municipality.
Regional	Impacts affect the wider area or the Eastern Cape Province as a whole.
National	Impacts affect the entire country.
International/Global	Impacts affect other countries or have a global influence.
LIKELIHOOD *(THE CONFIDENCE WITH WHICH ONE HAS PREDICTED THE SIGNIFICANCE OF AN IMPACT)*	
Definite	More than 90% sure of a particular fact. Should have substantial supportive data.
Probable	Over 70% sure of a particular fact, or of the likelihood of that impact occurring.
Possible	Only over 40% sure of a particular fact, or of the likelihood of an impact occurring.
Unsure/Unlikely	Less than 40% sure of a particular fact, or of the likelihood of an impact occurring.

Table 1.2: Impact Severity Rating.

Impact severity *(The severity of negative impacts, or how beneficial positive impacts would be on a particular affected system or affected party)*	
Very severe	***Very beneficial***
An irreversible and permanent change to the affected system(s) or party(ies) which cannot be mitigated. For example the permanent loss of land.	A permanent and very substantial benefit to the affected system(s) or party(ies), with no real alternative to achieving this benefit. For example the vast improvement of sewage effluent quality.

Severe	*Beneficial*
Long term impacts on the affected system(s) or party(ies) that could be mitigated. However, this mitigation would be difficult, expensive or time consuming, or some combination of these. For example, the clearing of forest vegetation.	A long term impact and substantial benefit to the affected system(s) or party(ies). Alternative ways of achieving this benefit would be difficult, expensive or time consuming, or some combination of these. For example an increase in the local economy.
Moderately severe	***Moderately beneficial***
Medium to long term impacts on the affected system(s) or party (ies), which could be mitigated. For example constructing a sewage treatment facility where there was vegetation with a low conservation value.	A medium to long term impact of real benefit to the affected system(s) or party(ies). Other ways of optimising the beneficial effects are equally difficult, expensive and time consuming (or some combination of these), as achieving them in this way. For example a 'slight' improvement in sewage effluent quality.
Slight	***Slightly beneficial***
Medium or short term impacts on the affected system(s) or party(ies). Mitigation is very easy, cheap, less time consuming or not necessary. For example a temporary fluctuation in the water table due to water abstraction.	A short to medium term impact and negligible benefit to the affected system(s) or party(ies). Other ways of optimising the beneficial effects are easier, cheaper and quicker, or some combination of these.
No effect	***Don't know/Can't know***
The system(s) or party(ies) is not affected by the proposed development.	In certain cases it may not be possible to determine the severity of an impact.

Table 1.3: Overall Significance Rating.

OVERALL SIGNIFICANCE *(THE COMBINATION OF ALL THE ABOVE CRITERIA AS AN OVERALL SIGNIFICANCE)*	
VERY HIGH NEGATIVE	**VERY BENEFICIAL**
These impacts would be considered by society as constituting a major and usually permanent change to the (natural and/or social) environment, and usually result in severe or very severe effects, or beneficial or very beneficial effects. Example: The loss of a species would be viewed by informed society as being of VERY HIGH significance. Example: The establishment of a large amount of infrastructure in a rural area, which previously had very few services, would be regarded by the affected parties as resulting in benefits with VERY HIGH significance.	
HIGH NEGATIVE	**BENEFICIAL**
These impacts will usually result in long term effects on the social and/or natural environment. Impacts rated as HIGH will need to be considered by society as constituting an important and usually long term change to the (natural and/or social) environment. Society would probably view these impacts in a serious light. Example: The loss of a diverse vegetation type, which is fairly common elsewhere, would have a significance rating of HIGH over the long term, as the area could be rehabilitated. Example: The change to soil conditions will impact the natural system, and the impact on affected parties (such as people growing crops in the soil) would be HIGH.	
MODERATE NEGATIVE	**SOME BENEFITS**
These impacts will usually result in medium to long term effects on the social and/or natural environment. Impacts rated as MODERATE will need to be considered by society as constituting a fairly important and usually medium term change to the (natural and/or social) environment. These impacts are real but not substantial. Example: The loss of a sparse, open vegetation type of low diversity may be regarded as MODERATELY significant.	
LOW NEGATIVE	**FEW BENEFITS**
These impacts will usually result in medium to short term effects on the social and/or natural environment. Impacts rated as LOW will need to be considered by the public and/or the specialist as constituting a fairly unimportant and usually short term change to the (natural and/or social) environment. These impacts are not substantial and are likely to have little real effect. Example: The temporary changes in the water table of a wetland habitat, as these systems are adapted to	

fluctuating water levels. Example: The increased earning potential of people employed as a result of a development would only result in benefits of LOW significance to people who live some distance away.
NO SIGNIFICANCE
There are no primary or secondary effects at all that are important to scientists or the public. Example: A change to the geology of a particular formation may be regarded as severe from a geological perspective, but is of NO significance in the overall context.
DON'T KNOW
In certain cases it may not be possible to determine the significance of an impact. For example, the primary or secondary impacts on the social or natural environment given the available information. Example: The effect of a particular development on people's psychological perspective of the environment.

All feasible alternatives and the "no-go option" will be equally assessed in order to evaluate the significance of the "as predicted" impacts (prior to mitigation) and the "residual" impacts (that remain after mitigation measures are taken into account). The reason(s) for the judgement will be provided when necessary.