Appendix H.2

AVIFAUNAL ASSESSMENT

Proposed Dalmanutha Wind Energy Facility

Avifaunal Impact Assessment – EIA phase

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Submitted to:

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Executive summary

ENERTRAG South Africa (hereafter the "Developer") is proposing the development of the Dalmanutha Wind Energy Facility and the Dalmanutha West Wind Energy Facility (hereafter referred to as the "Projects"), including associated and grid connection infrastructure for each facility. The Projects will be operated under two Special Purpose Vehicles, namely, Dalmanutha Wind (Pty) Ltd and Dalmanutha West Wind (Pty) Ltd. These Projects are being developed in the context of the Department of Mineral Resources and Energy (DMRE) Integrated Resource Plan and the Country's plan for a Just Transition.

The current report assesses the Dalmanutha Wind Energy Facility. Two alternatives are provided for assessment for this project: Alternative 1 - a fully wind energy facility, with a capacity of up to 300MW, comprising up to 70 wind turbines; and Alternative 2 - a hybrid facility, with a capacity of up to 300MW, comprising up to 44 wind turbines and two solar fields.

The proposed site is located in an area of the country which provides a mosaic of land uses or micro habitats. As a result, a rich diversity of birds occur here, many of which are regionally Red Listed. The most important of these for the proposed project are: Wattled Crane (regionally Critically Endangered); Grey-crowned Crane (regionally Endangered); African Marsh-Harrier (regionally endangered); Cape Vulture (regionally Endangered); Black-rumped Buttonquail (regionally Endangered); White-bellied Korhaan (regionally Vulnerable); Southern Bald Ibis (regionally Vulnerable); Denham's Bustard (regionally Vulnerable); Lanner Falcon (regionally Vulnerable); Secretarybird (regionally Vulnerable); and Blue Crane (regionally Near-threatened) (Taylor *et al,* 2015).

All bird species will to some extent be susceptible to habitat destruction and disturbance if the project (Alternative 1/Alternative 2) is built. However, it is the direct mortality risk through collision with turbines, and collision and electrocution on overhead power lines which is of most concern. The larger species are particularly at risk of these impacts. We have made the following assessments of the significance of the potential impacts of the proposed project on avifauna (using methods and criteria supplied by WSP):

		Alternative 1		**Alternative 2**	
Phase	**Impact**	**Significance Pre-mitigation**	**Significance Post-mitigation**	**Significance Pre-mitigation**	**Significance Post-mitigation**
Construction	Habitat destruction	High	Moderate	High	Moderate
	Disturbance	Low	Low	Low	Low
Operation	Disturbance	Low	Low	Low	Low
	Displacement	Low	Low	Low	Low
	Collision of birds with turbines	Very High	High	Very High	High
	Collision & electrocution of birds on overhead	High	Low	High	Low

	power lines				
	Bird fatality on Solar PV facility	n/a	n/a	Low	Low
Decommissioning	Disturbance of birds	Low	Low	Low	Low
Cumulative impacts	Collision of birds with turbines	High	High	High	High

Although these risks have to a certain extent been avoided by the application of No-Go sensitivity mapping, there is a need for extensive mitigation should the project go ahead:

- The sensitive (No-Go) areas identified by this study should be adhered to.
- A pre-construction avifaunal walk down should be conducted to confirm final layout and identify any sensitivities that may arise between the conclusion of the EIA process and the construction phase.
- All human activities associated with construction, operation and decommissioning should be strictly managed according to generally accepted environmental best practice standards, so as to avoid any unnecessary impact on the receiving environment.
- Use should be made of existing roads as far as possible.
- All staff, vehicle and machinery activities should be strictly controlled at all times so as to ensure that the absolute minimum of surface area is impacted.
- Care should be taken not to introduce or propagate alien plant species/weeds during construction.
- No internal medium voltage power lines should be overhead. All such cables should be buried, and follow road verges at all times, unless specifically agreed to by the avifaunal specialist.
- Any overhead conductors or earth wires should be fitted with an Eskom approved anti-bird collision line-marking device to make cables more visible to birds in flight and reduce the likelihood of collisions.
- The pole design of any overhead power line should be approved by an ornithologist in terms of the electrocution risk it may pose to large birds such as eagles and vultures.
- The combination of turbine hub height and rotor diameter must be optimised to maximise the lower blade tip height above ground. Raising the lower turbine blade tip height from a typical 30m above ground to approximately 50m above ground will reduce collision risk for most species, as most flight is low over the ground.
- A post-construction site inspection must be conducted by an avifaunal specialist to confirm that all aspects have been appropriately handled and in particular that road and hard stand verges do not provide additional substrate for raptor prey species. It is essential that the new facility does not create favourable conditions for such mammals in high risk areas. We therefore recommend that within the first year of operations a full assessment of this aspect be made by the ornithologist contracted for post-construction monitoring. If such conditions

have been created, case-specific solutions will need to be developed and implemented by the project operator.

- It is strongly recommended that rodenticides not be used at the newly established Operation and Maintenance (O&M) buildings or around auxiliary infrastructure on the project site. While pest control of this nature may be effective, even so-called “environmentally friendly” rodenticides are toxic and pose significant secondary poisoning risk to predatory avifauna, especially owls.
- A ‘Cape Vulture Food Management Programme’ must be implemented on site to ensure all dead livestock/wildlife on site are removed as soon as possible and made unavailable to vultures for feeding. This programme will reduce the amount of available vulture food on site and reduce vulture-turbine collision risk. This programme will require the deployment of a dedicated (i.e. no other tasks) and adequately resourced (transport, binoculars, GPS, cameras, training) team of staff to patrol the full site and immediate surrounds during all daylight hours. The co-operation of landowners will also be essential to ensure that reported carcasses are disposed of effectively. This programme must be operational by the time the first turbine blades are turning on site and should not wait for Commercial Operations Date (COD). A full detailed method statement for this programme must be designed by an ornithologist prior to COD, and included in the EMPr.
- The landowner agreements should ensure specifically that any vulture feeding sites be stopped from the start of wind farm construction and not used for the full lifespan of the wind farm. Landowners should also be sensitised to the need to cooperate with the above Cape Vulture Food Management Programme.
- Cape Vultures will have to be effectively deterred from roosting on overhead power lines on site. This will need to be achieved well before turbines are operational and maintained through the project lifespan. Eskom Bird Guards (perch deterrents) must be installed on all pylons at the two roost sites, with full coverage of steel cross members (not just above live phases as per Eskom standard). In addition, the team of staff employed to implement the Cape Vulture Food Management Programme described above should also be tasked with patrolling the relevant sections of power line early morning and late evenings to scare any perching vultures away. This should first be trialled by in collaboration with an avifaunal specialist to ensure that such actions don’t increase turbine collision risk in the short term by flushing vultures into turbines.
- An Observer-Led Turbine Shutdown on Demand (OLSDOD) programme must be implemented on site from COD. This is required in order to mitigate the risk of turbine collision for priority bird species. This programme must consist of a suitably qualified, trained, dedicated and resourced team of observers present on site for all daylight hours 365 days of the year. This team must be stationed at vantage points with full visible coverage of all turbine locations. The observers must detect incoming priority bird species, track their flights, judge when they enter a turbine proximity threshold, and alert the control room to shut down the relevant

turbine/s until the risk has reduced. A full detailed method statement must be designed by an ornithologist prior to COD, and included in the EMPr. The effectiveness of this programme is highly dependent on hiring the correct staff and managing them appropriately. The project must pay careful attention to this aspect to minimise collision risk.

- All turbines must have one of their blades painted according to the approval to be obtained by the South African Civil Aviation Authority (SACAA) from the outset. Provision must be made by the developer for the resolution of any technical, warranty or supplier challenges that this may present.
- A bird fatality threshold and adaptive management plan must be designed by an ornithologist for the site prior to the Commercial Operation Date (COD) and included in the EMPr. This plan should identify most importantly the number of bird fatalities of priority species which will trigger a management response, appropriate responses, and time lines for such responses. Fatalities of priority bird species are usually rare events (but with very high consequence) and it is difficult to analyse trends or statistics related to these fatalities as they occur. It is therefore important to have a threshold policy in place proactively to assist adaptive management.
- Any residual impacts recorded during operations by operational phase bird monitoring after all possible mitigation measures have been implemented will need to be mitigated off site. The facility will need to address other sources of mortality of priority species in a measurable way so as to compensate for residual effects on the facility itself. This will need to be detailed in a Biodiversity Action Plan to be developed as part of the operational phase bird monitoring programme.
- The “during construction” and “post-construction” monitoring programme outlined in Appendix 10 should be implemented according to the latest available version of the Best Practice Guidelines at the time. The findings from Operational Phase monitoring should inform the adaptive management programme to mitigate any impacts on avifauna to acceptable levels.
- This is a rapidly evolving field and as more wind farms become operational, the learning curve steepens in terms of mitigation of risks to birds. A number of new technology options are possibly on the horizon, including: blade illumination; radar technology; and acoustic deterrents. The project must keep abreast of these developments and implement if deemed necessary and reasonable as per the projects’ adaptive management plan.

The proposed project is in a highly sensitive area for avifauna. The applicant has applied a substantial amount of risk avoidance through the application of No-Go areas and the reduction in the number of turbines (from 77 to 70 in the EIA phase – Alternative 1) and more so through the presentation of Alternative 2 which includes a further reduction to 44 wind turbines (plus solar PV). We recommend strongly against the selection of Alternative 1, given that Alternative 2 has far fewer wind turbines. Alternative 2 is strongly preferred from an avifaunal perspective, since fewer turbines should cause fewer turbine collision bird fatalities. However, 44 turbines (Alternative 2) is still a large wind farm in a highly sensitive area, and the estimated number of bird fatalities pre-mitigation are still high for priority species. The significance of the turbine collision risk for multiple Red Listed (including Critically Endangered & Endangered) bird species is judged to be Very High pre-mitigation and High post-mitigation for Alternative 2. To reduce this significance would require a substantial further reduction in the number of turbines. Reducing the number of turbines would result in a decrease in the estimated pre-mitigation bird fatality rate, and mean that the implication of mitigation not being fully effective is lower, and the extent of any potentially necessary offset of residual impacts during the operational phase is smaller. Several of the recommended mitigation measures (for example Shutdown on Demand, and Cape Vulture food management) also have a greater likelihood of being effectively implemented on a smaller scale since a smaller area needs to be covered.

NEMA requirements for specialists reports – check list

NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 (ACT NO. 107 OF 1998) AND ENVIRONMENTAL IMPACT REGULATIONS, 2014 (AS AMENDED) - REQUIREMENTS FOR SPECIALIST REPORTS (APPENDIX 6)

Regulation GNR 326 of 4 December 2014, as amended 7 April 2017, Appendix 6	Section of Report
1. (1) A specialist report prepared in terms of these Regulations must contain- a) details of- i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	Appendix 9
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Appendix 11
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 2
(cA) an indication of the quality and age of base data used for the specialist report;	Section 6
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 6
d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 6
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 4
f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 7
g) an identification of any areas to be avoided, including buffers;	Section 7
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 7
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 4
j) a description of the findings and potential implications of such findings on the impact of the proposed activity, (including identified alternatives on the environment) or activities;	Section 8
k) any mitigation measures for inclusion in the EMPr;	Section 9
l) any conditions for inclusion in the environmental authorisation;	Section 9
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 9
n) a reasoned opinion- i. (as to) whether the proposed activity, activities or portions thereof should be authorised;	Section 10

(iA) regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Section 4
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	n/a
q) any other information requested by the competent authority.	n/a
2) Where a government notice *gazetted* by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	n/a

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Glossary of terms & abbreviations

The following terms are used in this study:

Red Listed – regionally	The latest regional conservation status for the species as per Taylor *et al,* 2015
Red Listed – globally	The latest global conservation status for the species as per IUCN (2022)
Priority Species	Priority species are those that this study focuses on in more detail
Endemic/near	Occurring only here, southern African endemics as taken from BirdLife South Africa Checklist 2018
kV	Kilovolt (1000 volts)
EN	Endangered
VU	Vulnerable
NT	Near-threatened
LC	Least concern
Rec	Number of records

1. Introduction

ENERTRAG South Africa (hereafter the "Developer") is proposing the development of the Dalmanutha Wind Energy Facility and Dalmanutha West Wind Energy Facility, including (hereafter referred to as the "Projects") associated and grid connection infrastructure. The Projects will be operated under two Special Purpose Vehicles, namely, Dalmanutha Wind (Pty) Ltd and Dalmanutha West Wind(Pty) Ltd. These Projects are being developed in the context of the Department of Mineral Resources and Energy (DMRE) Integrated Resource Plan and the Country's plan for a Just Transition.

The current report assesses the Dalmanutha Wind Energy Facility. Two alternatives are provided for assessment for this project: a fully wind energy facility, with a capacity of up to 300MW, comprising up to 70 wind turbines ; and a hybrid facility, with a capacity of up to 300MW, comprising 44 turbines and two solar fields.

In terms of the EIA Regulations various aspects of the proposed development may have an impact on the environment and are considered to be listed activities. These activities require authorisation from the National Competent Authority (CA), namely the Department of Forestry, Fisheries and the Environment (DFFE), prior to the commencement thereof. Specialist studies have been commissioned to verify the sensitivity and assess the impacts of the project (Alternative 1 and 2) under the Gazetted specialist protocols (GN R 320 and GN R 1150 of 2020).

WildSkies Ecological Services (Pty) Ltd *w*as appointed by ENERTRAG to conduct the pre-construction bird monitoring and impact assessment studies at the site.

2. Project description

The Dalmanutha Wind Energy Facility (WEF) ("Dalmanutha WEF") is located approximately 7 kilometres southeast of the Belfast town within Emakhazeni Local Municipality, Mpumalanga Province. Site access is via the N4, which is approximately 220 meters from the Dalmanutha WEF. To connect the Dalmanutha WEF to the Eskom grid, the applicant proposes collecting the various turbine 33kV cables, to be laid underground where practical, to a 33/132kV onsite IPP substation, which will in turn be connected to a 132kV Common Collector Switching Station, which will form part of a separate application for Environmental Authorisation, via an over the fence 132kV cable. The onsite IPP substation is proposed to occupy an area of up to 4ha. This onsite IPP substation will be located adjacent to the Common Collector Switching Station.

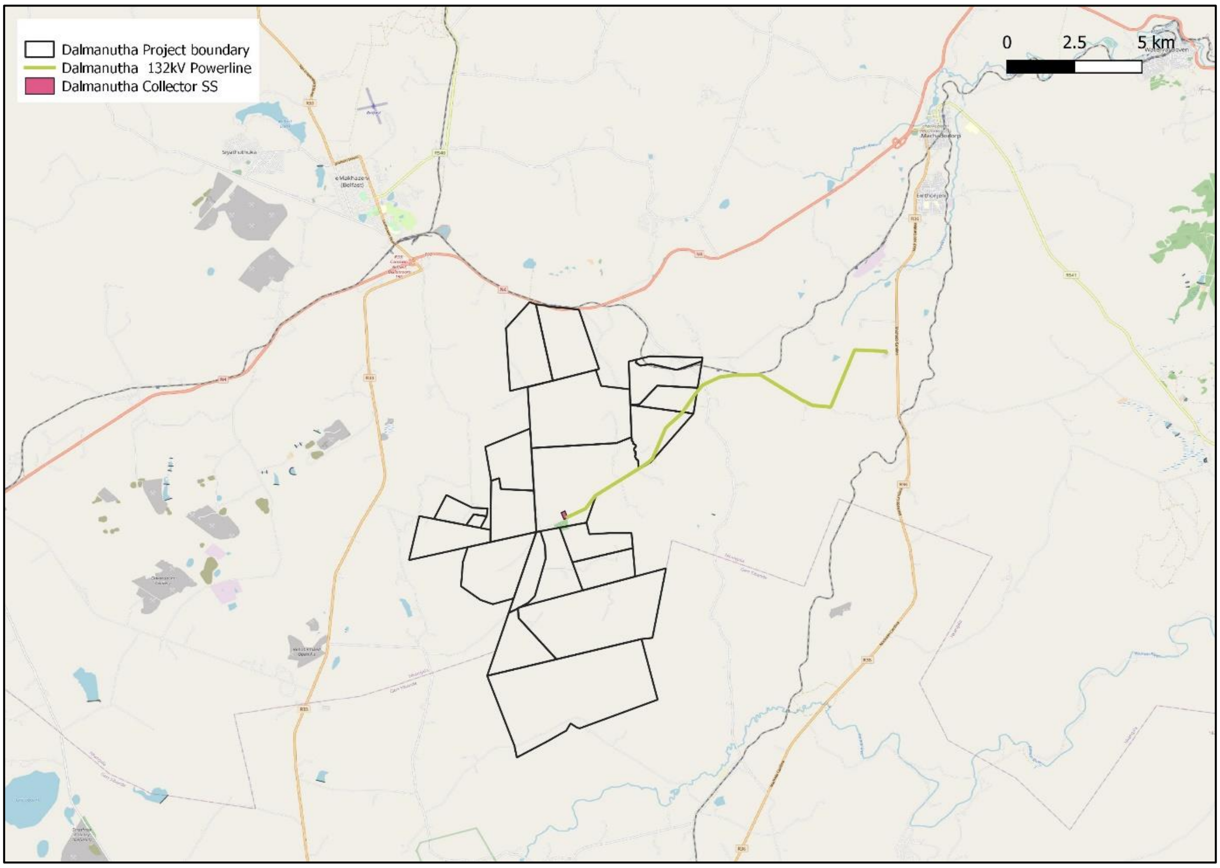

Figure 1. The location and layout of the overall project.

Note that the current application is for the Dalmanutha Wind Farm only, the grid connection falls under a separate application

2.1 Alternative 1 - Dalmanutha Wind Facility

The proposed Dalmanutha WEF will be developed with a capacity of up to 300 megawatts (MW), and will comprise the following key components:

Wind Turbines

- Up to 70 turbines[1], each with a foundation of approximately 25m^2 in diameter (500m^2 area and requiring ~2 500m^3 concrete each) and approximately 3m depth;
- Turbine hub height of up to 200m;
- Rotor diameter up to 200m; and
- Permanent hard standing area for each wind turbine (approximately 1ha). Figure 2 illustrates the typical hardstanding requirements for the construction of each turbine (it should be noted

[1] An up to 77 turbine layout was considered during the scoping phase however as a result of the avifauna specialist input the turbine layout has been optimised to include up to 70 turbines. The optimised up to 70 turbine layout will be assessed in the EIA phase

that the figure below is for illustration purposes only – the exact layout and specification of the hardstanding will be determined once the design phase has been completed).

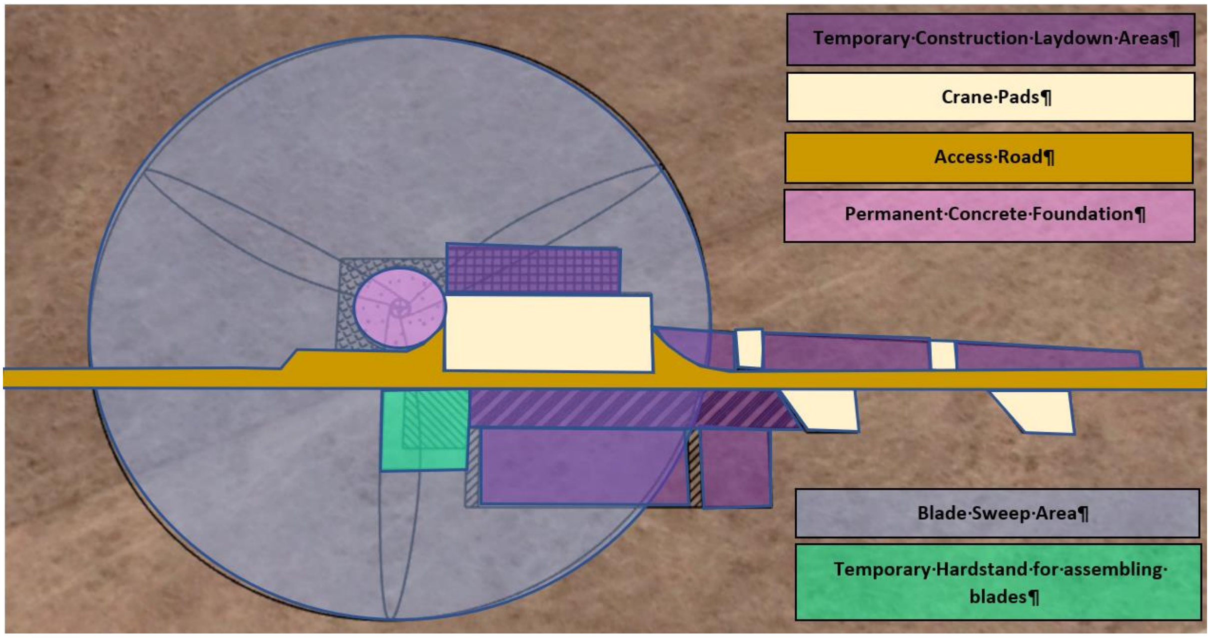

Figure 2. Typical Turbine Hard Standing Requirements (illustration purposes only)

IPP portion onsite Substation and Battery Energy Storage System (BESS)

- IPP portion onsite substation of up to 4ha. The substation will consist of a high voltage substation yard to allow for multiple up to 132kV feeder bays and transformers, control building, telecommunication infrastructure, access road, etc.; and
- The Battery Energy Storage System (BESS) storage capacity will be up to 300MW/1200 megawatt-hour (MWh) with up to four hours of storage. It is proposed that Lithium Battery Technologies, such as Lithium Iron Phosphate, Lithium Nickel Manganese Cobalt oxides or Vanadium Redox flow technologies will be considered as the preferred battery technology; however, the specific technology will only be determined following Engineering, Procurement, and Construction (EPC) procurement. The main components of the BESS include the batteries, power conversion system and transformer which will all be stored in various rows of containers.

Operation and Maintenance Building Infrastructure

- Operations and maintenance (O&M) building infrastructure will be required to support the functioning of the WEF and for services required by operations and maintenance staff. The O&M building infrastructure will be near the onsite substation and will include:
    - Operations building of approximately 200m^2;
    - Workshop and stores area of approximately 150m^2 each;
    - Stores area of approximately 150m^2; and

    - Refuse area for temporary waste and septic/conservancy tanks with portable toilets to service ablution facilities.

The total combined area of the buildings will not exceed 5 000m^2.

Construction Camp Laydown

- Temporary laydown or staging area -Typical area 220m x 100m = 22000m^2.
- Laydown area could increase to 30000m^2 for concrete towers, should they be required.
- Sewage: septic and/or conservancy tanks and portable toilets.
- Temporary cement batching plant, wind tower factory & yard of approximately 7ha, comprising amongst others, a concrete storage area, batching plant, electrical infrastructure and substation, generators and fuel stores, gantries and loading facilities, offices, material stores (rebar, concrete, aggregate and associated materials), mess rooms, workshops, laydown and storage areas, sewage and toilet facilities, offices and boardrooms, labour mess and changerooms, mixers, moulds and casting areas, water and settling tanks, pumps, silos and hoppers, a laboratory, parking areas, internal and access roads - Gravel and sand will be stored in separate heaps whilst the cement will be contained in a silo. The maximum height of the silo will be 20m.

Access Roads

- The Project site can be accessed easily via either the tarred R33 or the N4 national road which run along the northern and western boundaries of the site.
- There is an existing road that goes through the land parcels to allow for direct access to the project development area.
- Internal and access roads with a width of between 8m and 10m, which can be increased to approximately 12m on bends. The roads will be positioned within a 20m wide corridor to accommodate cable trenches, stormwater channels and bypass /circles of up to 20m during construction. Length of the internal roads will be approximately 60km.

Associated Infrastructure

- The medium voltage collector system will comprise of cables up to and including 33kV that run underground, except where a technical assessment suggest that overhead lines are required, within the facility connecting the turbines to the onsite substation.
- Over the fence 132kV cable to connect the onsite IPP substation to the Common Collector Switching Station.
- Fencing of up to 4m high around the construction camp and lighting.
- Lightning protection.
- Telecommunication infrastructure.
- Stormwater channels.
- Water pipelines.

- Offices.
- Operational control centre.
- Operation and Maintenance Area / Warehouse/workshop.
- Ablution facilities.
- A gatehouse.
- Control centre, offices, warehouses.
- Security building.
- A visitor's centre.
- Substation building.

The proposed development footprint (buildable area) is approximately 400ha (subject to finalisation based on technical and environmental requirements), and the extent of the project area is approximately 9 197ha. The development footprint includes the turbine positions and all associated infrastructure as outlined above

2.2 Alternative 2 – Dalmanutha Wind & Solar Facility

The proposed Dalmanutha Wind and Solar Energy Facility will be developed with a capacity of up to 300 megawatts (MW)[2], and will comprise the following key components:

Wind Turbines

- Up to 44 turbines, each with a foundation of approximately 25m^2 in diameter (500m^2 area and requiring ~2 500m^3 concrete each) and approximately 3m depth;
- Turbine hub height of up to 200m;
- Rotor diameter up to 200m; and
- Permanent hard standing area for each wind turbine (approximately 1ha per turbine). Figure 2 illustrates the typical hardstanding requirements for the construction of each turbine (it should be noted that the figure below is for illustration purposes only – the exact layout and specification of the hardstanding will be determined once the design phase has been completed).

Solar Fields

- Solar PV array comprising PV modules (solar panels), which convert the solar radiation into direct current (DC);

[2] The MW split for the Wind and Solar Facilities will be dependent on the technology available at the time of construction and financial model.

- PV panels will be up to a height of 6m (when the panel is horizontal) and will be mounted on fixed tilt, single axis tracking or dual axis tracking mounting structures. Monofacial or bifacial Solar PV Modules are both considered;
- Footprint: ~160 ha; and
- Inverters, transformers and other required associated electrical infrastructure and components.

IPP portion onsite Substation and Battery Energy Storage System (BESS)

- IPP portion onsite substation of up to 4ha. The substation will consist of a high voltage substation yard to allow for multiple up to 132kV feeder bays and transformers, control building, telecommunication infrastructure, access road, etc.; and
- The Battery Energy Storage System (BESS) storage capacity will be up to 300MW/1200 megawatt-hour (MWh) with up to four hours of storage. It is proposed that Lithium Battery Technologies, such as Lithium Iron Phosphate, Lithium Nickel Manganese Cobalt oxides or Vanadium Redox flow technologies will be considered as the preferred battery technology; however, the specific technology will only be determined following Engineering, Procurement, and Construction (EPC) procurement. The main components of the BESS include the batteries, power conversion system and transformer which will all be stored in various rows of containers.

Operation and Maintenance Building Infrastructure

- Operations and maintenance (O&M) building infrastructure will be required to support the functioning of the WEF and SEF and for services required by operations and maintenance staff. The O&M building infrastructure will be near the onsite substation and will include:
- Operations building of approximately 200m^2;
- Workshop and stores area of approximately 150m^2 each;
- Stores area of approximately 150m^2; and
- Refuse area for temporary waste and septic/conservancy tanks with portable toilets to service ablution facilities.

The total combined area of the buildings will not exceed 5 000m^2.

Construction Camp Laydown

- Temporary laydown or staging area -Typical area 220m x 100m = 22000m^2.
- Laydown area could increase to 30000m^2 for concrete towers, should they be required.
- Sewage: septic and/or conservancy tanks and portable toilets.
- Temporary cement batching plant, wind tower factory & yard of approximately 7ha, comprising amongst others, a concrete storage area, batching plant, electrical infrastructure and substation, generators and fuel stores, gantries and loading facilities, offices, material

stores (rebar, concrete, aggregate and associated materials), mess rooms, workshops, laydown and storage areas, sewage and toilet facilities, offices and boardrooms, labour mess and changerooms, mixers, moulds and casting areas, water and settling tanks, pumps, silos and hoppers, a laboratory, parking areas, internal and access roads - Gravel and sand will be stored in separate heaps whilst the cement will be contained in a silo. The maximum height of the silo will be 20m.

Access Roads

- The Project site can be accessed easily via either the tarred R33 or the N4 national road which run along the northern and western boundaries of the site.
- There is an existing road that goes through the land parcels to allow for direct access to the project development area.
- Internal and access roads with a width of between 8m and 10m for the WEF, which can be increased to approximately 12m on bends. The roads will be positioned within a 20m wide corridor to accommodate cable trenches, stormwater channels and bypass /circles of up to 20m during construction. Length of the internal roads will be approximately 60km. For the SEF, internal gravel roads will be established between the arrays and will be up to 4m wide.

Associated Infrastructure

- For the WEF, the medium voltage collector system will comprise of cables up to and including 33kV that run underground, except where a technical assessment suggest that overhead lines are required, within the facility connecting the turbines to the onsite substation. The SEF will comprise low and medium voltage cabling between components (above or below ground as needed).
- Over the fence 132kV cable to connect the onsite IPP substation to the Common Collector Switching Station.
- Fencing of up to 4m high around the construction camp and lighting.
- Lightning protection.
- Telecommunication infrastructure.
- Stormwater channels.
- Water pipelines.
- Offices.
- Operational control centre.
- Operation and Maintenance Area / Warehouse/workshop.
- Ablution facilities.
- A gatehouse.
- Control centre, offices, warehouses.
- Security building.

- A visitor's centre.
- Substation building.

The proposed development footprint (buildable area) for the Dalmanutha Wind and Solar Energy Facility (Alternative 2) is approximately 400ha (subject to finalisation based on technical and environmental requirements), and the extent of the project area is approximately 9 197ha. The development footprint includes the turbine positions, solar PV array, and all associated infrastructure as outlined above.

The detailed project layout is shown in Figure 3 below.

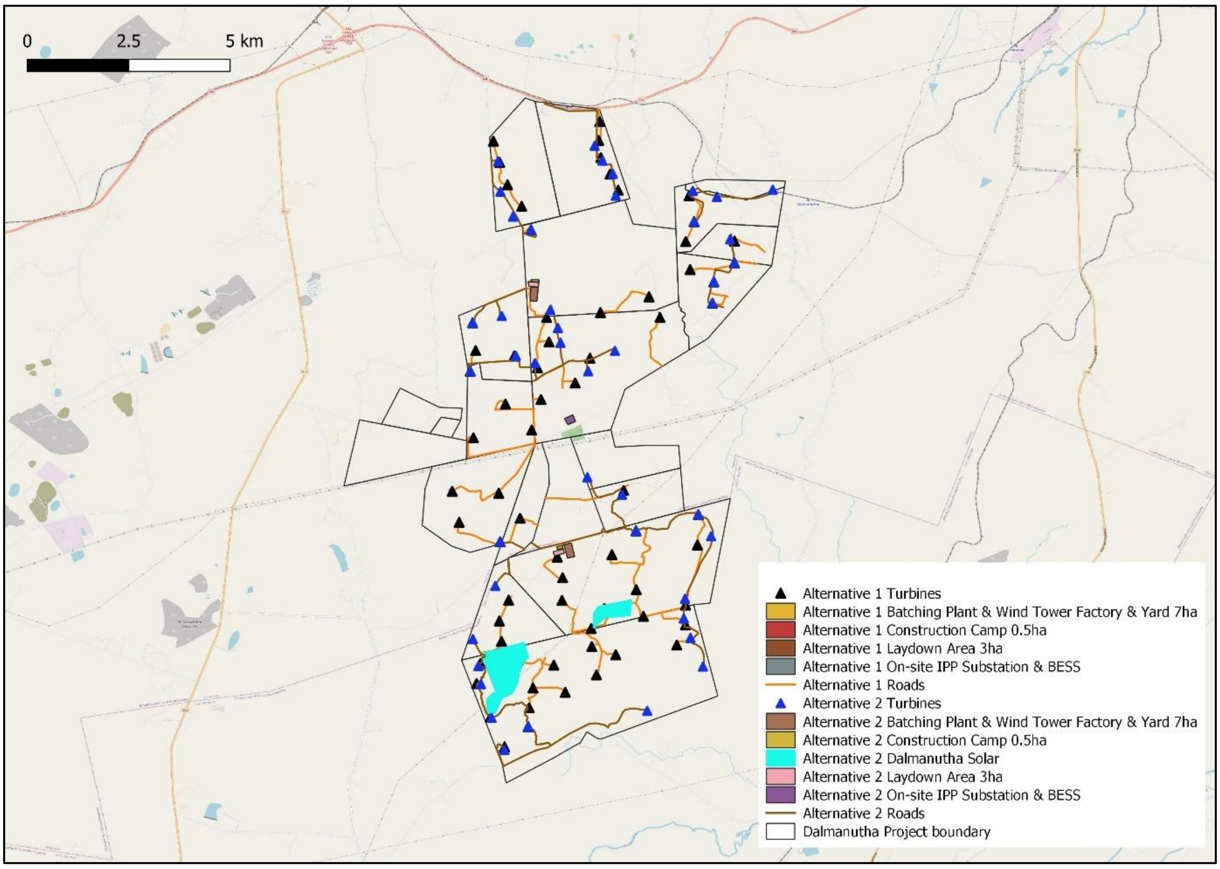

Figure 3. Detailed project layout for both alternatives.

Based on the extensive in-house scoping study done in the province, the Project location has been selected based on several factors namely: location to Eskom power station, wind resources, environmental constraints, grid connection and grid capacity in the Mpumalanga Province, topography, site access, existing competition, and land availability.

3. Legislative context

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

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

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

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

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

The *National Environmental Management – Biodiversity Act - Threatened or Protected Species* list (TOPS). Those TOPS species occurring in this study are described in this report.

The *Mpumalanga Nature Conservation Act (MNCA; Act 10 of 1998).* This Act makes provision with respect to nature conservation in Mpumalanga Province. It provides for, among other things, protection of wildlife, hunting, fisheries, protection of endangered fauna and flora as listed in the CITES, the control of harmful animals, freshwater pollution and enforcement. This act lists the following bird species as 'Protected Game': any wild bird excluding 'ordinary game birds' and the following: White-breasted Cormorant; Reed Cormorant; Red-eyed Turtle Dove; Cape Turtle Dove; Laughing Dove; all mousebirds; Pied Crow; Black Crow; Red-eyed and Black-eyed Bulbul; Red-winged Starling; Cape Sparrow; Spotted-backed Weaver; Cape Weaver; Masked Weaver; Red-billed Quelea; and Red Bishop.

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

The *National Environmental Management Act, No. 107 of 1998* (NEMA as amended): An Environmental Authorisation is required for Listed Activities in Regulations pursuant to NEMA. The avifaunal assessment feeds into the Environmental Authorisation process to inform whether the project can proceed or not.

The "Best practice guidelines for assessing and monitoring the impact of wind energy facilities on birds in southern Africa" Unpublished guidelines by BirdLife South Africa & Endangered Wildlife Trust (Jenkins et al, 2015, 2021).

The South African *Important Bird and Biodiversity Area (IBA*) data was consulted. Important Bird and Biodiversity Areas are spatial areas identified around the country as important for the conservation of birds. Development within or close to these areas is generally discouraged. The Karoo National Park is an IBA.

The *Species Environmental Assessment Guideline (SANBI, 2020)* is applicable, this report adheres to the guideline.

4. Assessment methodology

4.1. Specialist Credentials

See Appendix 9 for the avifaunal specialists full *curriculum vitae*.

4.2. Terms of Reference

Specialists shall undertake all necessary data collection and fieldwork to assess the project and meet the requirements of Appendix 6 to the EIA Regulations (as amended) including, but not limited to:

- Providing a detailed project specific description
- A detailed baseline description of the receiving environment in and surrounding the site, including a description of key no go areas or features or other sensitive areas to be avoided.
- A description of all methodology and processes used to source information, collect baseline data, generate models and the age or season when the data was collected. A description of any assumptions made and any uncertainties or gaps in knowledge.
- A description of relevant legal matters, policies, standards and guidelines.
- A list of potentially significant environmental impacts that may arise in the construction, operation and decommissioning phases of the project, including cumulative impacts
- A preliminary impact assessment of each impact
- Any other information the specialist believes to be important, including recommendations that should be included as conditions in the Environmental Authorisation.

4.3. General approach

The general approach to this study was as follows:

- Pre-construction bird monitoring was initiated in 2021. The study design and setup were conducted during April 2021, as was the first seasonal site visit (autumn). The second site visit was conducted in July (winter) and the third in November 2021 (spring). The fourth site visit was completed in February 2022 (summer). Each site visit consisted of approximately 14 consecutive days on site by a team of two skilled observers, to record data on bird species and abundance on and near site. These site visits covered summer (when summer migrants are present); winter (when raptors breed and Blue Cranes *Grus paradisea* flock); spring (when summer migrants are arriving on site and many species start to breed); and autumn (when summer migrants are leaving and many raptors are preparing to breed). We believe this sampling is sufficient to capture data representative of conditions on site. Pre-construction bird monitoring complied with the general birds and wind energy best practice guidelines (Jenkins et al, 2015, 2021). The detailed methods employed by this pre-construction monitoring are described in Section 2.7.
- Since a high risk to Cape Vulture *Gyps coprotheres* was identified during the first year of pre-construction bird monitoring, a second year of monitoring was initiated, in compliance with the Cape Vulture and wind energy guidelines (BirdLife South Africa, 2018). Six site visits were conducted during the second year of monitoring, which was concluded in March 2023.
- Additional specialist site visits were conducted during April 2022.
- To summarise, the 10 monitoring surveys were conducted on the following dates:
    - S1 – 27 April to 11 May 2021
    - S2 – 3 to 16 July 2021
    - S3 – 5 to 18 November 2021

- S4 – 14 to 27 February 2022
- S5 – 12 to 22 May 2022
- S6 – 26 August to 4 September 2022
- S7 – 19 to 22 September and 13 to 17 October 2022
- S8 – 7 to 15 December 2022
- S9 – 19 to 27 February 2023
- S10 – 20 to 28 March 2023

Note that pre-construction bird monitoring and all specialist field assessments were designed to assess the full Dalmanutha Wind Energy Facility site. This is an advantage when it comes to the assessment of each project component on its own, as data has been collected for a larger area. Since birds are mobile this presents a far stronger assessment than would otherwise be the case.

4.4. Information sources used

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

- The pre-construction bird monitoring raw data and progress reports (WildSkies, 2021 - 2023).
- The data captured by specialist site visits.
- The Southern African Bird Atlas Project data (SABAP1 - Harrison *et al*, 1997) for the relevant quarter degree squares covering the site, and the Southern African Bird Atlas Project 2 data, available at the pentad level (http://sabap2.adu.org.za/v1/index.php)(accessed at www.mybirdpatch.adu.org.za)
- The conservation status of all relevant bird species was determined using Taylor *et al* (2015) & IUCN 2023. The endemism of species was determined using the BirdLife South Africa Checklist.
- The vegetation classification of South Africa (Mucina & Rutherford, 2018) was consulted in order to determine which vegetation types occur on site.
- Aerial photography from the Surveyor General was used for planning purposes.
- The 'Avian Wind Farm Sensitivity Map: Criteria and procedures used (Retief *et al*, 2011, update 2014).
- The Important Bird & Biodiversity Areas programme was consulted (Marnewick *et al*, 2015).
- A review report entitled "Wind energy's impacts on birds in South Africa: a preliminary review of the results of operational monitoring at the first wind farms of the Renewable Energy Independent Power Producer Procurement Programme Wind Farms in South Africa" (Ralston-Paton, Smallie, Pearson, & Ramalho, 2017) was consulted extensively.
- A more recent review of the species affected by turbine collisions at south African wind farms was conducted by Perold *et al* (2020) and consulted for this study.

- Coordinated Avifaunal Road count data for the area (accessed at www.car.adu.org.za) was consulted.
- Coordinated Wetland bird count data (CWAC) was consulted to obtain information on waterbird abundance in the area.
- The "Best practice guidelines for assessing and monitoring the impact of wind energy facilities on birds in southern Africa" Unpublished guidelines by BirdLife South Africa & Endangered Wildlife Trust (Jenkins *et al*, 2015, 2021).
- Available published literature on wind energy – bird interactions.
- The Cape Vulture and wind energy best practice guidelines (BirdLife South Africa, 2018).
- Priority bird species records made in the site area over the last 12 years was received from a stakeholder/neighbouring landowner (Mr Geoff Lockwood) (Appendix 5).
- Habitat suitability models for priority bird species were consulted on the DFFE Online Screening Tool.
- Comments on the scoping phase assessment were received from three organisations: BirdLife South Africa (BLSA); Mpumalanga Department of Agriculture, Rural Development, land and Environmental Affairs; and Mpumalanga Tourism and Parks Agency. Comment was also received from Ms Annatjie Burke of the farm Vogelstruispoort 384 JT portion.
- The above organisations have also submitted relevant avifaunal data collected on an *ad hoc* basis in the area. This has been cross checked against our systematically collected monitoring data (over 24 months). We are aware of one inaccuracy in the data submitted by stakeholders, where a Blue Crane nest location is cited, but our own observation is that the nest area has been ploughed by the landowner in 2021/2022.

4.5. Assumptions and Limitations

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

The presence of the observers on site is certain to have an effect on the birds itself. For example, during walked transects, certain bird species will flush more easily than others (and therefore be detected), certain species may sit undetected, certain species may flee, and yet others may be inquisitive and approach the observers. Likewise, with the vantage point counts, it is extremely unlikely that two observers sitting in position for hours at a time will have no effect on bird flight. Some species may avoid the vantage point position because there are people present, and others may approach out of curiosity.

In almost all data collection methods large bird species will be more easily detected, and their position in the landscape more easily estimated. This is particularly relevant at the vantage points where a large eagle may be visible several kilometres away, but a smaller kestrel perhaps only within 800 metres. A particularly important challenge is that of estimating the height at which birds fly above the ground. With no reference points against which to judge, it is exceptionally difficult and subjective. It is for this reason that the flight height data has been treated cautiously by this report, and much of the analysis conducted using flights of all height.

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

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. To control for this subjectivity, the same pairs of observers have 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. Further, to maximise the returns from available resources, the walked transects were located close to each Vantage Point. This systematic selection may result in some as yet unknown bias in the data, but it has numerous logistical benefits.

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

4.6. Site sensitivity verification report

Government Notice No. 320, dated 20 March 2020, includes the requirement that an Initial Site Sensitivity Verification Report must be produced for a development footprint. As per Part 1, Section 2.3, the outcome of the Initial Site Verification must be recorded in the form of a report that - Confirms or disputes the current use of the land and environmental sensitivity as identified by the national web based environmental screening tool; Contains a motivation and evidence of either the verified or different use of the land and environmental sensitivity; is submitted together with the relevant reports prepared in accordance with the requirements of the Environmental Impact Assessment Regulations. The required report has been produced specifically to consider the avian and animal themes and addresses the content requirements of (a) and (b) above. This report can be viewed in Appendix 7 and is summarised in Section 7.1.

4.7. Pre-construction bird monitoring methodology

Data was collected on site through five primary data collection techniques, described in detail below.

4.7.1 Sample counts of small terrestrial species

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

4.7.2 Counts of large terrestrial species & raptors

This is a very similar data collection technique to the above, the aim being to establish indices of abundance for large terrestrial species and raptors. These species are relatively easily detected from a vehicle, hence driven transects (DTs) are conducted in order to determine the number of birds of relevant species in the study area. Detection of these large species is less dependent on their activity levels and calls, so these counts can be done later in the day. Four DTs were established on suitable roads in the area, ranging between 8 and 11 km in length, and totalling 39km (Figure 5). These transects were each counted once per site visit.

4.7.3 Focal site surveys

Four Focal Sites were identified for the site: Focal Sites 1 and 3 are man-made dams; and Focal Sites 2 and 4 are natural pans. These sites are important open water sources in the landscape and were surveyed each season.

4.7.4 Incidental observations

This monitoring programme comprises a significant amount of field time on site by the observers, much of it spent driving between the above activities. 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 recorded.

4.7.5 Direct observation of bird movements

The aim of direct observation is to record bird flight activity on site. An understanding of this flight behaviour will help explain any future interactions between birds and the wind farm. Spatial patterns in bird flight movement may also be detected, which will allow for input into turbine placement. Direct observation was conducted through counts at 7 fixed Vantage Points (VPs) in the study area (Figure 5). These VP's provide coverage of a reasonable and representative proportion of the entire study area. VPs were identified using GIS (Geographic Information Systems), and then fine-tuned during the project setup, based on access and other information. Since these VP's aim at capturing both usage and behavioural data, they were positioned mostly on high ground to maximise visibility. The survey radius for VP counts is 2 kilometres (although large birds are sometimes recorded further). Vantage Point counts are conducted by four teams of two observers each. Birds are recorded 360° around the observers. Data should be collected during representative conditions, so the sessions are spread throughout the day, with each VP being counted over 'early to mid-morning', 'mid-morning to early afternoon', and 'mid-afternoon to evening'. Each VP session is 4 hours long, which is believed to be towards the upper limit of observer concentration span, whilst also maximising duration of data capture relative to travel time required in order to get to the Vantage Points. A total of 12 hours of observation was collected per Vantage Point on each Site Visit (x 6). A maximum of two VP sessions were conducted per day, to avoid observer fatigue compromising data quality. As far as logistically possible, two different Vantage Points were visited per day per team of observers.

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

During each VP session, flight paths of priority species in conjunction with their corresponding heights, flight modes and flight times were drawn onto printed 1:50 000 maps which were later digitised using QGIS software for further analysis.

The layout of the Vantage Points is shown in Figure 4.

4.7.6 Cape Vulture roost counts

During the second year of monitoring a local organisation (Dullstroom Birds of Prey Centre) assisted us to achieve a greater frequency of surveys at the vulture power line roost locations. These roosts were surveyed 11 times during the second year period in addition to the 6 full monitoring surveys.

4.7.7 Control site

A control or reference site was established to the south of the Dalmanutha site and was monitored as part of this programme (Jenkins *et al.* 2015). At this site, 2 vantage points, 1 drive transect and 3 walked transects were monitored (Figure 5). These data will not be reported on in the EIA phase of this study.

The location of the above described monitoring activities are shown in Figure 4.

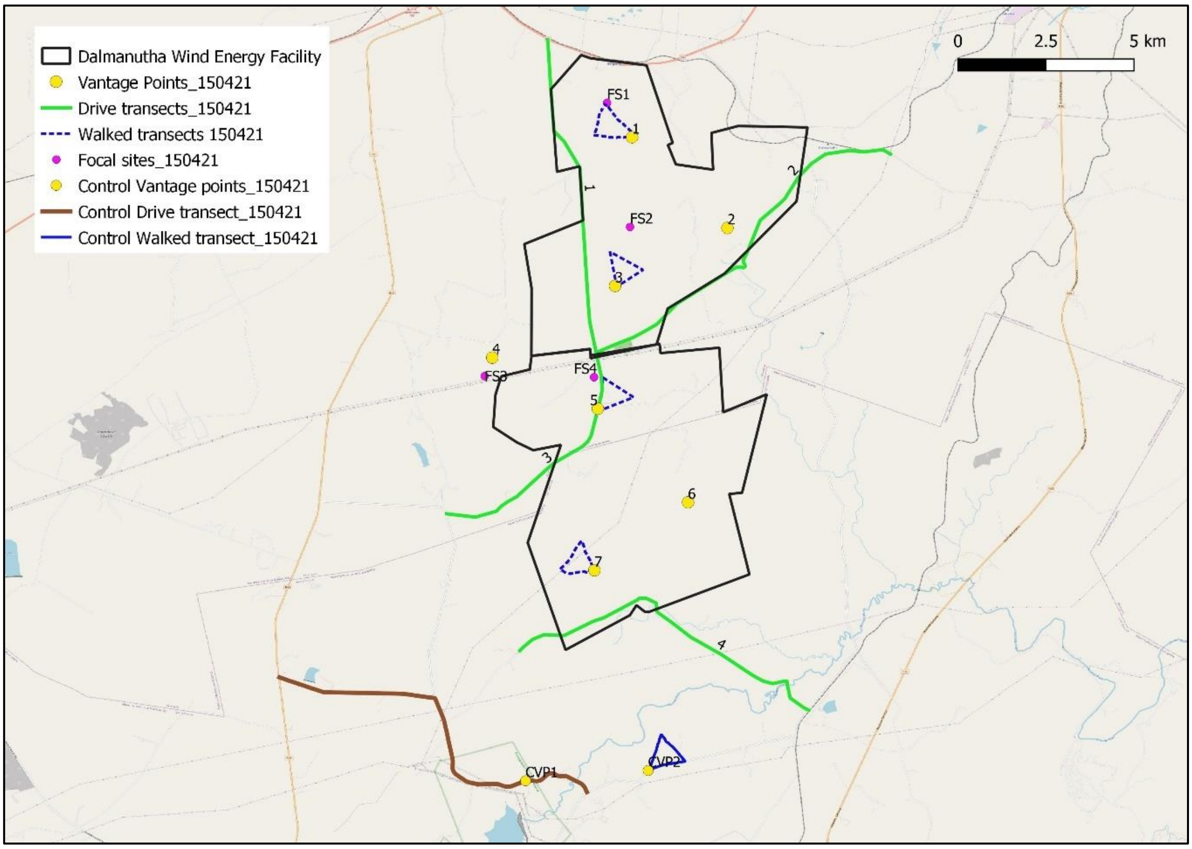

Figure 4. The layout of bird monitoring activities.

5. Background to wind & solar facilities & birds

5.1 Wind energy & birds

The first documented interaction between birds and wind farms was that of birds killed through collisions with turbines, dating back to the 1970s. Certain sites, such as Altamont Pass – California, and Tarifa – Spain, killed many birds and focused attention on the issue. However, as the research developed 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; Rydell *et al*, 2017; Ralston-Paton *et al* 2017). Impacts have so far proven to differ significantly between sites (Bose *et al.* 2018; Ralston-Paton *et al.* 2017; Thaxter *et al*. 2017).

With time it became apparent that there are actually four ways in which birds can be affected by wind farms: 1) collisions – which is a direct mortality factor; 2) habitat alteration or destruction (less direct); 3) disturbance – particularly whilst breeding; and 4) displacement/barrier effects (various authors including Rydell *et al* 2012; Rydell *et al*, 2017). Whilst the impacts of habitat alteration and disturbance are probably fairly similar to that associated with other forms of development, collision and displacement/barrier effects are unique to wind energy.

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

5.1.1 Collision of birds with turbine blades

Without doubt the impact of bird collision with turbines has received the most attention to date amongst researchers, operators, conservationists, and the public (Dwyer *et al.* 2018; Bose *et al.* 2018; Thaxter *et al.* 2017; Vasiliakis *et al.* 2017, Ralston Paton *et al*. 2017; Perold *et al*, 2020).

It is important to understand that not all birds that fly through a wind farm at rotor height collide with blades. In fact, avoidance rates for certain species have proven to be extremely high internationally. Avoidance rates have not been determined for South African species.

The two most common measures for collision fatality data used to date are, the number of birds killed per turbine per year, and number of birds killed per megawatt installed per year. Rydell *et al* (2012) reviewed studies from 31 wind farms in Europe and 28 in North America and found a range between 0 and 60 birds killed per turbine per year, with a median of 2.3. European average bird fatality rates were much higher at 6.5 birds per turbine per year compared to the 1.6 for North America. These figures include an 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.

Eagle turbine collision fatalities are particularly relevant to the proposed site as described later in this report. Internationally, fatalities at wind farms have been reported for Golden Eagle (e.g. Smallwood 2013), White-tailed Sea Eagle (e.g. Hötker *et al.* 2006), Bald Eagle (Pagel *et al.* 2013) and White-bellied Sea Eagle (Smales & Muir 2005).

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 (adjusted 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 (Rydell *et al*, 2012).

The composition of the South African bird turbine collision 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 by turbine collision to date at these operational sites included Verreaux's Eagle *Aquila verreauxii* (5 - Vulnerable), Martial Eagle *Polemaetus bellicosus* (2 - Endangered), Black Harrier *Circus maurus* (5 - Endangered), and Blue Crane (3 – Near-threatened). Although not Red Listed, a large number of Jackal Buzzard *Buteo rufofuscus* fatalities (24) were also reported.

Ralston-Paton *et al's* review included the first year of operational monitoring at the first 8 facilities. At least one more year has elapsed at each of these facilities and additional facilities have come online. Ralston-Paton (2019) presented an update of the findings in October 2019 at the Birds and Renewable Energy Forum. We have used these findings for this study where relevant, supplemented with our own knowledge of fatality findings at sites we have worked at.

A more recent review was conducted by Perold *et al* (2020) of the bird fatality data across 20 operational wind farms in SA between 2014 and 2018. The overall adjusted fatality rate was 4.6 birds/turbine/year. Thirty families and 130 bird species were affected. Diurnal raptors were killed most often (36% of carcasses, 23 species) followed by passerines (30%, 49 species), waterbirds (11%, 24 species), swifts (9%, six species), large terrestrial birds (5%, 10 species), pigeons (4%, six species) and other near passerines (1%, seven species). The species of most conservation concern killed include endangered Cape Vultures and Black Harriers, both of which are endemic to southern Africa.

5.1.2. Loss or alteration of habitat during construction

During the construction of wind farms and associated infrastructure, some habitat destruction and alteration will take place. This happens with the construction of access roads, the clearing of servitudes and areas for turbine hardstands and laydown areas, and the levelling of substation yards (including associated battery storage facility). This removal of vegetation which provides habitat for avifauna and food sources may have an impact on birds breeding, foraging and roosting (Dwyer *et al.* 2018; Tarr *et al.* 2016). The area of land directly affected by a wind farm and associated infrastructure is often relatively small when compared with the extent of the site. Typically, actual habitat loss is between 2 and 5 % of the total development area (Drewitt & Langston 2006). As a result, in most cases habitat destruction or alteration in its simplest form (removal of natural vegetation) is unlikely to be of great significance for many bird species. 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), which is certainly the case at the proposed site. 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-Paton *et al* (2017) did not review habitat destruction or alteration. From our own work to date, we have recorded a range of habitat destruction on 6 wind farms from 0.6 to 4% (mean of 2.4%) of the total site area (defined by a polygon drawn around the outermost turbines and other infrastructure) and 6.9 to 48.1ha (mean of 27.8ha) of aerial space. The surface area impacted on by this proposed project is described later in this report.

5.1.3. Disturbance of birds

Activities associated with construction of wind farms (including heavy machinery, earth moving, vehicle and staff traffic) can disturb birds in the receiving environment (Dwyer *et al*, 2018; Tarr *et al*. 2016; Ledec *et al.* 2011). 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 (seasonal). Effects of disturbance during breeding could include loss of breeding productivity; temporary (within that particular season) or permanent (never to breed again) abandonment of breeding; or even abandonment of a nest site.

Ralston-Paton *et al* (2017) found no conclusive evidence of disturbance of birds at the sites reviewed. It may be premature to draw this conclusion after only one year as effects are likely to vary with time

(Stewart *et al*, 2007) and statistical analysis was not as in depth as desired. At this stage in the industry, a simplistic view of disturbance has been applied whereby the presence or absence of active breeding at breeding sites of key species is used as the basis for findings.

5.1.4. Associated infrastructure

Infrastructure associated with wind energy facilities also has the potential to impact on birds, in some cases more than the turbines themselves. Overhead power lines pose a collision and possible 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 (including associated battery storage facility) and offices constructed will also have a disturbance and habitat destruction impact.

Collision with power lines is one of the biggest single threats facing birds in southern Africa (van Rooyen 2004). Most heavily impacted upon are bustards, storks, cranes, and various species of water birds (many of which occur in the study area). These species are mostly heavy-bodied birds with limited manoeuvrability, which makes it difficult for them to take the necessary evasive action to avoid colliding with power lines (van Rooyen 2004, Anderson 2001). Unfortunately, many of the collision sensitive species are also considered threatened in southern Africa. The Red List species vulnerable to power line collisions are generally long living, slow reproducing species under natural conditions.

Electrocution refers to the scenario where a bird is perched or attempts to perch on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (van Rooyen 2004). The larger bird species (such as eagles) are most affected since they are most capable of bridging critical clearances on hardware.

Ralston-Paton *et al* (2017) did not review power line impacts at the 8 sites.

5.1.5. Displacement & barrier effects

A barrier effect 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. Displacement occurs when birds leave an area due to the disturbance or habitat destruction that has taken place there (Dwyer *et al*, 2018).

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

5.1.6. Mitigation

Possible mitigation measures for bird turbine collision include: increasing turbine visibility (for example through painting turbine blades; restriction of turbine operation 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 in South Africa but have been used elsewhere in the world. In South Africa, observer led Shutdown on Demand has recently shown initial promise at an operational wind farm in the Western Cape. It is likely that by the time of construction of the proposed project more experience on this mitigation will be available in country. Likewise, with blade painting, a paper out of Norway recently showed significant promise for the effectiveness of this measure (May *et al*. 2020). A trial for this method is currently underway in SA, with Civil Aviation Authority (CAA) approval (Arcus, pers comm, Umoya Energy paints wind turbine blades to protect birds (engineeringnews.co.za)). Currently, indications are that CAA will approve the use of signal red only for this purpose.

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 as correct siting, both of the entire facility, and of the individual turbines themselves. Siting of individual turbines has already been done in detail with the proposed project whereby no go areas for avifauna were used in developing the layout being assessed.

5.2 Solar energy & birds

Photovoltaic technology uses cells to convert sunlight into electric current. Commercial scale facilities typically consist of the following components: PV modules; Inverters and power electronics; structural and wiring hardware; roads; fences; substations; and office buildings.

5.2.1 Habitat destruction

Due primarily to the surface area required for the PV modules or panels (typically approximately 2-5ha per MW – Ong *et al*, 2013; Hernandez *et al,* 2014 or 1.4 to 6.2 ha/MW according to US Department of Energy 2012) and the associated roads, substations, offices and its ancillary grid connection, solar PV facilities occupy a relatively large amount of land and therefore represent a significant anthropogenic land use in the environment (Walston *et al*, 2015). Lovich and Ennen (2011) and DeVault *et al* (2014) state that in 'many' cases vegetation removal is complete at PV facilities. This will however not be the case for the proposed facilities which will allow vegetation to grow between and below panels as far as possible. This is important for the smaller bird species some of which will use these areas. Larger bird species such as korhaans, bustards and cranes are unlikely to enter these areas. Our own observations of operational PV facilities in South Africa to date confirm that vegetation removal is complete in all cases. Vegetation removal translates into habitat removal or destruction for bird species. Habitat removal is a consequence of almost any new form of development, and is not particularly unique to solar PV energy. The significance of the habitat removal depends on factors such as: the amount of habitat affected; the uniqueness of the habitat; and the sensitivity and conservation status of the bird species utilizing that habitat.

5.2.2 Disturbance of birds & displacement effects

Construction of a facility of this nature requires a significant amount of machinery and labour to be present on site for 12 months. For the more shy and sensitive bird species this could disturb them and displace them from the area at least for the duration of construction and possibly longer. In addition, species commuting around the area may avoid the site once operational (for approximately 20 years) and fly longer distances than usual as a result. For some species this may have critical energy implications. Disturbance of breeding birds is of particular concern since this could result in lower breeding productivity, total breeding failure, and/or temporary or permanent abandonment of the breeding site. All of these can have significant consequences for threatened bird species.

5.2.3 Bird fatality at PV facilities

Until recently very little information on bird fatality at PV facilities around the world was available. As a result there was relatively low concern for this impact amongst ornithologists, certainly when compared to wind energy facilities for example. However, in the 2010 to 2015 period some data emerged from the USA which pointed towards the direct fatality impacts at PV facilities possibly being far greater than previously understood (Kagan *et al,* 2014; Walston *et al*, 2015). Bird fatalities were recorded in high numbers at at-least one site in the USA (Kagan *et al,* 2014; Walston *et al*, 2015; Walston *et al*, 2016).

Walston *et al* (2016) reviewed bird fatality information at Solar Energy Facilities (SEFs) across the USA (although finding that most information was available for a smaller area in California). They found that 3 facilities had systematically collected data on avian mortalities, one of which was a PV facility, the California Valley Solar Ranch project of 250MW. At this facility, a total mortality rate of 10.7birds/MW/year was recorded, consisting of 0.5birds/MW/year from known fatality causes (attributable to the facility) and 10.2birds/MW/year of unknown causes.

In addition to the above information, much has been written about the potential to attract certain bird guilds to a PV facility (Kagan *et al,* 2014). Glare and polarized light could attract insects and in turn foraging bird species (Horváth *et al*, 2009). The PV panels provide shade for smaller species. The infrastructure can provide nesting substrate. The so called "lake effect" created by the reflective surfaces of the PV panels has been hypothesized to attract migrating waterfowl that then collide with the panels when they attempt to land (Kagan *et al*, 2014). To date no empirical research has been conducted on this "lake effect" (Walston *et al,* 2015) and it remains unproven. At the Springhaas facility we do not identify any significant attractants. There will be on open water sources on site in particular.

More locally, we are aware of one operational utility scale PV facility (the 96MW Jasper facility) which monitored impacts on birds and published the results (Visser, 2016, Visser *et al*, 2019). Seven bird mortalities were recorded during a 3 month period under the PV panels, although they could not all be attributed to a specific case of death since in almost all cases only feathers were found. An eighth bird fatality was found during the initial clearing of bird fatalities before the three months. Five bird species were killed during this study: Fiscal Flycatcher *Sigelus silens*; Eastern Clapper Lark *Mirafra apiata*; Orange River Francolin *Scleroptila levaillantoides*; Speckled Pigeon *Columba guinea*; and Red-eyed Bulbul *Pycnonotus nigricens*. Visser (2016) estimated the annual bird fatality rate at the site to be 4.5 fatalities per MW per year, although the confidence limits in this estimate were very high due to the low number of fatalities found. One fatality of a bird which became entangled in the perimeter fence was recorded (Orange River Francolin). Most fatality species showed an over representation on the facility when compared to the surrounds, indicating that they were possibly attracted to the facility. Bird species richness and diversity were found to be lower on the facility than on the border or off the facility. This indicates a possible displacement effect amongst certain bird groups, particularly those that favoured the woody vegetation previously present on the site.

It is important to understand that bird abundance and flight activity levels differ according to habitat availability, and other natural features. Therefore the impact on birds through direct fatality is very site specific. The risk can be greatly reduced if the location of the project takes the following features relating to bird habitat into account: migratory flyways; wetlands; riparian vegetation; and availability of habitat amongst the arrays. Avoiding siting the solar project infrastructure in these sensitive areas can greatly reduce the impact on birds (Walston *et al*, 2015).

Birds can also be killed through collision with the overhead power line conductors/earth wires, electrocution on electrical infrastructure such as pole tops, substations and switching gear on site, in addition to entanglement in or collision with fences (this may be lessened by the use of mesh panel style fencing). Avian collision occurs when a bird physically strikes either the conductor or the earth (shield) wire of an overhead power line while in flight. Most heavily impacted upon are bustards, storks, cranes and various species of water birds, owing to their morphology and propensity for low level flights. 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 electrical hardware.

5.2.4 Nesting & other utilization of facility by birds

Various bird species are quick to seize a new opportunity for perching, roosting or nesting, including on man- made structures (van Rooyen & Ledger 1999, de Goede 2011 and de Goede & Jenkins 2001). It is likely then that birds (particularly passerine and corvid species) could use certain parts of the proposed facility once commissioned (Visser *et al,* 2019). Whilst this nesting could be viewed as a positive impact for birds, it typically creates operational problems for the facility, which require management actions such as nest management in order to ensure that the nests don't interfere with operations or increase fire risk. Nest relocation or removal should be done under permit from the provincial authority.

It is also likely that some small species will use the PV panels for shade and this will create a new microhabitat on the site. This should not adversely affect the operation of the equipment however and should also not lead to direct mortalities by these small species.

5.2.5 Altered water runoff patterns

It is likely that altering the nature of the sites surface from natural vegetation to infrastructure, roads, gravel, and possible paving – will alter the way in which water moves on the site after rainfall and cleaning of infrastructure. If this is not carefully managed this could cause soil erosion and thereby alter more bird habitat than necessary by affecting off site areas. There is a detailed stormwater assessment underway for the project, and this will take care of any concerns in this regard. In addition vegetation will be allowed to grow around panels and this will attenuate run off. Increased runoff could also create moister conditions on or near the site thereby attracting more birds to the area and increasing the likelihood of other interactions with the facility. This is a very minor impact and will be covered by general environmental good practice, and will not be assessed formally in Section 8.

5.2.6 Chemical pollution associated with PV panel cleaning

It has been suggested (Jenkins *et al,* 2017) that pollution could occur if hazardous chemicals are used to clean PV panels once operational. This could have secondary effects on vegetation, invertebrate populations and in turn food availability and habitat for birds. The developer has also committed to using biodegradable detergents for this reason. This is a very minor impact and will be covered by general environmental good practice, and will not be assessed formally in Section 8.

5.3 Contextualising wind & solar 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 shortcoming 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 and solar farms, and particularly Red List species in South Africa are unlikely to frequent tall buildings or to be caught by cats. Since many of these bird species are already struggling to maintain sustainable populations, we should be striving 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.

6. Baseline description of receiving environment

6.1. Vegetation & habitat

The Dalmanutha Wind Energy Facility site is comprised mostly of two vegetation types. In the west is 'Eastern Highveld Grassland' (Mucina & Rutherford, 2018). This is an 'Endangered' and 'Hardly protected' vegetation type. In the east is 'Lydenburg Montane Grassland', which is a 'Vulnerable' and 'Poorly protected' vegetation type. A small portion of the site in the south is classified as 'KaNgwane Montane Grassland' which is 'Vulnerable' and 'Hardly protected'. The vegetation on site and potential impacts will no doubt be described in more detail by the biodiversity specialist.

Effectively, a number of bird micro habitats are available to birds in the area including: man-made dams; pans; drainage lines; wetlands; rocky ridges and cliffs; exotic trees; and arable lands. Examples of these are shown in Figure 5.

Figure 5. Typical micro-habitats available to birds in the study area.

6.2. Pre-construction bird monitoring findings

Throughout the two years of avifaunal monitoring and studies on site, we have recorded 244 bird species on site across all methodologies, and incidentally. Total species diversity per Site Visit is shown in Appendix 1 and ranges from a minimum of 106 species in S10 (autumn 2023) to 174 species in S4 (summer 2022).

The South African Bird Atlas Project 2 (SABAP 2) reports an additional 75 species which were absent from our species lists but present in the SABAP 2 data, albeit often at low reporting rates, or submitted as *ad hoc* accounts (Appendix 1). These species include a number of Vulnerable, Near-threatened and/or near endemic species, the most notable of which include: Yellow-breasted Pipit *Anthus chloris* (0.5%), Verreaux's Eagle (0.9%), Abdim's Stork *Ciconia abdimii* (0.5%), Red-footed Falcon *Falco vespertinus* (1.4%) and Lesser Flamingo *Phoeniconaias minor* (0.5%).

Fifteen species recorded on the site are regionally Red Listed: **Wattled Crane** *Grus carunculata* and **White-backed Vulture** *Gyps africanus* are Critically Endangered; **Grey Crowned Crane** *Balearica* *regulorum*, **African Marsh Harrier** *Circus ranivorus*, **Cape Vulture**, **Martial Eagle** and **Black-rumped Buttonquail** *Turnix nanus* are Endangered; **White-bellied Bustard** *Eupodotis senegalensis*, **Southern Bald Ibis** *Geronticus calvus*, **Denham's Bustard** *Neotis denhami*, **Crowned Eagle** *Stephanoaetus coronatus*, **Lanner Falcon** *Falco biarmicus*, and **Secretarybird** *Sagittarius serpentarius* are Vulnerable, and **Blue Crane** and **Pallid Harrier** *Circus macrourus* are Near-Threatened. An additional two species are Regionally Least Concern although listed Globally as Near Threatened: **Blue Korhaan** *Eupodotis caerulescens* and **Forest Buzzard** *Buteo trizonatus*. Twenty-three of the 318 species recorded by our observers or additional SABAP 2 records are either near endemic to South Africa, or endemic to South Africa, Lesotho and eSwatini.

6.2.1 Small terrestrial bird species

A total of 134 bird species were recorded on the Walked Transects on the site through the two years of monitoring. This included 2 511 records of 6 670 individual birds. Walked Transects totalled 102km overall, averaging 10.2km per Site Visit. The number of species recorded each Site Visit ranged from 40 (S10) to 83 (S3). Table 1 shows the data for the full year for the 20 most abundant species. Appendix 2 shows the full species set and the breakdown across all of the Site Visits. In each case the number of birds, number of records, and number of birds per kilometre of transect are presented, although the index of birds per kilometre is relatively crude. However, since this will be used primarily to compare the effects of the facility on these species post-construction, this index is considered adequate at this stage. If more complex analysis is required during post-construction monitoring in order to demonstrate effects, the raw data is available for this purpose.

The most abundant species encountered on the Walked Transects were not surprisingly all species already known to be common in the area, such as: Southern Red Bishop *Euplectes orix (*80 records of 1064 birds), Long-tailed Widowbird *Euplectes progne (*97 records of 546 birds), Cape Longclaw *Macronyx capensis* (225 records of 428 birds), Wing-snapping Cisticola *Cisticola ayresii (*201 records of 420 birds) and Barn Swallow *Hirundo rustica (72* records of 311 birds). These species share the traits of either flocking in large numbers or performing aerial displays or frequent, recognisable vocalisations which increases their detectability in the landscape.

Of the 134 species identified on the Walked Transects, ten are endemic or near endemic to South Africa, Lesotho and eSwatini: Pied Starling *Lamprotornis bicolor*, Eastern Long-billed Lark *Certhilauda semitorquata*, Fiscal Flycatcher *Melaenornis silens*, Cloud Cisticola *Cisticola textrix*, Cape White-eye *Zosterops capensis*, Drakensberg Prinia *Prinia hypoxantha*, Buff-streaked Chat *Campicoloides bifasciatus*, Cape Grassbird *Sphenoeacus afer*, South African Cliff Swallow *Petrochelidon spilodera* and Cape Weaver *Ploceus capensis*.

The small terrestrial bird community on site is as expected for the highveld grassland vegetation that occurs on site. Seeding grasses and abundant insect prey (specifically in the warmer months) provide adequate food for a relatively diverse assemblage of both granivorous and insectivorous birds. There are no particularly concerning species present on site from this sector of the avifauna. Black-rumped Buttonquail, a small Endangered species, was not detected on dedicated walks, but was recorded by other methodologies during the monitoring program, generally when flushed from the side of the road.

6.2.2 Large terrestrial & raptors

A total of 23 large terrestrial, raptor or threatened species were recorded across the Driven Transects totalling approximately 400 kilometres on the site through the two years of monitoring. This included 209 individual birds from 95 records. The summarised data for the full period are shown in Table 2, whilst Appendix 3 has the breakdown per Site Visit. Table 2 also presents the species' regional and global Red List and endemism status. Eight of these species are regionally or globally Red Listed. Additionally, Jackal Buzzard is near endemic to South Africa, and Forest Buzzard and Southern Bald Ibis are endemic to SA, Lesotho and eSwatini. In terms of the number of individuals sighted, the most abundant species recorded by this method was Amur Falcon, with 26 records made of 90 birds. Amur Falcon was followed by Cape Vulture (9 records of 36 birds) and Black-winged Kite (10 records of 12 birds) in terms of abundance.

These data represent a good diversity of target species recorded by this method although at relatively low abundance. Although Secretarybird (one pair throughout 2 years) korhaans and cranes are generally conspicuous in the landscape because of their greater size, or readily flush when approached, the method was not particularly effective at detecting them in the landscape. Many of the species detected on Driven Transects were only recorded singly, or in pairs, and infrequently. Their density (or abundance) in the area could be considered fairly low if only this methodology were considered, although they were encountered incidentally as well on VP sessions on numerous occasions. Very good visibility to further than 1-2km during these transects was often compromised by thick vegetation, obstructing Black Wattle stands, or by smoke hanging in the air from frequent burning regimes. When considering other methods (Incidental Observations and VP) it becomes clearer that our target species are more abundant than these DT data suggest.

The large terrestrial birds and raptors are the most important sector of the avifauna on this site, with a number of regionally Red Listed species included. Most of the priority species for the site come from this sector (Section 6.6).

6.2.3 Focal sites

The implications of these on-site sensitivities are discussed comprehensively in Section 7.4.

Nests

Raptor nests are typically the most sensitive receptor in avifaunal studies for renewable projects such as this. Perhaps surprisingly, no raptor nests have been located on site, although the large number of suitable trees (often in inaccessible kloofs and valleys) certainly does not preclude their existence on site.

Dams

Focal Site dams were designated as FS 1 - 5. A typical assortment of waterfowl has been recorded at these five dam Focal Sites across the Site Visits during our monitoring. Species recorded (to name the most abundant) included: African Darter *Anhinga rufa*; African Snipe *Gallinago nigripennis*; African Swamphen *Porphyrio madagascariensis*; Blacksmith Lapwing *Vanellus armatus*; Common Moorhen *Gallinula chloropus*; Egyptian Goose *Alopochen aegyptiaca*; Hadeda Ibis *Bostrychia hagedash*; Little Grebe *Tachybaptus ruficollis;* Intermediate Egret *Ardea intermedia;* Purple Heron *Ardea purpurea*; Red-knobbed Coot *Fulica cristata*; Reed Cormorant *Microcarbo africanus*; Spur-winged Goose *Plectropterus gambensis*; South African Shelduck *Tadorna cana*; Whiskered Tern *Chlidonias hybrida* and Yellow-billed Duck *Anas undulata.* Cryptic, reed-dwelling species such as African Rail *Rallus caerulescens*, Red-chested Flufftail *Sarothrura rufa* and Black Crake *Amaurornis flavirostra* have also been recorded at a low incidence.

These wetland and dam areas also provide important habitat for reed-dwelling species such as warblers, nesting habitat for a variety and great abundance of weaver species, aerial foraging space for swifts, swallows, terns and martins, and the margins provide resources for lapwings, waders, wagtails and many other species.

During S5, a pair of Grey-crowned Crane was seen at FS 1, and a lone Wattled Crane at FS 2. In S7, a number of Southern Bald Ibis were recorded at FS 4 and FS 5, otherwise none of the species listed above is regionally Red Listed.

A pair of Grey Crowned Crane nested in the FS 5 wetland at the end of Year 1 monitoring; they were seen with three chicks judged to be between 4-5 weeks of age. No Grey Crowned Crane breeding activity was recorded at FS 5 in Year 2, however. Observers noted that this area was heavily disturbed at the time they surveyed the Focal Site during S7, with in excess of 100 cattle drinking from the banks and grazing in the area. It appeared that many large trees had recently been logged immediately south of this wetland area which highlights just one example of the anthropogenic impact of farming practices across the site. Limited birdlife was present here at the time, although FS 4 (approximately 2km north) was surveyed on the same morning and birdlife was very diverse and abundant here. There is surely a lot of passage between these water bodies and other such features in the vicinity which were not formally surveyed. Our Focal Site dams will each receive at least a 500m No-go turbine buffer, and up to 750m for FS 4 on account of Blue and Wattled Cranes reportedly breeding here. Sensitive aquatic features must also be avoided according to the NFEPA database.

Roosts

A small gorge with cliffs has been identified as being used as a roost by Southern Bald Ibis. This was designated as FS 6. Up to 10 birds have been recorded roosting here by our own surveys. Our survey of the cliffs revealed no evidence of breeding, although it cannot be ruled out in the future, and

Lockwood (*pers. comm*) reports five active nests at this location. It appears that the roost may not be used every evening and it is conceivable that it is used for breeding in some years and not others. This location site has been buffered by 1km to provide protection for these birds flying in and out of the roost. During the latest Site Visit (S8), flight paths on VP 1 sessions followed a very consistent flyway towards/from this kloof, and birds were photographed perching on the steep walls upon closer inspection Appendix 4.

6.2.4 Incidental observations

A total of 35 species were recorded on the site as Incidental Observations, the summary of which is provided in Table 3. Appendix 5 presents the findings per Site Visit. The most abundant species (by a significant margin) recorded by this method was Cape Vulture, with 44 records made of 292 birds. Common Buzzard was the second most abundant species with 17 records of 179 birds. Observers made 21 incidental records of 148 individual Southern Bald Ibis in the two years of monitoring. Thirteen of the species recorded by this method are regionally or globally Red Listed. These include one Critically Endangered species (Wattled Crane); four Endangered species (Cape Vulture, Grey Crowned Crane, Black-rumped Buttonquail and African Marsh Harrier); five Vulnerable species (Lanner Falcon, Secretarybird, Southern Bald Ibis, White-bellied Bustard and Denham's Bustard); and one Near-threatened species (Blue Crane). In addition, Forest Buzzard and Blue Korhaan were recorded and are regionally Least Concern, but Globally Near-threatened. Since these data are not the product of systematic data collection methods, they should be used cautiously and we do not discuss these findings any further here other than presenting the summarised data.

6.2.5 Bird flight activity

A total of 768 hours of bird flight observation was completed on site over the course of the two years of monitoring. Overall, 32 target bird species were recorded flying on the site during the Vantage Point surveys. These data are shown in Table 4, summarised for the full year, whilst the breakdown per Site Visit is shown in Appendix 6. Twelve of these 32 species are regionally Red Listed (Taylor *et al.* 2015): White-backed Vulture and Wattled Crane are Critically Endangered; Cape Vulture, Martial Eagle and are Endangered; Lanner Falcon, Southern Bald Ibis, White-bellied Bustard, Denham's Bustard, Crowned Eagle and Secretarybird are all Vulnerable, and Blue Crane and Pallid Harrier are Near-Threatened. Jackal Buzzard is near endemic to South Africa. Table 4 also presents each species' overall passage rate (birds/hour).

The species recorded flying most frequently and in the largest numbers on site during dedicated Vantage Point sessions was by quite a large margin Cape Vulture, with 554 individual birds recorded across 224 records. Common Buzzard was the second most frequent flyer with 67 records of 342 birds. Most of these records were in late February in 2023, including one single record of approximately 200 buzzards flying at once. These records provide some indication that possibly this species is migrating over the site, as this is the prime time for the species to start migrating northwards. The third most frequent flyer (in terms of overall number of birds) was Black-winged Kite, with 105 records of 114 individuals. It is concerning how prevalent Cape Vulture are in the airspace on site, given their risky flight behaviour in which a large proportion of their flight height is well within the rotor swept area (RSA) of the proposed turbines.

The spatial representation of all flight activity is presented in Section 6.2.7.

6.2.6 Estimating turbine collision fatality rates

Crude turbine collision fatality rates were calculated for each species recorded flying, in order to estimate how many bird fatalities could occur at the proposed project once operational (and before mitigation). This was based on the species' passage rates (number of birds recorded flying per hour) recorded on site. Generally speaking we expect those species which fly more often to be more susceptible to turbine collision. In order to calculate crude passage rates for each species, we assumed that the 2 kilometre radius around vantage points was approximately equal to the maximum distance over which sightings were made, and that the coverage was approximately circular. This meant that at each vantage point an area of 12.57 km² was sampled ($A = \pi r^2$). Secondly, we assumed that the area of the wind farm directly presenting a collision risk is described by the area of each turbine's rotor zone multiplied by the number of turbines. We assumed a turbine model with a rotor swept area of 31 415.93m² (turbines with rotor diameter of 200m) and the preliminary layout of 70 turbines. This equates to a wind farm collision risk area of 2.199 115km² (70 x 31 415.93m²). Thirdly, we assumed that the survey area around each of the vantage points was a representative sample of the area in which built turbines will operate. Fourthly we assumed that species passage rates calculated from our six site visits of sampling can be reasonably extrapolated to annual passage rates (by multiplying hourly passage rates by 12 x 365 in the case of resident diurnal species (12 daylight hours) and 12 x 365 x 0.5 in the case of migrants (present in the study area for only 6 months). We also assumed a 98% avoidance rate for these birds, i.e. 2% of birds passing through the rotor zone would collide with blades (as recommended by Scottish Natural Heritage guidance for species for which no established avoidance rate is available, www.project-gpwind.eu). Finally, we used all recorded flights of all heights above ground for this analysis, since all flight represents some risk, particularly given that species flight behaviour may change once wind turbines are operational, and that estimation of bird height above ground is subjective.

We believe that the estimated fatality rates calculated represent a worst case scenario, for the following reasons: flights of all heights above ground were included, whereas in reality some flights would be below or above rotor zone; no consideration is given to actual turbine locations relative to actual flight path positions; a relatively conservative avoidance rate of 98% was used; and these estimates are pre-mitigation (and we have recommended multiple mitigation measures).

Although the calculations we have made are not a Collision Risk Model (CRM-Scottish Natural Heritage) some of the principles and assumptions made are similar. In South Africa, one of the main reasons CRM is not often used is that we have not established accurate species specific avoidance rates yet, and the model is so sensitive to these avoidance rates. For example if we used a 99% avoidance rate it would halve the estimated number of fatalities calculated as described below. Our confidence in these estimates is therefore low, but the exercise is worthwhile nonetheless.

Priority bird species turbine collision fatality rates (pre-mitigation) were calculated under four scenarios, which we consider typical for the industry (noting that if the maximum specifications for both hub height and rotor diameter of this application are in fact built this would result in a 200m radius rotor with lower blade tip of 100m above ground, however our experience has been that the below scenarios where a 200m hub height is not achieved are more likely):

> **Scenario 1 (Alternative 1 70 turbines**) – where Rotor Swept Area was 30m to 230m above ground. This is derived from the approximate lowest that the blade tip could be, and the maximum rotor diameter
>
> **Scenario 2 (Alternative 1 70 turbines**) – where Rotor Swept Area was 50 to 250m above ground (lower blade tip raised to the maximum envelope according to turbine specifications provided - as a mitigation measure since much bird flight activity on this site is <30m above ground)
>
> **Scenario 3 (Alternative 2 44 turbines)** – Rotor Swept Area of 30 to 230m
>
> **Scenario 4 (Alternative 2 44 turbines)** – Rotor Swept Area of 50 to 250m

Note these scenarios are used for indicative purposes and do not commit the developer to specific turbine parameters. The application remains for a "Hub Height up to 200m and Rotor Diameter up to 200m".

<u>Scenario 1 – Rotor Swept Area of 30m - 230m (70 turbines)</u>
Using the above-described methods, it is estimated that approximately 18.46 fatalities could be recorded at the wind farm per year across the target bird species recorded flying on site (Table 5) prior to the application of mitigation measures. This includes most notably the following regionally Red Listed species fatalities: Cape Vulture – 10.20 birds/year; Southern Bald Ibis – 1.14 birds/year; Blue Crane – 0.72 birds/year; White-bellied Bustard – 0.26 birds/year.

<u>Scenario 2 – Rotor Swept Area of 50m - 250m (70 turbines)</u>
When the lower blade tip is raised to 50m above ground, the fatality rates decreased for most species as shown in Table 5. We estimate a total of approximately 15.64 fatalities could be recorded at the wind farm per year across the target bird species recorded flying on site, prior to the application of mitigation measures. This includes the following regionally Red Listed species fatalities: Cape Vulture – 9.76 birds/year; Southern Bald Ibis – 0.44 birds/year; Blue Crane – 0.68 birds/year; White-bellied Bustard – 0.04 birds/year.

Scenario 3 -Rotor Swept Area of 30m to 230m (44 turbines)

Using the above-described methods, it is estimated that approximately 11.60 fatalities could be recorded at the wind farm per year across the target bird species recorded flying on site (Table 5) prior to the application of mitigation measures. This includes the following regionally Red Listed species fatalities: Cape Vulture – 6.41 birds/year; Southern Bald Ibis – 0.71 birds/year; Blue Crane – 0.45 birds/year; White-bellied Bustard – 0.16 birds/year.

Scenario 4 – Rotor Swept Area of 50m to 250m (44 turbines)

When the lower blade tip is raised to 50m above ground, the fatality rates decreased for most species as shown in Table 6. We estimate a total of approximately 9.83 fatalities could be recorded at the wind farm per year across the target bird species recorded flying on site, prior to the application of mitigation measures. This includes the following regionally Red Listed species fatalities: Cape Vulture – 6.13 birds/year; Southern Bald Ibis – 0.28 birds/year; Blue Crane – 0.43 birds/year; White-bellied Bustard – 0.03 birds/year.

Overall, there was a significant reduction in estimated annual fatality for many species under the scenario of raising the lower turbine blade tip to 50m above ground. This is particularly true for Black-winged Kite, Amur Falcon, Southern Bald Ibis, White-bellied Bustard and Black Sparrowhawk (to name the most frequent flyers on site with a robust sample size). There was a marginal increase in estimated fatality for Common Buzzard (2.94%), and a larger proportional increase for White-backed Vulture (from two flights within RSA to nine). All other species experienced a positive outcome.

Human caused fatalities of Red Listed or otherwise threatened bird species are always cause for concern and should be avoided as far as possible. In this study, raising the minimum RSA has been predicted to reduce the risk to species that typically commute at low heights through the landscape. This is mostly true for harriers, cranes, bustards and korhaans in other studies we are aware of. There are currently no established thresholds for acceptable impacts on bird species in South Africa. In the absence of this information, we are forced to make a subjective finding as to the acceptability of the above estimates (Section 8). It is however essential that all mitigation measures recommended in this report be implemented to ensure that these fatality rates are reduced where possible. It is also essential that an adaptive management approach be adopted, ensuring that the wind farm is prepared to respond timeously and effectively if unsustainable impacts are detected.

Table 1. Small passerine bird data from Walked Transects for two years monitoring: 20 most abundant species (see Appendix 2 for full dataset).

	FULL 2 YEARS			**S1**		**S2**		**S3**		**S4**		**S5**		**S6**		**S7**		**S8**		**S9**		**S10**	
Transect Length (km)	**102**			12		12		12		12		9		9		9		9		9		9	
# Species	**135**			62		68		83		75		41		46		48		59		45		40	
Common Name	**Birds**	**Records**	**Birds/km**	**Birds**	**Records**	**Birds**	**Records**	**Birds**	**Records**	**Birds**	**Records**	**Birds**	**Records**	**Birds**	**Records**	**Birds**	**Records**	**Birds**	**Records**	**Birds**	**Records**	**Birds**	**Records**
Southern Red Bishop	**1064**	**80**	**10.431**	279	10	324	13	169	15	45	8	24	6	3	3	32	2	69	13	90	6	29	4
Long-tailed Widowbird	**546**	**97**	**5.353**	7	3	271	14	52	13	61	17	22	5	19	7	43	12	45	21	24	4	2	1
Cape Longclaw	**428**	**225**	**4.196**	53	21	71	34	50	22	57	32	43	23	24	14	19	13	29	19	37	19	45	28
Wing-snapping Cisticola	**420**	**201**	**4.118**	25	12	15	10	76	28	118	56	23	14	11	9	55	27	26	13	50	21	21	11
Barn Swallow	**311**	**72**	**3.049**	4	1			86	15	107	19							12	8	75	17	27	12
Common Waxbill	**220**	**39**	**2.157**	4	1	9	2	31	5	41	10	46	2			8	1	28	8	12	3	41	7
Ring-necked Dove	**206**	**130**	**2.020**	16	9	36	19	26	13	35	25	15	10	13	12	14	13	9	6	4	2	38	21
Banded Martin	**187**	**63**	**1.833**					15	7	21	11					4	2	34	16	10	6	103	21
African Pipit	**171**	**84**	**1.676**	11	7	40	14	40	16	17	10	3	2	3	3	12	9	34	19	1	1	10	3
Levaillant's Cisticola	**137**	**77**	**1.343**	14	5	14	9	15	7	16	10	9	6	8	6	9	6	24	14	18	8	10	6
Alpine Swift	**125**	**2**	**1.225**	50	1					75	1												
Cape Canary	**113**	**39**	**1.108**	25	7	5	1	36	12			19	2	6	5	17	9			5	3		
Cape Crow	**113**	**25**	**1.108**	35	5	9	6			2	1	6	2	2	1							59	10
Red-capped Lark	**111**	**38**	**1.088**	28	4	37	16	8	5	18	4	13	3			1	1	6	5				
Red-billed Quelea	**107**	**8**	**1.049**	60	1	2	1	5	1	17	2	1	1			10	1			12	1		
African Stonechat	**101**	**72**	**0.990**	2	2	19	10	9	7	9	9	11	8	6	4	9	5	16	11	7	6	13	10
Fan-tailed Widowbird	**94**	**36**	**0.922**					5	2	5	3					3	2	23	14	33	7	25	8
Quailfinch	**92**	**55**	**0.902**	24	12	11	5	20	8	24	20	8	5	1	1					4	4		
Zitting Cisticola	**89**	**68**	**0.873**	4	3			15	7	25	24							37	26	8	8		
Southern Boubou	**84**	**58**	**0.824**	12	8	7	6	17	11	12	10	17	9	3	2	6	5			5	3	5	4

Table 2. Summary of large terrestrial & raptor species recorded on the Drive Transects at the site (see Appendix 3 for full dataset).

Common Name	**Taxonomic Name**	**Red Data: Regional, Global* (Endemism**)**	**Number of Birds**	**Number of Records**	**Birds/ km**
Amur Falcon	*Falco amurensis*		90	26	0.225
Cape Vulture	*Gyps coprotheres*	EN, VU	36	9	0.090
Black-winged Kite	*Elanus caeruleus*		12	10	0.030
Southern Bald Ibis	*Geronticus calvus*	VU, VU (SLS)	12	6	0.030
Common Buzzard	*Buteo buteo*		11	11	0.028
South African Shelduck	*Tadorna cana*		10	3	0.025
Grey-crowned Crane	*Balearica regulorum*	EN, EN	6	2	0.015
Brown Snake Eagle	*Circaetus cinereus*		5	4	0.013
Black-chested Snake Eagle	*Circaetus pectoralis*		4	4	0.010
Jackal Buzzard	*Buteo rufofuscus*	(NE)	4	3	0.010
Forest Buzzard	*Buteo trizonatus*	LC, NT (SLS)	3	3	0.008
Black-headed Heron	*Ardea melanocephala*		2	2	0.005
Secretarybird	*Sagittarius serpentarius*	VU, EN	2	1	0.005
Wattled Crane	*Grus carunculata*	CR, VU	2	2	0.005
White-backed Vulture	*Gyps africanus*	CR, CR	2	1	0.005
African Fish Eagle	*Haliaeetus vocifer*		1	1	0.003
African Goshawk	*Accipiter tachiro*		1	1	0.003
Black Sparrowhawk	*Accipiter melanoleucus*		1	1	0.003
Booted Eagle	*Hieraaetus pennatus*		1	1	0.003
Lanner Falcon	*Falco biarmicus*	VU, LC	1	1	0.003
Long-crested Eagle	*Lophaetus occipitalis*		1	1	0.003
Peregrine Falcon	*Falco peregrinus*		1	1	0.003
Rufous-breasted Sparrowhawk	*Accipiter rufiventris*		1	1	0.003

Table 3. Summary of Incidental Observations of relevant bird species on the site (see Appendix 5 for full dataset).

Common Name	**Scientific Name**	**Red Data: Regional, Global (Endemism)**	**Number of Birds**	**Number of Records**
Cape Vulture	*Gyps coprotheres*	EN, EN	292	44
Common Buzzard	*Buteo buteo*		179	17
Southern Bald Ibis	*Geronticus calvus*	VU, VU (SLS)	148	21
Amur Falcon	*Falco amurensis*		103	10
Red-winged Francolin	*Scleroptila levaillantii*		82	37
White-bellied Bustard	*Eupodotis senegalensis*	VU, LC	69	29
Black-winged Kite	*Elanus caeruleus*		37	32
Grey-winged Francolin	*Scleroptila afra*	(SLS)	30	9
Blue Crane	*Grus paradisea*	NT, VU	19	9
Lanner Falcon	*Falco biarmicus*	VU, LC	16	7
Secretarybird	*Sagittarius serpentarius*	VU, EN	14	12
Brown Snake Eagle	*Circaetus cinereus*		13	11
Jackal Buzzard	*Buteo rufofuscus*	(NE)	11	11
Black Sparrowhawk	*Accipiter melanoleucus*		10	7
Grey Crowned Crane	*Balearica regulorum*	EN, EN	10	3
Hamerkop	*Scopus umbretta*		10	5
Black-rumped Buttonquail	*Turnix nanus*	EN, LC	9	8
Lesser Spotted Eagle	*Clanga pomarina*		9	2
Blue Korhaan	*Eupodotis caerulescens*	LC, NT (SLS)	7	3
South African Shelduck	*Tadorna cana*		6	3
Wattled Crane	*Grus carunculata*	CR, VU	6	6
Spotted Eagle-Owl	*Bubo africanus*		4	4
Denham's Bustard	*Neotis denhami*	VU, NT	3	2
Forest Buzzard	*Buteo trizonatus*	LC, NT (SLS)	3	3

Temminck's Courser	*Cursorius temminckii*		3	2
African Marsh Harrier	*Circus ranivorus*	EN, LC	2	1
Marsh Owl	*Asio capensis*		2	2
Yellow-billed Kite	*Milvus aegyptius*		2	2
African Goshawk	*Accipiter tachiro*		1	1
African Harrier Hawk	*Polyboroides typus*		1	1
Black-chested Snake Eagle	*Circaetus pectoralis*		1	1
Cape Eagle-Owl	*Bubo capensis*		1	1
Eurasian Hobby	*Falco subbuteo*		1	1
Long-crested Eagle	*Lophaetus occipitalis*		1	1
Western Marsh Harrier	*Circus aeruginosus*		1	1

Table 4. Target bird species recorded during Vantage Point counts at the site (see Appendix 6 for full dataset).

Common Name	**Scientific Name**	**Red List: Regional, Global (Endemism)**	**Number of Birds**	**Number of Records**	**Number of Birds/hr**
Cape Vulture	*Gyps coprotheres*	EN, EN	554	224	0.721
Common Buzzard	*Buteo buteo*		342	67	0.445
Black-winged Kite	*Elanus caeruleus*		114	105	0.148
Amur Falcon	*Falco amurensis*		102	38	0.133
Southern Bald Ibis	*Geronticus calvus*	VU, VU (SLS)	75	33	0.098
Black-chested Snake Eagle	*Circaetus pectoralis*		44	42	0.057
Blue Crane	*Grus paradisea*	NT, VU	38	11	0.049
White-bellied Bustard	*Eupodotis senegalensis*	VU, LC	32	17	0.042
Black Sparrowhawk	*Accipiter melanoleucus*		25	25	0.033
Jackal Buzzard	*Buteo rufofuscus*	(NE)	24	21	0.031
Lanner Falcon	*Falco biarmicus*	VU, LC	24	19	0.031
Brown Snake Eagle	*Circaetus cinereus*		21	21	0.027

Marsh Owl	*Asio capensis*		13	8	0.017
Hamerkop	*Scopus umbretta*		9	9	0.012
White-backed Vulture	*Gyps africanus*	CR, CR	9	5	0.012
White Stork	*Ciconia ciconia*		7	3	0.009
African Harrier-hawk	*Polyboroides typus*		6	5	0.008
European Honey Buzzard	*Pernis apivorus*		6	6	0.008
Long-crested Eagle	*Lophaetus occipitalis*		6	6	0.008
Secretarybird	*Sagittarius serpentarius*	VU, EN	6	5	0.008
Denham's Bustard	*Neotis denhami*	VU, NT	5	3	0.007
Martial Eagle	*Polemaetus bellicosus*	EN, VU	5	5	0.007
Wattled Crane	*Grus carunculata*	CR, VU	5	5	0.007
Yellow-billed Kite	*Milvus aegyptius*		5	4	0.007
African Fish Eagle	*Halieaetus vocifer*		4	4	0.005
Peregrine Falcon	*Falco peregrinus*		4	3	0.005
South African Shelduck	*Tadorna cana*		4	2	0.005
Western Marsh Harrier	*Circus aeruginosus*		3	3	0.004
Crowned Eagle	*Stephanoaetus coronatus*	VU, NT	2	2	0.003
Pallid Harrier	*Circus macrourus*	NT, NT	2	2	0.003
African Goshawk	*Accipiter tachiro*		1	1	0.001
Greater Kestrel	*Falco rupicoloides*		1	1	0.001

Table 5. Target bird species passage rates and estimated turbine collision fatalities at the site, **calculated for 70 turbines**

Common Name	Scientific Name	Red List: Regional, Global (Endemism)	Total Number of Flights	Scenario 1: Rotor swept height 30m – 230m		Scenario 2: Rotor swept height 50m – 250m		% Collision risk reduction
				# Flights (S1-S10)	Ann. Fat. rate (98% avoidance)	# Flights (S1-S10)	Ann. Fat. rate (98% avoidance)	
Cape Vulture	*Gyps coprotheres*	EN, VU	554	511	10.20	489	9.76	4.31
Common Buzzard†	*Buteo buteo*		342	68	0.68	70	0.70	-2.94
Black-winged Kite	*Elanus caeruleus*		114	71	1.42	34	0.68	52.11
Amur Falcon	*Falco amurensis*		102	44	0.88	19	0.38	56.82
Southern Bald Ibis	*Geronticus calvus*	VU, VU (SLS)	75	57	1.14	22	0.44	61.40
Black-chested Snake Eagle	*Circaetus pectoralis*		44	41	0.82	36	0.72	12.20
Blue Crane	*Grus paradisea*	NT, VU	38	36	0.72	34	0.68	5.56
White-bellied Bustard	*Eupodotis senegalensis*	VU, LC	32	13	0.26	2	0.04	84.62
Black Sparrowhawk	*Accipiter melanoleucus*		25	4	0.08	2	0.04	50.00
Jackal Buzzard	*Buteo rufofuscus*	(NE)	24	19	0.38	17	0.34	10.53
Lanner Falcon	*Falco biarmicus*	VU, LC	24	20	0.40	20	0.40	0.00
Brown Snake Eagle	*Circaetus cinereus*		21	21	0.42	20	0.40	4.76
Marsh Owl	*Asio capensis*		13	0	0.00	0	0.00	NA
Hamerkop	*Scopus umbretta*		9	7	0.14	5	0.10	28.57
White-backed Vulture	*Gyps africanus*	CR, CR	9	2	0.04	9	0.18	-350.00
White Stork†	*Ciconia ciconia*		7	6	0.06	6	0.06	0.00
African Harrier-hawk	*Polyboroides typus*		6	6	0.12	6	0.12	0.00
European Honey Buzzard†	*Pernis apivorus*		6	4	0.04	1	0.01	75.00
Long-crested Eagle	*Lophaetus occipitalis*		6	6	0.12	6	0.12	0.00
Secretarybird	*Sagittarius serpentarius*	VU, EN	6	5	0.10	5	0.10	0.00
Denham's Bustard	*Neotis denhami*	VU, NT	5	1	0.02	1	0.02	0.00

Martial Eagle	*Polemaetus bellicosus*	EN, VU	5	4	0.08	4	0.08	0.00
Wattled Crane	*Grus carunculata*	CR, VU	5	4	0.08	3	0.06	25.00
Yellow-billed Kite	*Milvus aegyptius*		5	5	0.10	4	0.08	20.00
African Fish Eagle	*Halieaetus vocifer*		4	2	0.04	2	0.04	0.00
Peregrine Falcon	*Falco peregrinus*		4	1	0.02	0	0.00	100.00
South African Shelduck	*Tadorna cana*		4	2	0.04	2	0.04	0.00
Western Marsh Harrier†	*Circus aeruginosus*		3	0	0.00	0	0.00	NA
Crowned Eagle	*Stephanoaetus coronatus*	VU, NT	2	2	0.04	2	0.04	0.00
Pallid Harrier†	*Circus macrourus*	NT, NT	2	2	0.02	1	0.01	50.00
African Goshawk	*Accipiter tachiro*		1	1	0.02	1	0.02	0.00
Greater Kestrel	*Falco rupicoloides*		1	0	0.00	0	0.00	NA

†Migrant species present for approximately 6 months of the year

Table 6. Target bird species passage rates and estimated turbine collision fatalities at the site, **calculated for 44 turbines**

				Scenario 3		Scenario 4		
Common name	**Taxonomic name**	**Status**	**Total # flights**	**# flights**	**Ann. Fat. rate (98% avoidance)**	**# flights**	**Ann. Fat. rate (98% avoidance)**	**% Reduction**
			1498	965	11.60	823	9.83	
Cape Vulture	*Gyps coprotheres*	EN, VU	554	511	6.41	489	6.13	4.31
Common Buzzard†	*Buteo buteo*		342	68	0.43	70	0.44	-2.94
Black-winged Kite	*Elanus caeruleus*		114	71	0.89	34	0.43	52.11
Amur Falcon	*Falco amurensis*		102	44	0.55	19	0.24	56.82
Southern Bald Ibis	*Geronticus calvus*		75	57	0.71	22	0.28	61.40
Black-chested Snake Eagle	*Circaetus pectoralis*		44	41	0.51	36	0.45	12.20
Blue Crane	*Grus paradisea*	NT, VU	38	36	0.45	34	0.43	5.56
White-bellied Bustard	*Eupodotis senegalensis*	VU, LC	32	13	0.16	2	0.03	84.62

Black Sparrowhawk	*Accipiter melanoleucus*		25	4	0.05	2	0.03	50.00
Jackal Buzzard	*Buteo rufofuscus*	(NE)	24	19	0.24	17	0.21	10.53
Lanner Falcon	*Falco biarmicus*	VU, LC	24	20	0.25	20	0.25	0.00
Brown Snake Eagle	*Circaetus cinereus*		21	21	0.26	20	0.25	4.76
Marsh Owl	*Asio capensis*		13	0	0.00	0	0.00	NA
Hamerkop	*Scopus umbretta*		9	7	0.09	5	0.06	28.57
White-backed Vulture	*Gyps africanus*	CR, CR	9	2	0.03	9	0.11	-350.00
White Stork†	*Ciconia ciconia*		7	6	0.04	6	0.04	0.00
African Harrier-hawk	*Polyboroides typus*		6	6	0.08	6	0.08	0.00
European Honey Buzzard†	*Pernis apivorus*		6	4	0.03	1	0.01	75.00
Long-crested Eagle	*Lophaetus occipitalis*		6	6	0.08	6	0.08	0.00
Secretarybird	*Sagittarius sepentarius*	VU, EN	6	5	0.06	5	0.06	0.00
Denham's Bustard	*Neotis denhami*	VU, NT	5	1	0.01	1	0.01	0.00
Martial Eagle	*Polemaetus bellicosus*	EN, VU	5	4	0.05	4	0.05	0.00
Wattled Crane	*Grus carunculata*	CR, VU	5	4	0.05	3	0.04	25.00
Yellow-billed Kite	*Milvus aegyptius*		5	5	0.06	4	0.05	20.00
African Fish Eagle	*Halieaetus vocifer*		4	2	0.03	2	0.03	0.00
Peregrine Falcon	*Falco peregrinus*		4	1	0.01	0	0.00	100.00
South African Shelduck	*Tadorna cana*		4	2	0.03	2	0.03	0.00
Western Marsh Harrier±	*Circus aeruginosus*		3	0	0.00	0	0.00	NA
Crowned Eagle	*Stephanoaetus coronatus*	VU, NT	2	2	0.03	2	0.03	0.00
Pallid Harrier†	*Circus macrourus*		2	2	0.01	1	0.01	50.00
African Goshawk	*Accipiter tachiro*		1	1	0.01	1	0.01	0.00
Greater Kestrel	*Falco rupicoloides*		1	0	0.00	0	0.00	NA

6.2.7 Spatial location of flight activity

The spatial location of all target bird species flight records for the site across the full two year monitoring programme can be seen below in Figure 6. Overall, flight activity across all target species was relatively evenly spread across the site, and it appears that almost all of the closely monitored airspace was utilised to some degree for commuting, display or foraging throughout the two years of monitoring. When non-priority species' flight paths are removed and priority species flights are separated (Figures 7 & 8), Cape Vulture clearly emerges as the most frequent flier on site. Much soaring behaviour was recorded, and once more, flights were relatively evenly spread across the landscape as a whole. This flight behaviour is considered to be risky, as it is determined by unpredictable foraging opportunities, with much time spent by the birds (often in flocks of large number) within turbine rotor swept height, increasing their risk of fatal collisions.

Considering other priority species, Southern Bald Ibis was observed to use a definite flyway to and from the identified roost in a gorge to the north of the site. Turbines are not currently proposed within this flyway. The species was observed much more frequently in the north of the site compared to the south. This was true for Blue Crane as well – these two species appeared to occur in the same general areas.

White-bellied Bustard, Lanner Falcon, Wattled Crane, Martial Eagle and Pallid Harrier were also recorded predominantly (or exclusively, in the case of the latter two species) in the north of the WEF. In terms of priority species occurrence, the north of the site appears to be more sensitive than the south.

No patterns of spatial preference emerged for the way in which Secretarybird, Denham's Bustard, Crowned Eagle and Jackal Buzzard utilised the WEF, owing either to a low incidence (low sample size) or an even, or random, spread of recorded flight paths.

White-backed Vulture was not frequently observed flying on site, although as a Critically Endangered Species, any records are significant. We presume that the large power lines on site provides roosting habitat for the species in the same way as it does for the Cape Vulture.

A number of the other, non-priority large terrestrial or raptor species recorded flying on site were relatively frequently encountered. Common Buzzard, a summer migrant, was one such bird, with one record including an estimated 200 individuals in late summer (22 Feb 2023), possibly suggestive of a northward migration movement (see Section 6.2.5). Black-winged Kite was also abundant in the flight data, and also more frequently encountered in the north of the site. Records were almost always single birds by comparison.

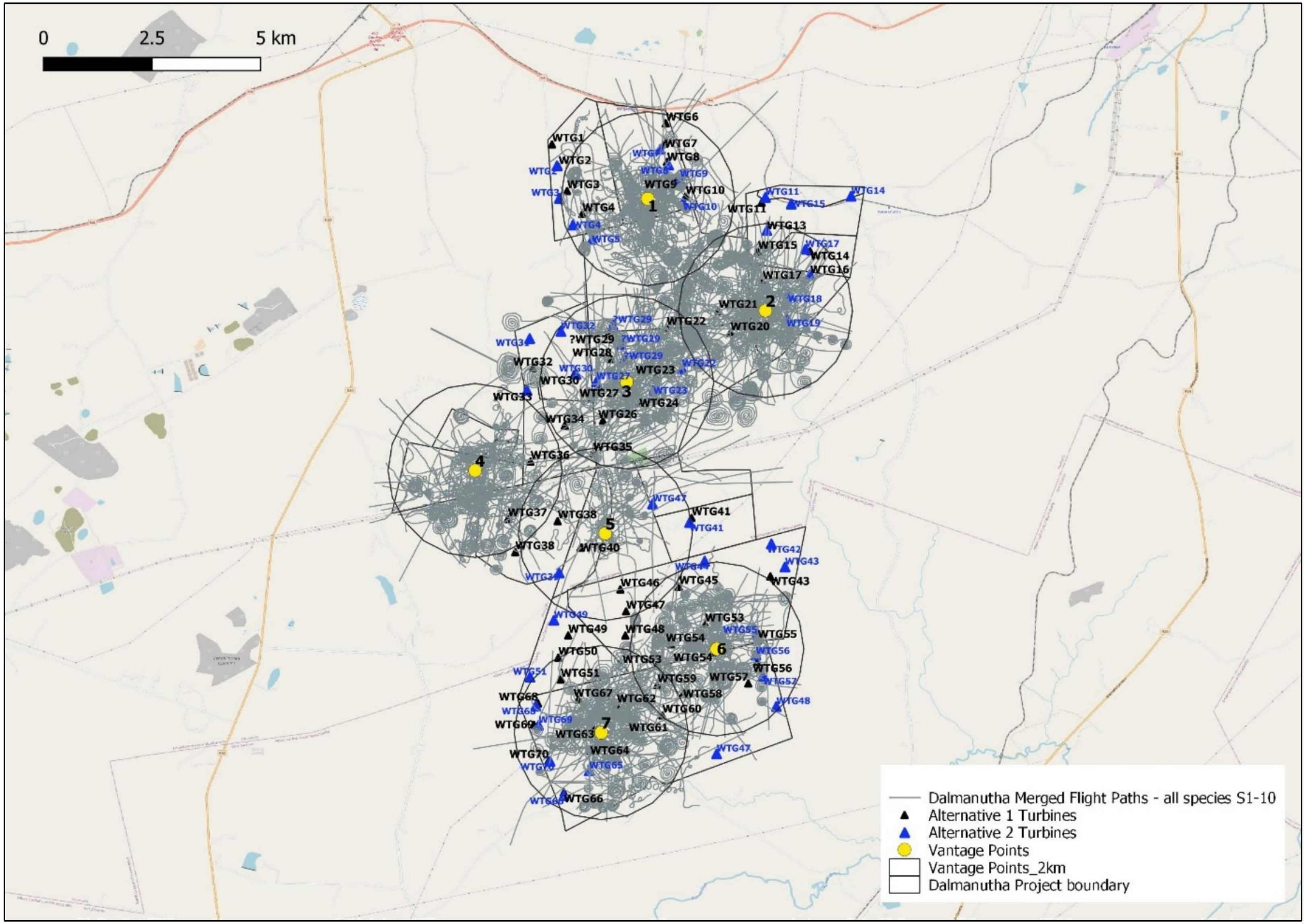

Figure 6. All species flight paths for full two years.

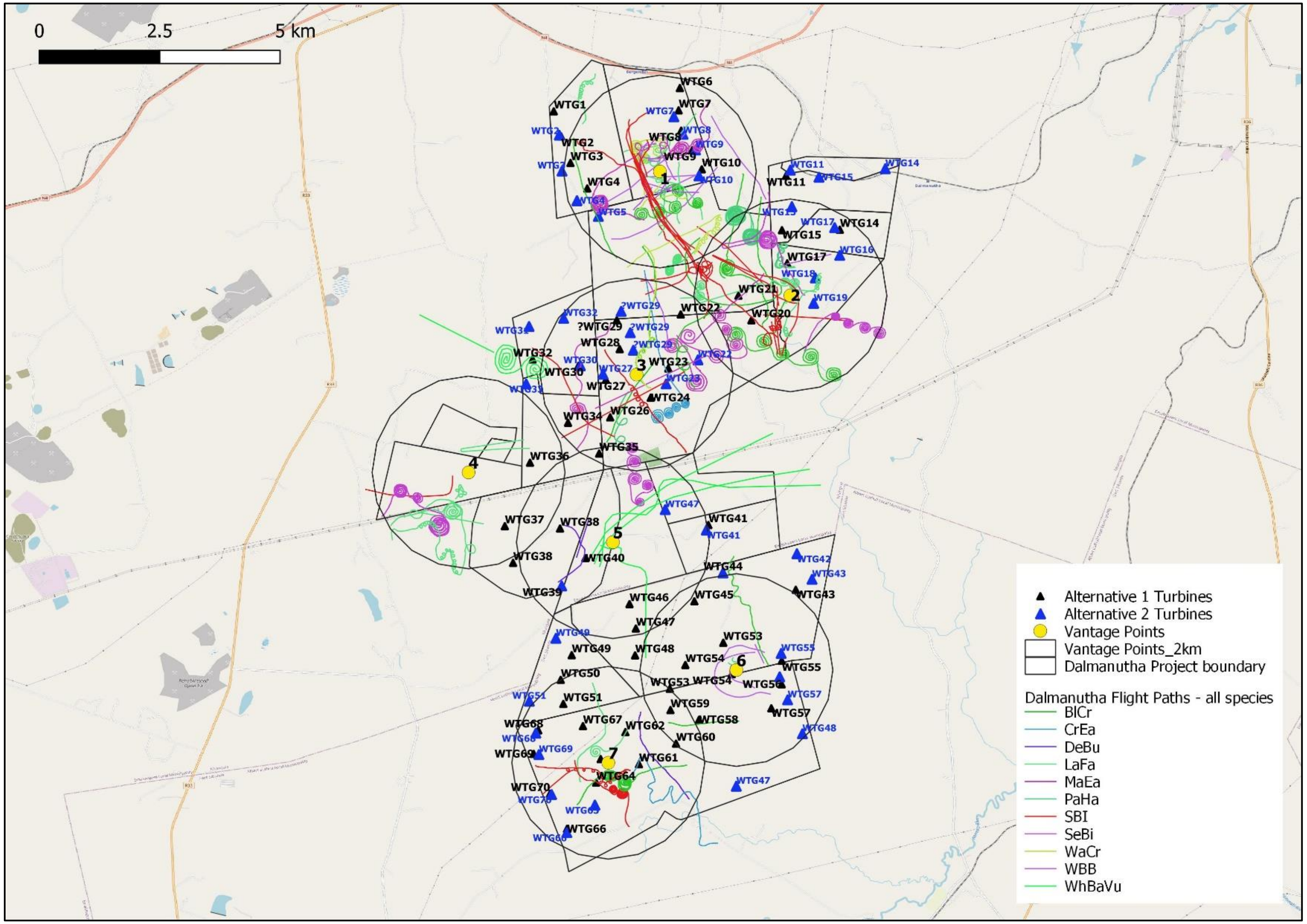

Figure 7. Flight paths of Red List species, excluding Cape Vulture).

(BlCr = Blue Crane;; CrEa = Crowned Eagle; DeBu = Denham's Bustard; LaFa = Lanner Falcon; MaEa = Martial Eagle; PaHa = Pallid Harrier; SBI = Southern Bald Ibis; SeBi = Secretarybird; WaCr = Wattled Crane; WBB = White-bellied Korhaan; WhBaVu = White-backed Vulture)

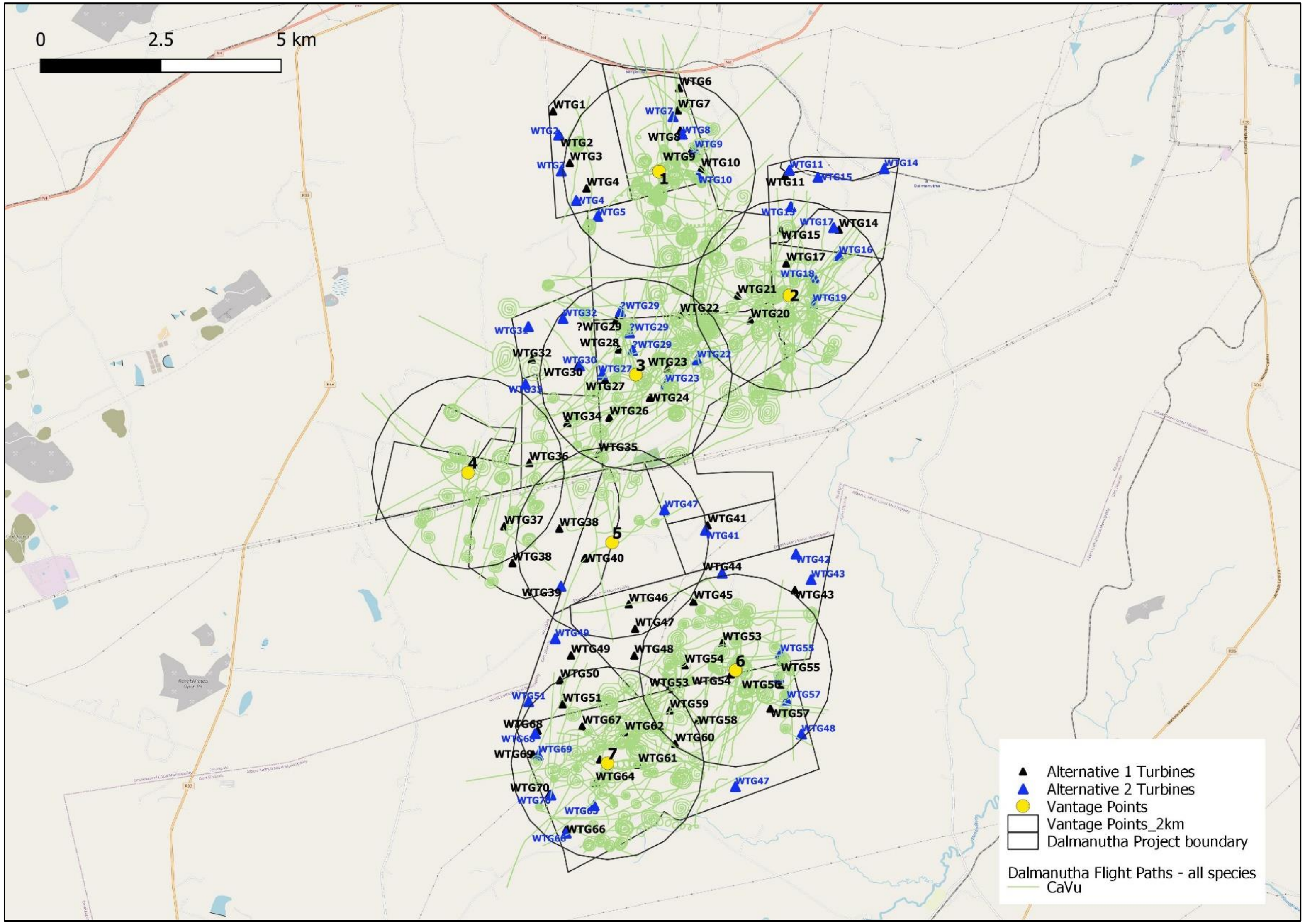

Figure 8. Flight paths of Cape Vulture only.

(CaVu = Cape Vulture)

6.2.8 Cape Vulture power line roost surveys

The two power line roosts were surveyed 11 times in addition to the standard 6 seasonal surveys. On 8 of these surveys no vultures were found on the roosts. The remaining surveys returned records of: 4 vultures (June); 1 vulture (June); 1 vulture (March); and 4 vultures (March).

6.3. Important Bird & Biodiversity Area (IBA) data

The proposed facility partially overlaps the Steenkampsberg Important Bird and Biodiversity Area (IBA - Marnewick *et al*, 2015)(Figure 9). The following description draws heavily from Marnewick *et al* (2015).

This IBA consists primarily of rolling high-altitude (1 700–2 100 m.a.s.l.) grassland interspersed with rocky outcrops. The area receives an average rainfall of 1 025 mm p.a. Annual average minimum and maximum temperatures are 5 °C and 20 °C respectively, with a range from -8 °C to 39 °C. Two wetland systems are particularly important in the Steenkampsberg area. The first is Lakensvleispruit, which lies 8 km north-east of Belfast. The second is Verloren Valei. Lying approximately 9 km north of Dullstroom.

The proposed facility is not in close proximity to either of these systems (although smaller wetlands exist on site).

The core area of the IBA, especially along Steenkampsberg towards Dullstroom, is covered by Endangered Dullstroom Plateau Grassland. Globally threatened species found in this IBA include: Southern Bald Ibis *Geronticus calvus*, Wattled Crane *Grus carunculata*, Blue Crane, Grey Crowned Crane *Balearica regulorum*, White-winged Flufftail *Sarothrura ayresi*, Rudd's Lark *Heteromirafra ruddi*, Yellow-breasted Pipit, Denham's Bustard *Neotis denhami*, Blue Korhaan *Eupodotis caerulescens* and Secretarybird *Sagittarius serpentarius*. Regionally threatened species are African Marsh Harrier *Circus ranivorus*, Black-rumped Buttonquail *Turnix nanus*, Striped Flufftail *Sarothrura affinis*, White-bellied Korhaan *Eupodotis senegalensis*, African Grass Owl *Tyto capensis*, Black Stork *Ciconia nigra* and Lanner Falcon *Falco biarmicus*. Restricted-range and biome-restricted species are Kurrichane Thrush *Turdus libonyanus* and Buff-streaked Chat *Campicoloides bifasciatus*, both of which are common. Rudd's Lark, Yellow-breasted Pipit and Gurney's Sugarbird *Promerops gurneyi* are uncommon, while White-bellied Sunbird *Cinnyris talatala* is fairly common.

Mining in the form of open-cast coal mining, and to a lesser extent sand and diamond mining, is one of the biggest threats to the area, and there has recently been a flood of prospecting and mining applications. According to the Environmental Management Framework developed for the Emakazheni local municipality in 2009, mining is not considered a suitable land use in this region. General threats include afforestation of the grasslands with pines *Pinus* species and blue gums *Eucalyptus* species, wetland degradation, and increased acid rain and sulphur emissions from local power stations.

Afforestation also has a harmful impact on wetlands, and they face several other significant threats. The construction of dams is disrupting ecosystem processes downstream, with the effect of turning wetlands into sterile stretches of open water. Overgrazing and the frequent burning of marshy areas in winter leads to accelerated run-off, soil erosion and the formation of dongas. Several threatened species are dramatically affected by this wetland degradation. The habitat of the White-winged Flufftail is continually being degraded and reduced by damming, draining, grazing, burning and afforestation.

6.4. Co-ordinated Avifaunal Roadcount (CAR) data

CAR counts are a census of birds (focussed on large terrestrial species) performed twice annually (in winter and summer) by volunteer birdwatchers. The purpose is to provide population data for use in science, especially conservation biology, by determining findings about the natural habitats and the birds that use them. Two CAR routes bisect the proposed site, MS08 and MS09 (Figure 9). Relevant species recorded on these two routes regularly include: Blue Crane; White Stork; Secretarybird; and Southern Bald Ibis. Grey Crowned Crane is also recorded occasionally.

6.5. Co-ordinated Waterbird Count (CWAC) data

There are several Coordinated Waterbird Count (CWAC) sites within approximately 30km of the proposed site (Figure 9), namely: Lakenvlei East, Lakenvlei West, Nooitgedacht Dam, Otter Pan, Grootpan and Blinkpan. Waterfowl counts at these sites are similar in diversity to that of our Focal Sites, although the abundances have at times been much greater (these water bodies are much larger than those on site). Both Greater and Lesser Flamingos have been recorded in impressive tallies at Grootpan and Blinkpan in particular, with maximum counts of 1 640 and 414 birds recorded respectively. Grey Crowned Crane and African Marsh Harrier (both Endangered) and Maccoa Duck and Black-winged Pratincole (both Near-threatened) were recorded at a number of these CWAC sites as well. Red-knobbed Coot was abundant at all sites and appears to be the most numerous waterbird in the area by a significant margin.

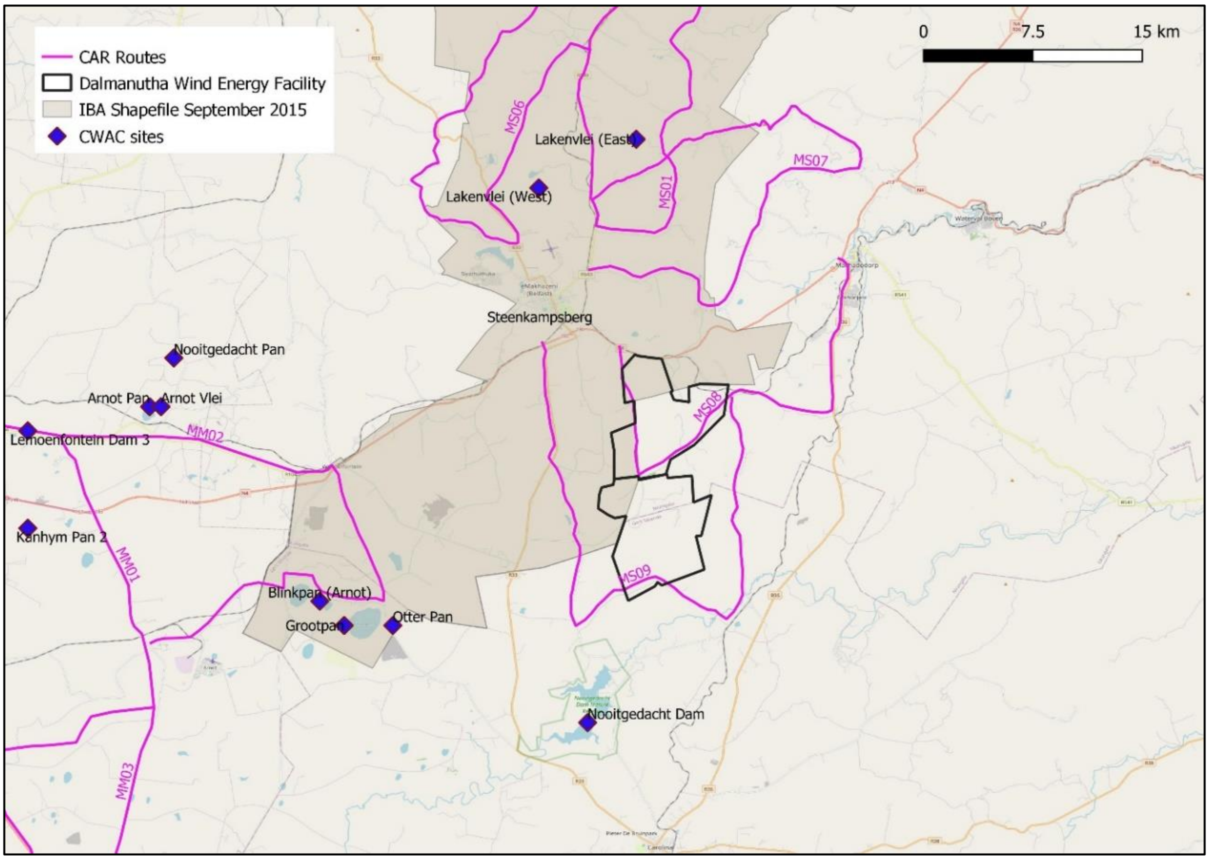

Figure 9. The Important Bird Area, Coordinated Roadcount & Coordinated Waterbird Count locations.

6.6 Priority species risk assessment (Species of Conservation Concern SCC)

Table 7 presents all those regionally Red Listed species identified as likely to occur on site based on SABAP2 data. Those species recorded by our own two years of data collection on site are presented with seasonal records, and several species were not recorded by our efforts. The likely importance of the site for the species, likely impacts and overall risk are rated. Of the 28 species, we recorded 15 on the site, and rate 11 of these at Medium or High risk from the proposed project. These species are described in Table 7 in order of conservation status. An additional species, White-winged Flufftail is also described as potentially being at risk.

Table 7. Risk assessment for regionally Red Listed bird species.

Common Name	Scientific Name	Status (Regional, Global, Endemism)	SABAP 2 Reporting Rate (%)	Survey										Confirmed on site	Site importance for species	Likely impacts
				1	2	3	4	5	6	7	8	9	10			
Wattled Crane	*Grus carunculata*	CR, VU	5	1	1	1	1	1	1	1	1		1	1	Medium	C, HD, D
White-backed Vulture	*Gyps africanus*	CR, CR	23	1										1	Low	-
Grey Crowned Crane	*Balearica regulorum*	EN, EN	15			1	1	1	1					1	Medium	C, HD, D
African Marsh Harrier	*Circus ranivorus*	EN, LC	25						1				1	1	Medium	C, HD, D
Cape Vulture	*Gyps coprotheres*	EN, EN	1	1	1	1	1	1	1	1	1	1	1	1	Medium	C
Yellow-billed Stork	*Mycteria ibis*	EN, LC	9												Low	-
Martial Eagle	*Polemaetus bellicosus*	EN, VU	4	1	1		1	1	1			1		1	Low	C, HD
Black-rumped Buttonquail	*Turnix nanus*	EN, LC	107	1			1	1				1		1	Medium	C, HD, D, DI
Short-tailed Pipit	*Anthus brachyurus*	VU, LC													Low	-
Yellow-breasted Pipit	*Anthus chloris*	VU, LC, E	46												Low	-
Verreaux's Eagle	*Aquila verreauxii*	VU, LC	2												Low	-
White-bellied Korhaan (Bustard)	*Eupodotis senegalensis*	VU, LC	36	1	1	1	1	1	1	1		1	1	1	High	C, HD, D, Di
Lanner Falcon	*Falco biarmicus*	VU, LC	24	1	1	1	1	1		1	1	1	1	1	Medium	C
Southern Bald Ibis	*Geronticus calvus*	VU, VU, SLS	8	1	1	1	1	1	1	1	1	1	1	1	High	C, HD, D
Denham’s Bustard	*Neotis denhami*	VU, NT	21	1	1				1					1	Medium	C, HD, D, DI
African Pygmy Goose	*Nettapus auritus*	VU, LC													Low	-
Secretarybird	*Sagittarius serpentarius*	VU, EN	13	1	1	1	1	1	1		1	1		1	Medium	C, HD, D, Di
Crowned Eagle	*Stephanoaetus coronatus*	VU, NT	26				1			1				1	Low	-
Bush Blackcap	*Sylvia nigricapillus*	VU, VU, SLS													Low	-
Half-collared Kingfisher	*Alcedo semitorquata*	NT, LC	105												Low	-
Abdim's Stork	*Ciconia abdimii*	NT, LC													Low	-
Pallid Harrier	*Circus macrourus*	NT, NT	41									1		1	Low	-
European Roller	*Coracias garrulus*	NT, LC													Low	-

Common Name	Scientific Name	Status (Regional, Global, Endemism)	SABAP 2 Reporting Rate (%)	Survey										Confirmed on site	Site importance for species	Likely impacts
				1	2	3	4	5	6	7	8	9	10			
Red-footed Falcon	*Falco vespertinus*	NT, NT	96												Low	-
Blue Crane	*Grus paradisea*	NT, VU	11			1	1			1	1	1	1	1	Medium	C, HD, D, Di
Maccoa Duck	*Oxyura maccoa*	NT, VU													Low	-
Lesser Flamingo	*Phoeniconaias minor*	NT, NT	28												Low	-
Greater Flamingo	*Phoenicopterus roseus*	NT, LC	29												Low	-

Wattled Crane (Critically Endangered). Wattled Crane is regionally Critically Endangered (Taylor *et al,* 2015). A single bird appears to be resident on site and has been recorded in all seasons, always in the same wetland (on Berg en Dal farm - see Section 7.4). The wetland was surveyed for a nest, but no such nest was identified. At a second wetland the farmer has advised that Wattled Crane normally breed, however this was not confirmed. Lockwood (pers comm – Appendix 8) reports up to 4 Wattled Cranes being seen together over the last 12 years in this area. We recorded the species flying 5 times in our 768 hours of vantage point monitoring. Although this species does not typically fly frequently or for long periods, it does commute around the landscape within which it is foraging. This species is anticipated to be highly susceptible to wind turbine collision when in flight. No fatalities have been recorded to date in South Africa since no wind farms are operating within the species' range (Ralston-Paton et al, 2017; Perold et al, 2020).

We do not believe the likelihood of a turbine collision is very high with only one bird flying on site occasionally. However, the consequences if such a collision does occur for a Critically Endangered species are very significant. The spatial avoidance of risk through a buffer around the wetland (Section 7.4) is not anticipated to be sufficient for such an endangered species, and the collision risk will also need to be mitigated through measures described in Section 9, such as observer led shutdown on demand.

Grey Crowned Crane (Endangered). Grey Crowned Crane is regionally Endangered (Taylor *et al,* 2015). A pair has been seen foraging at a pan at Leeukloof several times, and in May 2021 two adults were seen with a juvenile, indicating breeding took place in this area. The species was not recorded flying at all during vantage point sessions. Spatial protection has been provided around the presumed breeding wetland (see Section 7). However further mitigation will be required as described in Section 9. The species has not yet been recorded as a turbine fatality at operational wind farms, although few exist in the species' range to date (Ralston-Paton et al, 2017; Perold et al, 2020).

African Marsh-Harrier (Endangered). One record of a pair of marsh-harriers was made in August 2022. It is quite conceivable that one or more pairs of birds utilise wetland areas on the site from time to time. However we would expect to have recorded them for regularly if breeding was taking place on site. We expect that the spatial protection given to wetlands will provide protection for this species.

Cape Vulture (Endangered). Cape Vulture is regionally Endangered (Taylor *et al,* 2015). Multiple records of up to a maximum of 52 birds on site have been made in all seasons. A total of 554 birds were recorded flying during 768 hours of vantage point observation – which equates to a passage rate of 0.72 birds / hour. Birds have been found roosting at night on Eskom transmission lines on site. One of the landowners of the farm Leeuwkloof, has a vulture restaurant, and reports seeing up to 100 vultures on and around his property. This regular feeding of vultures would need to be closed if the project proceeds. The risk of attracting vultures onto site would be too high. Lockwood (pers comm) reports up to 43 vultures being seen in the area over the last 12 years. We consider the species to forage and roost regularly on the site. During the second year of monitoring we surveyed (with the help of the Dullstroom Birds of Prey Centre) the two sections of overhead power line used as roosts by the species monthly to investigate the extent of usage of these roosts. We recorded no vultures at these roosts on 8 of 11 surveys, and a maximum of 4 birds (In June 2022 & March 2023). Although these surveys indicate low numbers, on a precautionary basis (and considering all survey methods) we conclude that up to 50 vultures could utilise the site at times, and occasionally roost on the power lines. We obtained a map of the movement of four Cape Vultures fitted with satellite tracking devices from the Dullstroom Birds of Prey Centre (and the Endangered Wildlife Trust). These birds all spent considerable time moving across the Dalmanutha site in their foraging movements (Figure 10).

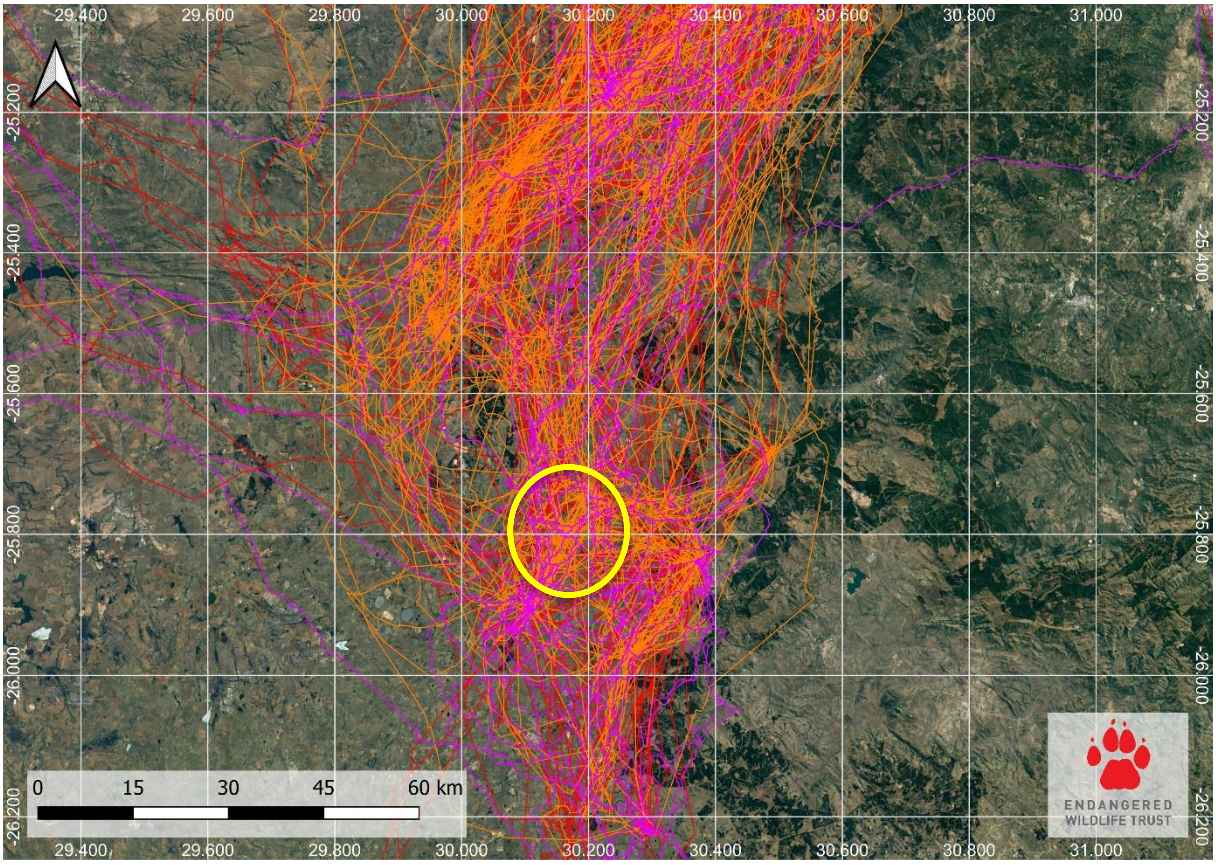

Figure 10. Movement of four tracked Cape Vultures since January 2021 relative to the site (map and data from Endangered Wildlife Trust).

Approximate project location shown in yellow polygon

The main driver of vulture activity in any given area is the location of roosting, breeding and supplementary feeding sites. Cervantes *et al*. (2023) has very recently mapped the population utilisation distribution (PUD) of the Cape Vulture across its range, considering these factors, and identified areas in which it is particularly prone to collisions with wind turbines. The current reliance on SABAP2 data as a Screening Tool for wind energy is limited by uneven data coverage, whereas PUD maps provide finer resolution modelling of spatial risk as a complementary tool.

Figure 11 shows the Cape Vulture map overlaid on the Dalmanutha site boundary. The proposed site is in an area of low utilisation or risk for the species according to Cervantes et al (2023). However as mentioned above one of the main input data into the Cervantes model was roost locations. It is possible that the power line roost at Dalmanutha was not known to these authors, resulting in the model not identifying high utilisation in the area.

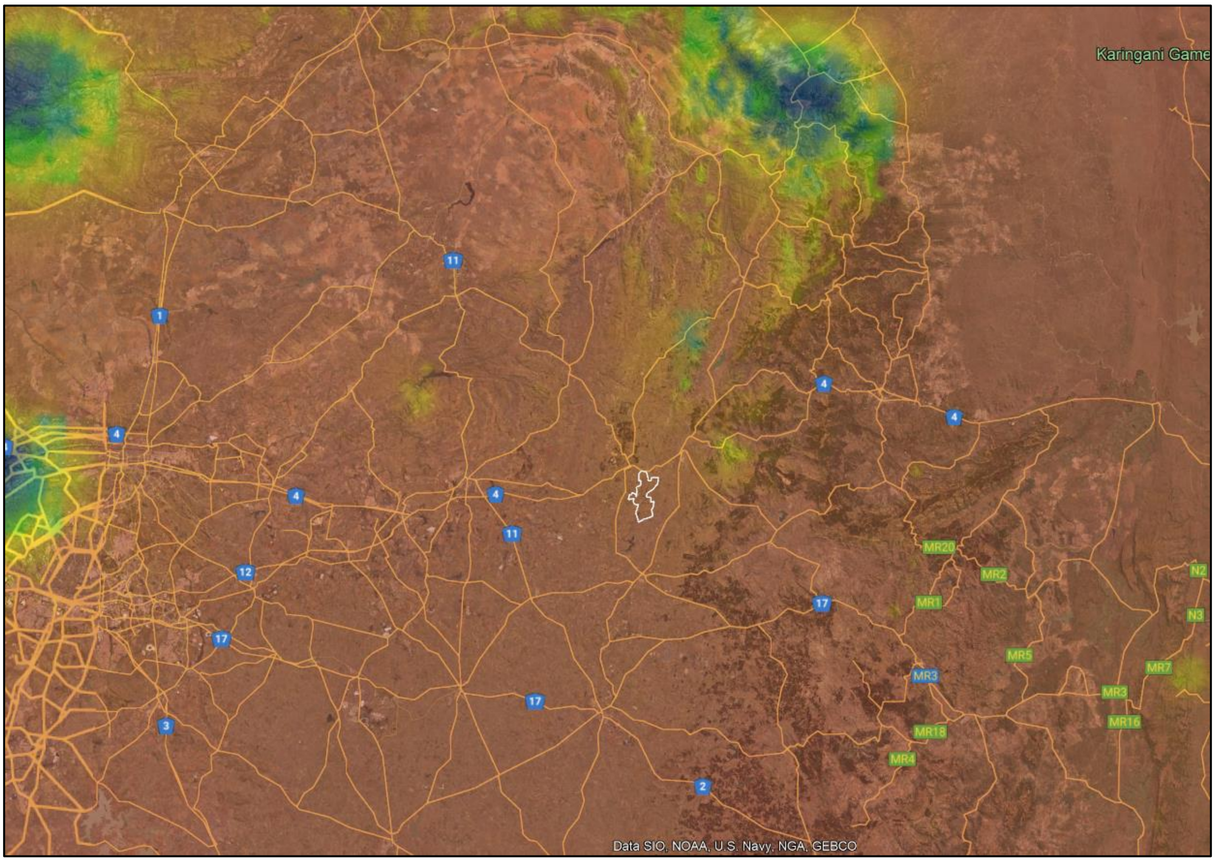

Figure 11. Cape Vulture population utilisation distribution map (from Cervantes 2023). (Dalmanutha site boundary shown in white).

The Cape Vulture was identified by Retief *et al* (2011) as the second highest risk species for interactions with wind energy facilities, and was then elevated to the number one species in the 2014 revision of this list. The species' large physical size, gregarious nature, high wing loading (which makes it less able to fly with great agility) and significant time spent in flight make it a species that is believed likely to be highly vulnerable to collision with wind turbines. A number of wind turbine collision fatalities have been recorded at operational wind farms in South Africa (Ralston-Paton *et al*, 2017; Perold *et al*, 2020). The spatial protection provided for this species around the power line roosts (Section 7) is not sufficient for a wide ranging species such as this, and extensive mitigation will be required (Section 9).

Black-rumped Buttonquail (Endangered). Black-rumped Buttonquail is regionally Endangered (Taylor *et al,* 2015). Several records of pairs of birds flushed from the side of the road were made during our monitoring. Lockwood (pers comm) reports 'fairly regular' records of the species in the area. We think the primary risk to this species will be through destruction of habitat and disturbance.

White-bellied Bustard (Vulnerable). White-bellied Korhaan is regionally Vulnerable (Taylor *et al,* 2015). The species was recorded on site in almost all seasons, in groups of up to four birds together. Thirty-two birds were recorded flying. Lockwood (pers comm) reports 'fairly regular' records in the area. A small population is probably more or less resident on site. This species will be susceptible to habitat destruction, disturbance, and turbine collision. Fatalities of this species have not yet been recorded at wind turbines (Ralston-Paton et al, 2017; Perold et al, 2020) although fatalities of other korhaan species indicate a possible susceptibility for the species.

Lanner Falcon (Vulnerable). Lanner Falcon is regionally Vulnerable (Taylor *et al,* 2015). Records of single birds have been in each season. Twenty-four single bird records were made of the species flying on site, for a passage rate of 0.03 birds / hour. This species has previously been recorded killed by wind turbines at operational wind farms elsewhere in South Africa (Ralston-Paton et al, 2017; Perold et al, 2020).

Southern Bald Ibis (Vulnerable). Southern Bald Ibis is regionally Vulnerable (Taylor *et al,* 2015). Several records of small groups have been made across all seasons. A roost site was identified on site, where up to 10 birds roost at night. Lockwood (pers comm) reports that up to 18 birds and 5 active nests have been recorded at this location. This roost was protected with a spatial buffer (Section 7). The species has not yet been recorded as a turbine fatality at operational wind farms, although no wind farms exist in the species' range to date (Ralston-Paton et al, 2017; Perold et al, 2020).

Denham's Bustard (Vulnerable). Denham's Bustard is regionally Vulnerable (Taylor *et al,* 2015). The species was recorded infrequently singly and in pairs during 5 of the 10 seasonal surveys. Five flight records were made during the vantage point sessions. We conclude that this is probably an occasional visitor to the site. This species has been killed through collision with wind turbines elsewhere in South Africa (Ralston-Paton et al, 2017; Perold et al, 2020).

Secretarybird (Vulnerable). Secretarybird is regionally Vulnerable (Taylor *et al,* 2015). Several records of single birds have been made in all seasons, and one record of a pair in S3. A nest has been found approximately 4.5km off site to the east, too far to be relevant for sensitivity mapping. Six flight records were made for the species. Lockwood (pers comm) reports 'fairly regular' records in the area. This species has been killed through collision with wind turbines elsewhere in South Africa (Ralston-Paton et al, 2017; Perold et al, 2020).

Blue Crane *Grus paradisea*. Blue Crane is regionally Near-threatened (Taylor *et al,* 2015). The species has been recorded in several seasons on site. A group of three birds was recorded on site in S3. Landowners have anecdotally reported to our field team that Blue Cranes breed on site but this remains unconfirmed during our own monitoring period. Lockwood (pers comm) has several records for the species, including a nest site (the grassland around which has subsequently been ploughed up) (Section 7.2). This species has been killed through collision with wind turbines elsewhere in South Africa (Ralston-Paton et al, 2017; Perold et al, 2020).

White-winged Flufftail (Critically Endangered). We did not record this species during our two years of monitoring on site. The DFFE Online Screening Tool identifies the species as possibly occurring on site. BirdLife South Africa (BLSA) has also suggested in comments on the scoping phase of this study that the species could occur on site. A second stakeholder (Ms Burke pers comm) has stated that it is suspected to occur on her property in the area (although no records appear to have been made). Based on the methods used during pre-construction bird monitoring (as prescribed by best practice) we cannot confirm whether the species occurs on site or not. This is a very shy, cryptic species, which has in most cases only been recorded elsewhere in its range through absolute chance, or through the use of acoustic recorders (to record it calling) and camera traps. Specialised methods are required to survey for the species (using trail cameras and acoustic recorders), and there are ethical considerations around disturbing such a rare bird through the surveys. BLSA are the experts in this field, but were not available to assist us conduct the specialised surveys. The primary reason for suspecting that the species could occur on site is a BLSA developed habitat suitability model (HSM). We applied to BLSA for access to this model to investigate it in more detail, but were referred to the DFFE online screening too, where the model should apparently be available. It appears that the species has been categorised as sensitive information and the HSM cannot be used in any meaningful way, or mapped for the purpose of this report.

If the species does occur on site, there is little doubt that it would be at high risk of collision with turbines. Other flufftail species have shown to be very susceptible to turbine collision (Ralston-Paton *et al*, 2017; Perold *et al*, 2020). There is good reason to suspect that White-winged Flufftail turbine collisions could occur, and if they did this would have high consequence for the species. In the case of the other flufftail species which have been recorded as turbine fatalities elsewhere at operational wind farms, these birds are almost never recorded flying, but are then found dead beneath turbines. This suggests the possibility of nocturnal movement by these species. If this were the case, traditional mitigation measures such as blade painting and observer led shutdown on demand may not mitigate the risk to this species. Alternative measures would need to be explored.

Although we have not recorded the species, Lockwood (pers comm) reports three records over 12 years of Yellow-breasted Pipit (regionally Vulnerable).

This is a very high diversity of Red Listed species, collectively utilising almost the full component of micro habitats on site: wetlands; grasslands; dams; arable lands; pans. The only micro habitat not considered useful is the exotic tree stands (wattle and eucalyptus).

Of particular concern are the Critically Endangered Wattled Crane & Endangered Cape Vulture. For both of these species, spatial avoidance of turbine collision risk is not considered sufficient. If the significance of the impact of turbine collision on these species is to be reduced to acceptable levels, extensive and effective mitigation measures will need to be implemented for the full project lifespan. These include Shutdown on Demand, on site vulture food management, and turbine blade painting. Also of concern is the sheer diversity of regionally Red listed birds on this site. Whilst the risk to most of them can be managed in various ways, the 'whole risk' to avifauna is almost certainly greater than the 'sum of the parts'.

7. Sensitivity mapping

7.1. Site Sensitivity Verification (SSV)

Appendix 7 presents the full SSV. Our work on site confirms that the site is of High sensitivity for avifauna. We have confirmed the presence of most of the above listed bird species on site, an exception being White-winged Flufftail.

7.2 Landscape level sensitivity

The "Avian Wind Farm Sensitivity map for South Africa (Retief *et al,* 2011) and the Important Bird & Biodiversity Areas programme data (IBBA - Marnewick *et al*, 2015) were consulted to determine the sensitivity of the site in national terms. Figure 12 shows that the northern part of the site falls in the highest sensitivity categories in terms of avifauna (darker colours indicate higher risk). For a full discussion on the methods used in producing this map see Retief *et al* (2011, 2014). The site falls partially within an IBA (Marnewick *et al*, 2015). This IBA has already been described in Section 6.3.

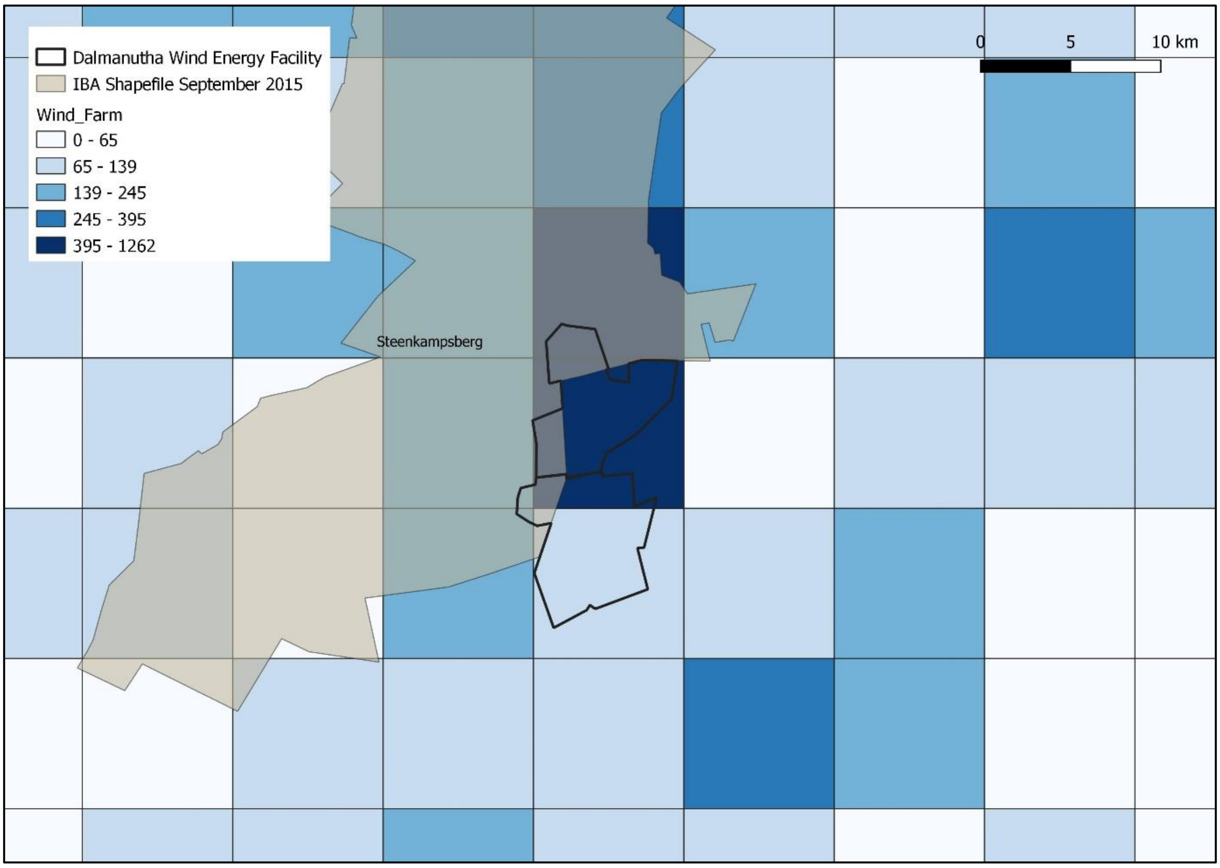

Figure 12. The position of the site relative to the Avian wind farm sensitivity map (Retief et al, 2011) & Important Bird Areas (Marnewick et al 2015).
(Darker colours indicate higher avifaunal sensitivity)

We note that the proposed site falls outside of the Renewable Energy Development Zones (Strategic Environmental Assessment for Wind Energy – www.redz.csir.co.za), and the Transmission Grid corridors identified. The REDZ are areas that are being strategically identified for potential wind energy development in future.

At a landscape level we would categorise the site as High sensitivity for avifauna, based on the above sources. The northern parts of the site certainly appear to be more sensitive and constrained than the southern parts.

7.3. Site Ecological Importance

Site Ecological Importance is derived from combining Biodiversity Importance and Receptor Resilience. Biodiversity Importance is in turn derived from combining Conservation Importance and Functional Integrity.

Conservation Importance (CI) is defined as: "*The importance of a site for supporting biodiversity features of conservation concern present, e.g. populations of IUCN threatened and Near Threatened species (CR, EN, VU and NT), Rare species, range-restricted species, globally significant populations of congregatory species, and areas of threatened ecosystem types, through predominantly natural processes."*

Functional integrity (FI) of the receptor (e.g. the vegetation/fauna community or habitat type) is defined here as: "*A measure of the ecological condition of the impact/receptor as determined by its remaining intact and functional area, its connectivity to other natural areas and the degree of current persistent ecological impacts."*

Receptor Resilience (RR) is defined as*: "The intrinsic capacity of the receptor to resist major damage from disturbance and/or to recover to its original state with limited or no human intervention."*

In the case of the proposed Dalmanutha site, we score:

1. Conservation Importance as High *(Confirmed or highly likely occurrence of CR, EN, VU species that have a global EOO of > 10 km2. IUCN threatened species (CR, EN, VU) must be listed under any criterion other than A. If listed as threatened only under Criterion A, include if there are less than 10 locations or < 10 000 mature individuals remaining. Small area (> 0.01% but < 0.1% of the total ecosystem type extent) of natural habitat of EN ecosystem type or large area (> 0.1%) of natural habitat of VU ecosystem type. Presence of Rare species. Globally significant populations of congregatory species (> 1% but < 10% of global population)..)*

1. Functional Integrity as Medium (*(> 5 ha but < 20 ha) semi-intact area for any conservation status of ecosystem type or > 20 ha for VU ecosystem types. Only narrow corridors of good habitat connectivity or larger areas of poor habitat connectivity and a busy used road network between intact habitat patches. Mostly minor current negative ecological impacts with some major impacts (e.g. established population of alien and invasive flora) and a few signs of minor past disturbance. Moderate rehabilitation potential)*

According to the figure below then this provides a Biodiversity Importance score of ' Medium'.

Biodiversity importance		Conservation importance				
		Very high	High	Medium	Low	Very low
Functional integrity	Very high	Very high	Very high	High	Medium	Low
	High	Very high	High	Medium	Medium	Low
	Medium	High	Medium	Medium	Low	Very low
	Low	Medium	Medium	Low	Low	Very low
	Very low	Medium	Low	Very low	Very low	Very low

Figure 13. Biodiversity Importance scoring table (extracted from SANBI 2022).

Site ecological importance		Biodiversity importance				
		Very high	High	Medium	Low	Very low
Receptor resilience	Very low	Very high	Very high	High	Medium	Low
	Low	Very high	Very high	High	Medium	Very low
	Medium	Very high	High	Medium	Low	Very low
	High	High	Medium	Low	Very low	Very low
	Very high	Medium	Low	Very low	Very low	Very low

Figure 14. Site Ecological Importance scoring table (extracted from SANBI 2022).

2. The Receptor Resilience is scored as Low for the site.

This then produces a Site Ecological Importance of 'High' as per the above figure. The recommendation (SANBI 2022) for this class of SEI is: *"Avoidance mitigation wherever possible. Minimisation mitigation – changes to project infrastructure design to limit the amount of habitat impacted; limited development activities of low impact acceptable. Offset mitigation may be required for high impact activities."*

In this case SEI cannot be mapped as birds are mobile and move across the entire site. On-site avifaunal sensitivity has instead been mapped below.

7.4 On site sensitivity

In terms of on-site avifaunal sensitivity, Table 8 below summarises the factors considered. The constraints identified were classified according to the four-tier sensitivity classification methods supplied by WSP (No-Go, Very High, High, Medium, and Low).

Table 8. Avifaunal Sensitivity mapping factors.

Sensitivity class	Avifaunal factors considered	Recommendation
No - Go	All wetlands. These have been identified using the NBA2018 shape file.	No wind turbines or overhead power lines should be placed within these areas. Other infrastructure such as roads and cabling may be placed in these areas in some situations, with agreement from the avifaunal specialist.
	Berg en Dal Main wetland body: The main body of this wetland has proven to be of high value with a rich diversity of birdlife including 2 pairs of Marsh Owl and a resident single Wattled Crane. Although no second Wattled Crane has been recorded and no nest found, breeding at this site remains a possibility in the future. We have buffered the main wetland body by 1km to provide protection.	
	Leeuwkloof Pan 1: A round, medium sized permanent pan covered in short emergent vegetation. This is ideal habitat for many waterfowl and wetland species. We have buffered this pan by 500m. Leeuwkloof Pan 2: A round, medium sized permanent pan covered in short emergent vegetation. This is ideal habitat for many waterfowl and wetland species. Based on two separate reports from farmers living in the immediate area, this pan of water is a regular seasonal breeding site for both Blue and Wattled Cranes. Our own work has however not confirmed breeding here. We have buffered this pan by 750m.	
	Cape Vulture Roosts: Cape Vultures have been recorded roosting on two stretches of existing Eskom powerlines in the evenings. Up to a maximum of approximately 40 vultures have been recorded roosting. The large pylons running through this broader area appear to be a regular overnight roost for Cape Vultures. These roosts were originally buffered by 500m, which is shown in Figure 14. However when the facility layout was refined to investigate the Alternative options, a 2km buffer was imposed. We acknowledge that alone, this size buffer is not sufficient for this species (mitigating risk would require many kilometres) but have recommended that the roost be prevented through several mitigation measures (Section 9).	
	Southern Bald Ibis roost. A small gorge with cliffs has been identified as being used as a roost by this species. Up to 10 birds have been recorded roosting here by our own surveys. Our survey of the cliffs revealed no evidence of breeding, although it cannot be ruled out in the future, and Lockwood (pers comm) reports 5 active nests at this location. It appears that the roost may not be used every evening and it is conceivable that it is used for breeding in some years and not others. This location has been buffered by 1km to provide protection for these birds flying in and out of the roost.	
	Blue Crane nest. Lockwood (pers comm) reported a nest location on site. We included this location in the initial sensitivity mapping and buffered the nest by 1km. However we have noted that landowners have recently ploughed up most of the grassland surrounding this nest location. In more recent sensitivity mapping we assumed that this nest is no more.	
	Grey Crowned Crane breeding area: A pair of adult cranes have been recorded in the area several times, and with two juveniles in one survey. This indicates that breeding took place somewhere in this vicinity. We identified and delineated the wetland area within which we assume these birds have bred. Without having a nest location itself it is difficult to impose a buffer on this area, but we do caution against planning any turbines closer to this area than the current positions.	

Sensitivity class	Avifaunal factors considered	Recommendation
High Sensitivity	The remainder of the site is classified as High sensitivity.	Infrastructure may enter these areas if necessary and remaining on existing infrastructure as far as possible (e.g. roads).
Medium Sensitivity	Not applicable	
Low Sensitivity	Not applicable	

Figure 15 shows the above information consolidated into one map. This spatial information has already been considered in designing the current draft turbine layout. The current proposed turbine layout avoids all of these areas.

In addition to the above typical sensitivity mapping approach, we were asked by the applicant to rank individual turbines in terms of their avifaunal risk. This was done as follows:

1. A priority bird species list was developed from the pre-construction monitoring data. This list included 14 regionally Red Listed species.

2. For each species a 'Collision Risk Score' was developed as follows.
    a. Relative importance of the overall site for the species was scored (1- 4)
    b. Vulnerability of the species was scored (Regional Red list status – Critically Endangered = 4, Endangered = 3, Vulnerable = 2, Near-threatened = 1)
    c. The Sensitivity of the species was calculated by multiplying 'a' x 'b'
    d. The Likelihood of Effect (theoretical probability of colliding with turbines) for each species was scored (1 – 4 scale)
    e. The species 'Collision risk score' was calculated by multiplying 'c' x 'd'
    f. The Collision Risk Score was converted into an Index of 1 to 4.
    g. Each turbine was rated it on a scale of 1 to 3 for risk to each of the 14 species. The turbine risk for a species was based on a combination of proximity of WTG to the species feature (roost, wetland etc), and species flight path data
    h. The species scores for all 14 species were then summed for each turbine to give an overall turbine Collision Risk Score.
    i. The turbines were then ranked according to their risk. Highest risk = 1 and lowest = 5.

The final scores and ranking can be seen in Figure 16. It is noted that the top ranked 7 turbines were close to both Wattled Crane area and Southern Bald Ibis roost in the far north of the site, and that these were dropped after the scoping phase. It is also noted that our recommendation was that from an impact point of view one would not want isolated singles or pairs of turbines spread out around the site, it would be far better to have a compact consolidated layout. This has not been achieved with the Alternative 2 layout which is very dispersed and essentially encompasses the same landscape as the Alternative 1 layout, including the sensitive northern areas of the site.

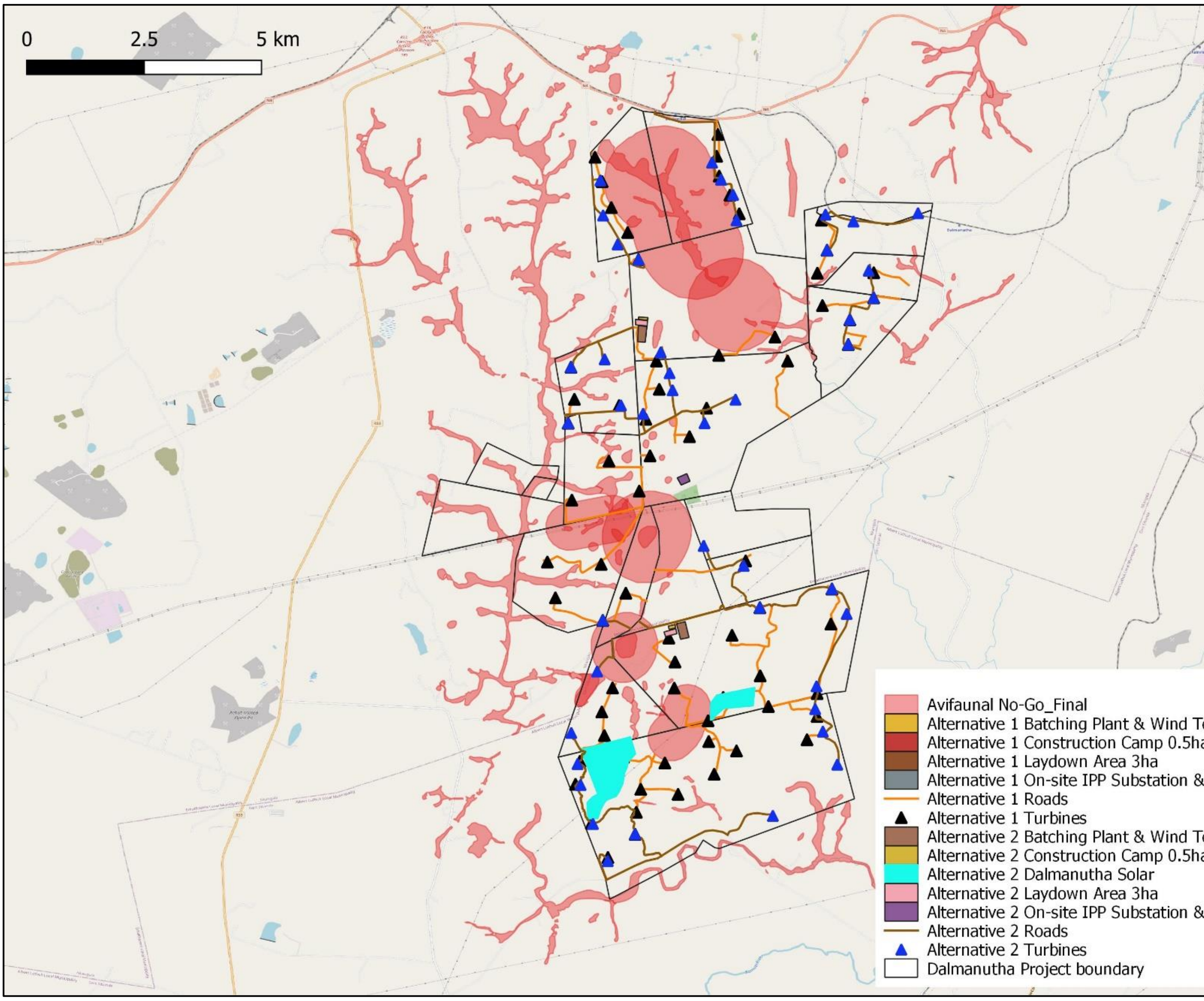

Figure 15. Avifaunal sensitivity map for the proposed project.

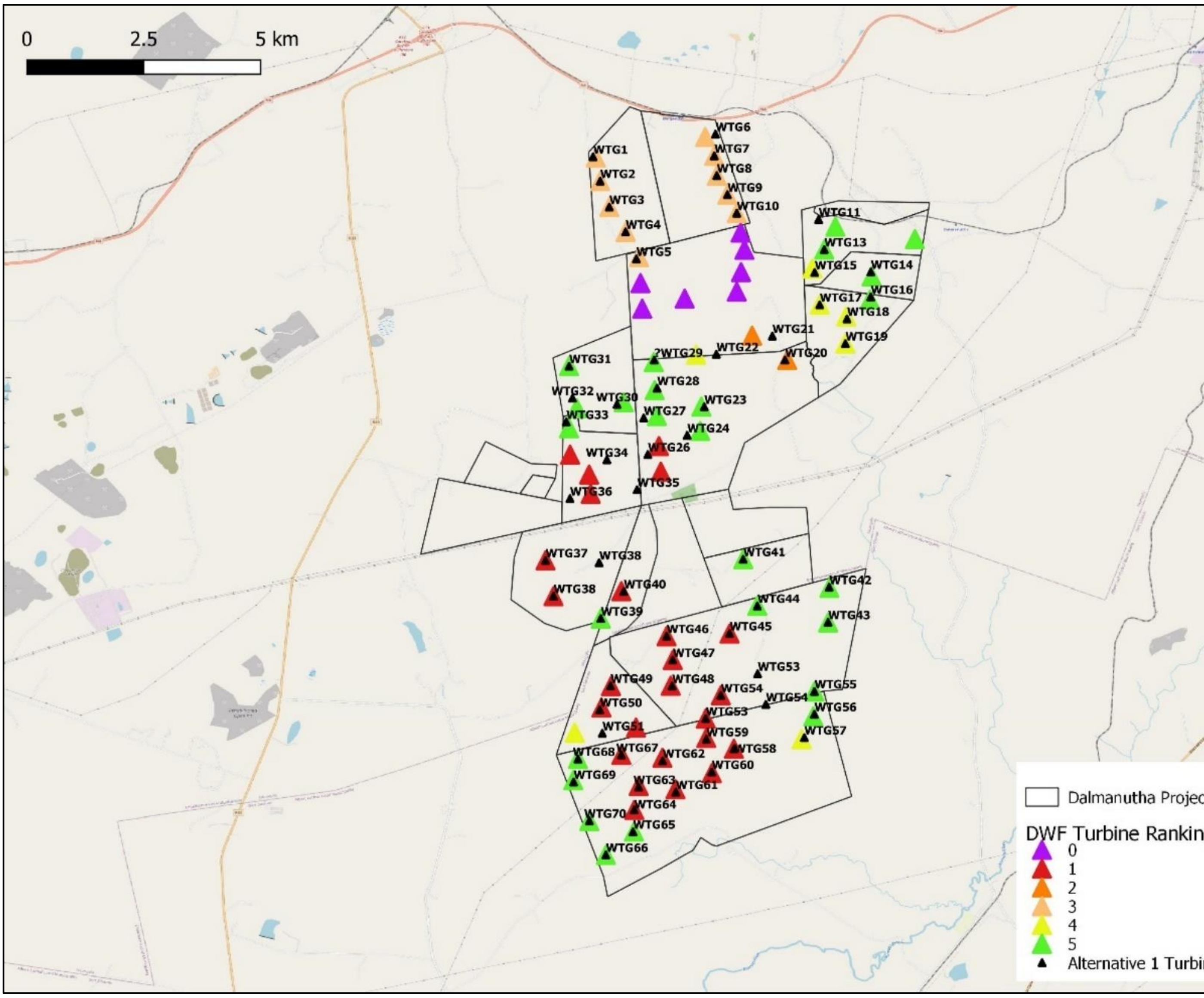

Figure 16. Individual turbine risk ranking.

8. Assessment of impacts

The following methodology is supplied by WSP.

The assessment of impacts and mitigation evaluates the likely extent and significance of the potential impacts on identified receptors and resources against defined assessment criteria, to develop and describe measures that will be taken to avoid, minimise or compensate for any adverse environmental impacts, to enhance positive impacts, and to report the significance of residual impacts that occur following mitigation.

The key objectives of the risk assessment methodology are to identify any additional potential environmental issues and associated impacts likely to arise from the proposed project, and to propose a significance ranking. Issues / aspects will be reviewed and ranked against a series of significance criteria to identify and record interactions between activities and aspects, and resources and receptors to provide a detailed discussion of impacts. The assessment considers direct[3], indirect[4], secondary[5] as well as cumulative[6] impacts.

A standard risk assessment methodology is used for the ranking of the identified environmental impacts pre-and post-mitigation (i.e. residual impact). The significance of environmental aspects is determined and ranked by considering the criteria[7] presented in Table 9.

Table 9. Impact Assessment Criteria and Scoring System

CRITERIA	SCORE 1	SCORE 2	SCORE 3	SCORE 4	SCORE 5
Impact Magnitude (M) The degree of alteration of the affected environmental receptor	Very low: No impact on processes	Low: Slight impact on processes	Medium: Processes continue but in a modified way	High: Processes temporarily cease	Very High: Permanent cessation of processes
Impact Extent (E) The geographical extent of the impact on a given environmental receptor	Site: Site only	Local: Inside activity area	Regional: Outside activity area	National: National scope or level	International: Across borders or boundaries

[3] Impacts that arise directly from activities that form an integral part of the Project.

[4] Impacts that arise indirectly from activities not explicitly forming part of the Project.

[5] Secondary or induced impacts caused by a change in the Project environment.

[6] Impacts are those impacts arising from the combination of multiple impacts from existing projects, the Project and/or future projects.

[7] The definitions given are for guidance only, and not all the definitions will apply to all the environmental receptors and resources being assessed. Impact significance was assessed with and without mitigation measures in place.

CRITERIA	SCORE 1	SCORE 2	SCORE 3	SCORE 4	SCORE 5
Impact Reversibility (R) The ability of the environmental receptor to rehabilitate or restore after the activity has caused environmental change	Reversible: Recovery without rehabilitation		Recoverable: Recovery with rehabilitation		Irreversible: Not possible despite action
Impact Duration (D) The length of permanence of the impact on the environmental receptor	Immediate: On impact	Short term: 0-5 years	Medium term: 5-15 years	Long term: Project life	Permanent: Indefinite
Probability of Occurrence (P) The likelihood of an impact occurring in the absence of pertinent environmental management measures or mitigation	Improbable	Low Probability	Probable	Highly Probability	Definite
Significance (S) is determined by combining the above criteria in the following formula:	$[S = (E + D + R + M) \times P]$ $Significance = (Extent + Duration + Reversibility + Magnitude) \times Probability$				
IMPACT SIGNIFICANCE RATING					
Total Score	**4 to 15**	**16 to 30**	**31 to 60**	**61 to 80**	**81 to 100**
Environmental Significance Rating (Negative (-))	**Very low**	**Low**	**Moderate**	**High**	**Very High**
Environmental Significance Rating (Positive (+))	**Very low**	**Low**	**Moderate**	**High**	**Very High**

Impact mitigation

The impact significance without mitigation measures will be assessed with the design controls in place. Impacts without mitigation measures in place are not representative of the proposed development's actual extent of impact and are included to facilitate understanding of how and why mitigation measures were identified. The residual impact is what remains following the application of mitigation and management measures and is thus the final level of impact associated with the development. Residual impacts also serve as the focus of management and monitoring activities during Project implementation to verify that actual impacts are the same as those predicted in this report.

The mitigation measures chosen are based on the mitigation sequence/hierarchy which allows for consideration of five (5) different levels, which include avoid/prevent, minimise, rehabilitate/restore, offset and no-go in that order. The idea is that when project impacts are considered, the first option should be to avoid or prevent the impacts from occurring in the first place if possible, however, this is not always feasible. If this is not attainable, the impacts can be allowed, however they must be minimised as far as possible by considering reducing the footprint of the development for example so that little damage is encountered. If impacts are unavoidable, the next goal is to rehabilitate or restore the areas impacted back to their original form after project completion. Offsets are then considered if all the other measures described above fail to remedy high/significant residual negative impacts. If no offsets can be achieved on a potential impact, which results in full destruction of any ecosystem for example, the no-go option is considered so that another activity or location is considered in place of the original plan.

The mitigation sequence/hierarchy is shown in Figure 17 below.

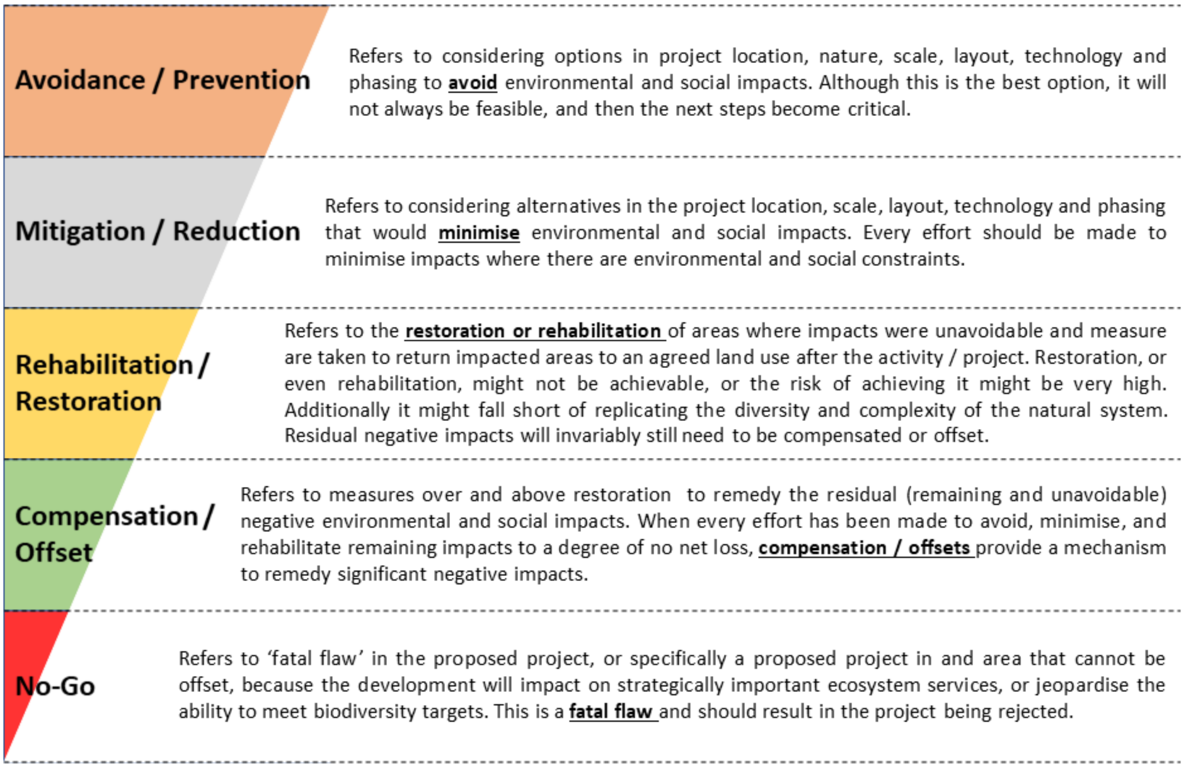

Figure 17. Mitigation Sequence/Hierarchy

8.1. Alternative 1

8.1.1 Construction Phase

Habitat destruction

Destruction and alteration of bird habitat during construction is a negative impact, which will definitely occur as a certain amount of habitat transformation is inevitable, in spite of any mitigation. Turbine hard stands, roads and other infrastructure need to be built and will transform habitat. The significance of this impact is rated as High Negative pre-mitigation, and Moderate Negative post-mitigation (Table 10).

Disturbance of birds

Disturbance of birds during construction is a negative impact, which will definitely occur to some extent. However, few sensitive species breeding sites (which would be most susceptible to impact) have been identified and these have been provided with spatial protection in the form of No-Go buffers. This impact is rated as Low Negative significance both pre and post-mitigation.

8.1.2. Operational Phase

Disturbance of birds

Since the risk to sensitive bird breeding sites has been adequately avoided through spatial protection, the magnitude of disturbance of birds in the operational phase will be low. We have rated this impact as Low Negative significance both pre and post-mitigation.

Displacement of birds

Similarly to the above, we have rated this impact as Low Negative significance both pre and post-mitigation.

Collision of birds with turbines

Collision of birds with the turbines once operating is the primary risk at the proposed site, and is a risk to multiple regionally Red Listed species, including Critically Endangered and Endangered species. This impact is rated as Very High Negative significance pre-mitigation. Although we have recommended a comprehensive suite of mitigation measures (Section 9), the most important of these (blade painting and observer led shutdown on demand) are either not fully proven in South Africa, or highly dependent on human effort, skill and management (and so somewhat risky). On a precautionary basis we judge the significance to remain at High Negative significance post-mitigation.

Collision & electrocution of birds on overhead power lines

Collision of birds with overhead power lines, and electrocution of birds perched on pylons (a negative impact since birds are killed) is rated as High Negative significance pre-mitigation. However by placing all internal collector power line underground (and only along road verges) this impact can easily be mitigated to Low Negative significance. A short piece of overhead 132kV line will be required for the 'over the fence' connection. This is acceptable from an avifaunal perspective. (the grid connection power line is not part of this application)

8.1.3 Decommissioning Phase

Disturbance of birds

Similarly to the construction phase disturbance, we judge this to be Low Negative significance both pre and post-mitigation.

Table 10. Impact assessment table – Alternative 1.

CONSTRUCTION																		
Impact number	**Aspect**	**Description**	**Stage**	**Character**	**Ease of Mitigation**	**Pre-Mitigation**							**Post-Mitigation**					
						(M+	**E+**	**R+**	**D)x**	**P=**	**S**	**Rating**	**(M+**	**E+**	**R+**	**D)x**	**P=**	**S**
Impact 1:	Habitat destruction	Habitat is destroyed and transformed	Construction	Negative	Moderate	3	1	5	4	5	**65**	**N4**	3	1	5	4	4	**52**
					Significance	**N4 - High**							**N3 - Moderate**					
Impact 2:	Disturbance of birds	Birds are disturbed during construction activities	Construction	Negative	Moderate	2	2	1	1	4	**24**	**N2**	2	2	1	1	3	**18**
					Significance	**N2 - Low**							**N2 - Low**					
OPERATIONAL																		
Impact number	**Receptor**	**Description**	**Stage**	**Character**	**Ease of Mitigation**	**Pre-Mitigation**							**Post-Mitigation**					
						(M+	**E+**	**R+**	**D)x**	**P=**	**S**		**(M+**	**E+**	**R+**	**D)x**	**P=**	**S**
Impact 1:	Disturbance of birds	Birds are disturbed during operations of the facility	Operational	Negative	Low	2	2	1	1	3	**18**	**N2**	2	2	1	1	3	**18**
					Significance	**N2 - Low**							**N2 - Low**					
Impact 2:	Displacement of birds from site	Birds are displaced entirely from the site	Operational	Negative	Low	2	2	1	1	3	**18**	**N2**	2	2	1	1	3	**18**
					Significance	**N2 - Low**							**N2 - Low**					
Impact 3:	Collision of birds with turbines	Birds are killed through collision with turbines	Operational	Negative	Moderate	4	4	5	4	5	**85**	**N5**	4	3	5	4	4	**64**
					Significance	**N5 - Very High**							**N4 - High**					
Impact 4:	Collision & electrocution of birds on overhead power lines	Birds are killed through flying into & colliding with power lines, or through perching on pylons & being electrocuted	Operational	Negative	High	4	3	5	4	5	**80**	**N4**	4	3	5	5	1	**17**
					Significance	**N4 - High**							**N2 - Low**					
DECOMISSIONING																		
Impact number	**Receptor**	**Description**	**Stage**	**Character**		**Pre-Mitigation**							**Post-Mitigation**					

					Ease of Mitigation	(M+	E+	R+	D)x	P=	S		(M+	E+	R+	D)x	P=	S
Impact 1:	Disturbance of birds	Birds are disturbed during construction activities	Construction	Negative	Moderate	2	2	1	1	4	**24**	**N2**	2	2	1	1	3	**18**
					Significance	**N2 - Low**							**N2 - Low**					

8.2. Alternative 2 (Wind & Solar PV)

8.2.1 Construction Phase

<u>Habitat destruction</u>

Destruction and alteration of bird habitat during construction is a negative impact, which will definitely occur as a certain amount of habitat transformation is inevitable, in spite of any mitigation. Turbine hard stands, solar PV arrays, roads and other infrastructure need to be built and will transform habitat. The significance of this impact is rated as High Negative pre-mitigation, and Moderate Negative post-mitigation (Table 11).

<u>Disturbance of birds</u>

Disturbance of birds during construction is a negative impact, which will definitely occur to some extent. However, few sensitive species breeding sites (which would be most susceptible to impact) have been identified and these have been provided with spatial protection in the form of No-Go buffers. This impact is rated as Low Negative significance both pre and post-mitigation.

8.2.2 Operational Phase

<u>Disturbance of birds</u>

Since the risk to sensitive bird breeding sites has been adequately avoided through spatial protection, the magnitude of disturbance of birds in the operational phase will be low. We have rated this impact as Low Negative significance both pre and post-mitigation.

<u>Displacement of birds</u>

Similarly to the above, we have rated this impact as Low Negative significance both pre and post-mitigation.

<u>Collision of birds with turbines</u>

Collision of birds with the turbines once operating is the primary risk at the proposed site, and is a risk to multiple regionally Red Listed species, including Critically Endangered and Endangered species. This impact is rated as Very High Negative significance pre-mitigation. Although we have recommended a comprehensive suite of mitigation measures (Section 9), the most important of these (blade painting and observer led shutdown on demand) are either not fully proven in South Africa, or highly dependent on human effort, skill and management (and so somewhat risky). On a precautionary basis we judge the significance to remain at High Negative significance post-mitigation.

<u>Collision & electrocution of birds on overhead power lines</u>

Collision of birds with overhead power lines, and electrocution of birds perched on pylons (a negative impact since birds are killed) is rated as High Negative significance pre-mitigation. However by placing all internal collector power line underground (and only along road verges) this impact can easily be mitigated to Low Negative significance. (the grid connection power line is not part of this application)

Bird fatality at solar PV facility

Bird fatalities could occur at the solar PV facility and associated infrastructure, through: collision with PV panels; entanglement in fences; and other mechanisms. Based on results from operational PV facilities elsewhere in South Africa (Visser, 2016, Visser *et al*, 2019), we conclude that this impact will be of Low Negative significance both pre and post mitigation.

8.2.3 Decommissioning Phase

Disturbance of birds

Similarly to the construction phase disturbance, we judge this to be Low Negative significance both pre and post-mitigation.

Table 11. Impact assessment table – Alternative 2.

CONSTRUCTION																		
Impact number	**Aspect**	**Description**	**Stage**	**Character**	**Ease of Mitigation**	**Pre-Mitigation**							**Post-Mitigation**					
						(M+	**E+**	**R+**	**D)x**	**P=**	**S**	**Rating**	**(M+**	**E+**	**R+**	**D)x**	**P=**	**S**
Impact 1:	Habitat destruction	Habitat is destroyed and transformed	Construction	Negative	Moderate	3	1	5	4	5	**65**	**N4**	3	1	5	4	4	**52**
					Significance	**N4 - High**							**N3 - Moderate**					
Impact 2:	Disturbance of birds	Birds are disturbed during construction activities	Construction	Negative	Moderate	2	2	1	1	4	**24**	**N2**	2	2	1	1	3	**18**
					Significance	**N2 - Low**							**N2 - Low**					
OPERATIONAL																		
Impact number	**Receptor**	**Description**	**Stage**	**Character**	**Ease of Mitigation**	**Pre-Mitigation**							**Post-Mitigation**					
						(M+	**E+**	**R+**	**D)x**	**P=**	**S**		**(M+**	**E+**	**R+**	**D)x**	**P=**	**S**
Impact 1:	Disturbance of birds	Birds are disturbed during operations of the facility	Operational	Negative	Low	2	2	1	1	3	**18**	**N2**	2	2	1	1	3	**18**
					Significance	**N2 - Low**							**N2 - Low**					
Impact 2:	Displacement of birds from site	Birds are displaced entirely from the site	Operational	Negative	Low	2	2	1	1	3	**18**	**N2**	2	2	1	1	3	**18**
					Significance	**N2 - Low**							**N2 - Low**					
Impact 3:	Collision of birds with turbines	Birds are killed through collision with turbines	Operational	Negative	Moderate	5	4	5	4	5	**90**	**N5**	5	4	5	4	4	**72**
					Significance	**N5 - Very High**							**N4 - High**					
Impact 4:	Collision & electrocution of birds on overhead power lines	Birds are killed through flying into & colliding with power lines, or through perching on pylons & being electrocuted	Operational	Negative	High	4	3	5	4	5	**80**	**N4**	4	3	5	5	1	**17**
					Significance	**N4 - High**							**N2 - Low**					
Impact 5:	Bird fatality on solar PV facility	Birds are killed through colliding with panels or entanglement in fences	Operational	Negative	Moderate	3	3	5	4	2	**30**	**N2**	3	3	5	4	2	**30**
					Significance	**N2 - Low**							**N2 - Low**					

DECOMISSIONING																			
Impact number	**Receptor**	**Description**	**Stage**	**Character**	**Ease of Mitigation**	**Pre-Mitigation**							**Post-Mitigation**						
						(M+	**E+**	**R+**	**D)x**	**P=**	**S**		**(M+**	**E+**	**R+**	**D)x**	**P=**	**S**	
Impact 1:	Disturbance of birds	Birds are disturbed during construction activities	Construction	Negative	Moderate	2	2	1	1	4	**24**	**N2**	2	2	1	1	3	**18**	
					Significance	**N2 - Low**							**N2 - Low**						

8.3. Comparison of Alternatives

The impact significance of the two alternatives has been formally assessed above. To summarise, both alternatives receive the same significance rating for the various identified impacts. In the case of the impacts of: habitat destruction; disturbance; and displacement, as per the project description supplied by the applicant the development footprint of the two alternatives will be identical (400ha). The impact significance is therefore the same for both alternatives.

In the case of bird fatality through collision with wind turbines, the reduction in the number of wind turbines from 70 to 44 for Alternative 2 is positive for the impact of bird-turbine collision, and certainly reduces the potential impact on birds. Our crude estimate of pre-mitigation bird fatality through turbine collision is as follows, repeated from Section 6.2.6:

- Alternative 1 – Rotor Swept Area of 30m - 230m (70 turbines). Approximately **18.46** fatalities could be recorded at the wind farm per year across the target bird species recorded flying on site prior to the application of mitigation measures. This includes most notably the following regionally Red Listed species fatalities: Cape Vulture – **10.20** birds/year; Southern Bald Ibis – 1.14 birds/year; Blue Crane – 0.72 birds/year; White-bellied Bustard – 0.26 birds/year.

- Alternative 2 -Rotor Swept Area of 30m to 230m (44 turbines). Approximately **11.60** fatalities could be recorded at the wind farm per year across the target bird species recorded flying on site (Table 5) prior to the application of mitigation measures. This includes the following regionally Red Listed species fatalities: Cape Vulture – **6.41** birds/year; Southern Bald Ibis – 0.71 birds/year; Blue Crane – 0.45 birds/year; White-bellied Bustard – 0.16 birds/year.

As an example, the species of most concern at the project, Cape Vulture, is estimated to have 10.20 fatalities per year with 70 turbines, or 6.41 per year with 44 turbines. Unfortunately 6.41 fatalities per year (before the application of mitigation) is still highly significant for an Endangered Species. We therefore judge the significance of this impact to be Very High (as with Alternative 1). This number of fatalities would reduce through the application of mitigation. However we cannot estimate the extent of this reduction. We therefore judge the significance of this impact to remain at High Negative post mitigation. The reduction in turbines proposed by the applicant is not enough to reduce the risk lower. Alternative 2 of 44 wind turbines is still a large wind farm project.

While Alternative 2 is strongly preferred from an avifaunal perspective (since fewer turbines should cause fewer collision fatalities) it remains a large wind farm in a highly sensitive area.

We recommend strongly against the selection of Alternative 1, given that Alternative 2 has far fewer wind turbines. Alternative 2 is strongly preferred from an avifaunal perspective (since fewer turbines should cause fewer turbine collision bird fatalities), however 44 turbines remains a large wind farm in a highly sensitive area, and the estimated number of bird fatalities remain high for priority species pre-mitigation. The significance of the turbine collision risk for multiple Red Listed (including Critically Endangered & Endangered) species remains at Very High pre mitigation and High post mitigation for Alternative 2. To reduce this significance will require a substantial further reduction in the number of turbines.

8.4. Cumulative Impacts

In relation to an activity, cumulative impact "means the past, current and reasonably 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 reasonably foreseeable impacts eventuating from similar or diverse activities" (NEMA EIA Reg GN R982 of 2014).

There are three approved projects within 40km of Dalmanutha (Figure 18):

- The construction of the 14MW Machadodorp PV 1 solar energy facility on portion 8 0f the farm De Kroon 363 in Mpumalanga Province – 11km NE of the Site
- Proposed establishment of the Haverfontein wind energy facility near Carolina, Mpumalanga Province – 9km S of the Site
- Eskom Arnot PV Facility at the Arnot Power Station on Remainder of Portion 24 of Reitkuil 491 JS near Middleburg in Mpumalanga – 31km SW of the site

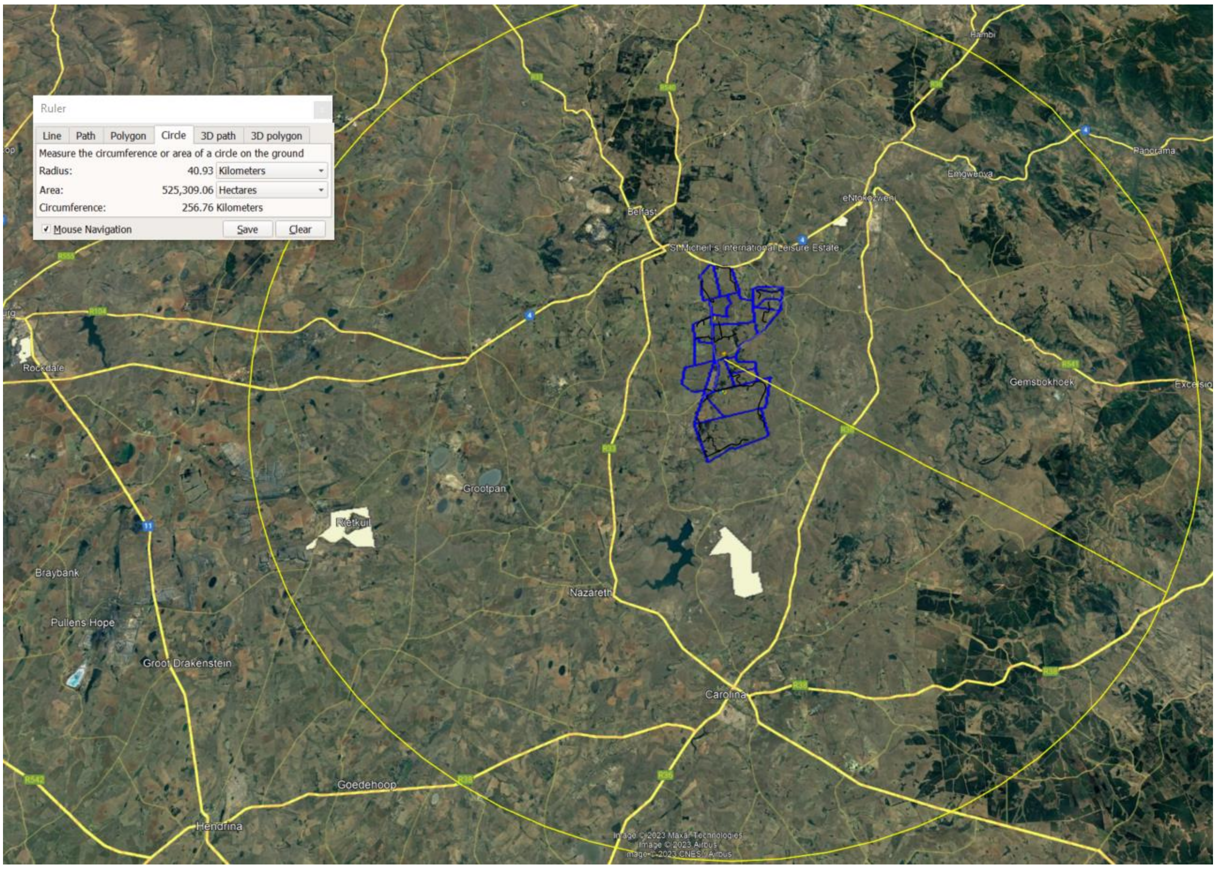

Figure 18. Renewable energy projects within 40km of the proposed site.

The cumulative impact of wind energy (and solar PV) on avifauna in the proposed area has 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 undertaken in the cumulative impact assessment section of the study were as follows:

- Define and assess the impacts of the proposed project. *See Section 8.1 and 8.2.*
- Identify and obtain details for all operational and authorised overhead power lines and wind farms (within 30km radius of the proposed project). *See above and Figure 17.*
- Identify impacts of the proposed project which are also likely or already exist at the other projects. *The primary impacts that are common to the various projects are: habitat destruction; and collision of birds with wind turbines.*
- Obtain reports and data for other projects (if possible). *We obtained the report for the Haverfontein wind farm only*
- As far as possible quantify the effect of all projects on key bird species local populations (will need to be defined and estimated). *The Haverfontein wind farm was proposed to be 33*

turbines. Assuming all factors equal, this would have roughly half the turbine collision fatality impact of the proposed Dalmanutha facility (70 turbines).

- Express the likely impacts associated with the proposed project as a proportion of the overall impacts on key species. *The proposed Dalmanutha project will have approximately two-thirds of the full impact on birds through turbine collision.*
- 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. *The impacts of wind turbines on birds in this area is a significant concern as expressed elsewhere. The fatality impact is directly proportional to the number of turbines, so the cumulative impact is certainly greater than that of one project alone.*

Table 12 assesses the cumulative impact of bird collision with wind turbines formally according to the methods supplied by WSP. The significance pre-mitigation is rated as High Negative, and it remains so post-mitigation.

Table 12. Impact assessment table – cumulative (for both alternatives).

CUMULATIVE																			
Impact number	**Receptor**	**Description**	**Stage**	**Character**	**Ease of Mitigation**	**Pre-Mitigation**							**Post-Mitigation**						
						(M+	**E+**	**R+**	**D)x**	**P=**	**S**		**(M+**	**E+**	**R+**	**D)x**	**P=**	**S**	
Impact 1:	Collision of birds with turbines	Birds are killed through collision with turbines	Cumulative	Negative	Moderate	2	3	5	4	5	**70**	**N4**	2	3	5	4	5	**70**	**N4**
					Significance	**N4 - High**							**N4 - High**						

8.5 Summary of impact assessment

The impacts identified and assessed by this current study are summarised in Table 13.

Table 13. Summary of impacts.

		Alternative 1		Alternative 2	
Phase	**Impact**	**Significance Pre-mitigation**	**Significance Post-mitigation**	**Significance Pre-mitigation**	**Significance Post-mitigation**
Construction	Habitat destruction	High	Moderate	High	Moderate
	Disturbance	Low	Low	Low	Low
Operation	Disturbance	Low	Low	Low	Low
	Displacement	Low	Low	Low	Low
	Collision of birds with turbines	Very High	High	Very High	High
	Collision & electrocution of birds on overhead power lines	High	Low	High	Low
	Bird fatality on Solar PV facility	n/a	n/a	Low	Low
Decommissioning	Disturbance of birds	Low	Low	Low	Low
Cumulative impacts	Collision of birds with turbines	High	High	High	High

9. Mitigation measures (for inclusion in EA Conditions)

Although extensive avoidance (see Section 7) of impacts has already been applied on this project via avifaunal sensitivity mapping, we recommend the following additional mitigation measures be applied to manage and further reduce the significance of impacts on birds. These mitigation measures apply to the three phases of construction, operations and decommissioning, and in many cases a particular measure applies to more than one of these phases.

- The sensitive (No-Go) areas identified by this study should be adhered to.
- A pre-construction avifaunal walk down should be conducted to confirm final layout and identify any sensitivities that may arise between the conclusion of the EIA process and the construction phase.
- All human activities associated with construction, operation and decommissioning should be strictly managed according to generally accepted environmental best practice standards, so as to avoid any unnecessary impact on the receiving environment.
- Use should be made of existing roads as far as possible.
- All staff, vehicle and machinery activities should be strictly controlled at all times so as to ensure that the absolute minimum of surface area is impacted.
- Care should be taken not to introduce or propagate alien plant species/weeds during construction.
- No internal medium voltage power lines should be overhead. All such cables should be buried, and follow road verges at all times, unless specifically agreed to by the avifaunal specialist.
- Any overhead conductors or earth wires should be fitted with an Eskom approved anti-bird collision line-marking device to make cables more visible to birds in flight and reduce the likelihood of collisions.
- The pole design of any overhead power line should be approved by an ornithologist in terms of the electrocution risk it may pose to large birds such as eagles and vultures.
- The combination of turbine hub height and rotor diameter must be optimised to maximise the lower blade tip height above ground. Raising the lower turbine blade tip height from a typical 30m above ground to approximately 50m above ground will reduce collision risk for most species, as most flight is low over the ground.
- A post-construction site inspection must be conducted by an avifaunal specialist to confirm that all aspects have been appropriately handled and in particular that road and hard stand verges do not provide additional substrate for raptor prey species. It is essential that the new facility does not create favourable conditions for such mammals in high risk areas. We therefore recommend that within the first year of operations a full assessment of this aspect be made by the ornithologist contracted for post-construction monitoring. If such conditions

have been created, case-specific solutions will need to be developed and implemented by the project operator.

- It is strongly recommended that rodenticides not be used at the newly established Operation and Maintenance (O&M) buildings or around auxiliary infrastructure on the project site. While pest control of this nature may be effective, even so-called "environmentally friendly" rodenticides are toxic and pose significant secondary poisoning risk to predatory avifauna, especially owls.
- A 'Cape Vulture Food Management Programme' must be implemented on site to ensure all dead livestock/wildlife on site are removed as soon as possible and made unavailable to vultures for feeding. This programme will reduce the amount of available vulture food on site and reduce vulture-turbine collision risk. This programme will require the deployment of a dedicated (i.e. no other tasks) and adequately resourced (transport, binoculars, GPS, cameras, training) team of staff to patrol the full site and immediate surrounds during all daylight hours. The co-operation of landowners will also be essential to ensure that reported carcasses are disposed of effectively. This programme must be operational by the time the first turbine blades are turning on site and should not wait for Commercial Operations Date (COD). A full detailed method statement for this programme must be designed by an ornithologist prior to COD, and included in the EMPr.
- The landowner agreements should ensure specifically that any vulture feeding sites be stopped from the start of wind farm construction and not used for the full lifespan of the wind farm. Landowners should also be sensitised to the need to cooperate with the above Cape Vulture Food Management Programme.
- Cape Vultures will have to be effectively deterred from roosting on overhead power lines on site. This will need to be achieved well before turbines are operational and maintained through the project lifespan. Eskom Bird Guards (perch deterrents) must be installed on all pylons at the two roost sites, with full coverage of steel cross members (not just above live phases as per Eskom standard). In addition, the team of staff employed to implement the Cape Vulture Food Management Programme described above should also be tasked with patrolling the relevant sections of power line early morning and late evenings to scare any perching vultures away. This should first be trialled by in collaboration with an avifaunal specialist to ensure that such actions don't increase turbine collision risk in the short term by flushing vultures into turbines.
- An Observer-Led Turbine Shutdown on Demand (OLSDOD) programme must be implemented on site from COD. This is required in order to mitigate the risk of turbine collision for priority bird species. This programme must consist of a suitably qualified, trained, dedicated and resourced team of observers present on site for all daylight hours 365 days of the year. This team must be stationed at vantage points with full visible coverage of all turbine locations. The observers must detect incoming priority bird species, track their flights, judge when they enter a turbine proximity threshold, and alert the control room to shut down the relevant turbine/s

until the risk has reduced. A full detailed method statement must be designed by an ornithologist prior to COD, and included in the EMPr. The effectiveness of this programme is highly dependent on hiring the correct staff and managing them appropriately. The project must pay careful attention to this aspect to minimise collision risk.

- All turbines must have one of their blades painted according to the approval to be obtained by the South African Civil Aviation Authority (SACAA) from the outset. Provision must be made by the developer for the resolution of any technical, warranty or supplier challenges that this may present.
- A bird fatality threshold and adaptive management plan must be designed by an ornithologist for the site prior to the Commercial Operation Date (COD) and included in the EMPr. This plan should identify most importantly the number of bird fatalities of priority species which will trigger a management response, appropriate responses, and time lines for such responses. Fatalities of priority bird species are usually rare events (but with very high consequence) and it is difficult to analyse trends or statistics related to these fatalities as they occur. It is therefore important to have a threshold policy in place proactively to assist adaptive management.
- Any residual impacts recorded during operations by operational phase bird monitoring after all possible mitigation measures have been implemented will need to be mitigated off site. The facility will need to address other sources of mortality of priority species in a measurable way so as to compensate for residual effects on the facility itself. This will need to be detailed in a Biodiversity Action Plan to be developed as part of the operational phase bird monitoring programme.
- The “during construction” and “post-construction” monitoring programme outlined in Appendix 10 should be implemented according to the latest available version of the Best Practice Guidelines at the time. The findings from Operational Phase monitoring should inform the adaptive management programme to mitigate any impacts on avifauna to acceptable levels.
- This is a rapidly evolving field and as more wind farms become operational, the learning curve steepens in terms of mitigation of risks to birds. A number of new technology options are possibly on the horizon, including: blade illumination; radar technology; and acoustic deterrents. The project must keep abreast of these developments and implement if deemed necessary and reasonable as per the projects’ adaptive management plan.

10. Conclusion

The proposed site is located in an area of the country which provides a mosaic of land uses or micro habitats. As a result, a rich diversity of birds occur here, many of which are regionally Red Listed. The most important of these for the proposed project are: Wattled Crane (regionally Critically Endangered); Grey-crowned Crane (regionally Endangered); African Marsh-Harrier (regionally endangered); Cape Vulture (regionally Endangered); Black-rumped Buttonquail (regionally Endangered); White-bellied Korhaan (regionally Vulnerable); Southern Bald Ibis (regionally Vulnerable); Denham's Bustard (regionally Vulnerable); Lanner Falcon (regionally Vulnerable); Secretarybird (regionally Vulnerable); and Blue Crane (regionally Near-threatened) (Taylor *et al,* 2015).

All bird species will to some extent be susceptible to habitat destruction and disturbance if the wind farm is built. However, it is the direct mortality risk through collision with turbines, and collision and electrocution on overhead power lines (should they be required) which is of most concern. The larger species are particularly at risk of these impacts. We have made the following assessments of the significance of the potential impacts of the proposed project on avifauna (using methods and criteria supplied by WSP):

		Alternative 1		**Alternative 2**	
Phase	**Impact**	**Significance Pre-mitigation**	**Significance Post-mitigation**	**Significance Pre-mitigation**	**Significance Post-mitigation**
Construction	Habitat destruction	High	Moderate	High	Moderate
	Disturbance	Low	Low	Low	Low
Operation	Disturbance	Low	Low	Low	Low
	Displacement	Low	Low	Low	Low
	Collision of birds with turbines	Very High	High	Very High	High
	Collision & electrocution of birds on overhead power lines	High	Low	High	Low
	Bird fatality on Solar PV facility	n/a	n/a	Low	Low
Decommissioning	Disturbance of birds	Low	Low	Low	Low
Cumulative impacts	Collision of birds with turbines	High	High	High	High

Although these risks have to a certain extent been avoided by the application of No-Go sensitivity mapping, there is a need for extensive mitigation should the project go ahead. The following measures should be included in the EA conditions and EMPr:

- The sensitive (No-Go) areas identified by this study should be adhered to.

- A pre-construction avifaunal walk down should be conducted to confirm final layout and identify any sensitivities that may arise between the conclusion of the EIA process and the construction phase.
- All human activities associated with construction, operation and decommissioning should be strictly managed according to generally accepted environmental best practice standards, so as to avoid any unnecessary impact on the receiving environment.
- Use should be made of existing roads as far as possible.
- All staff, vehicle and machinery activities should be strictly controlled at all times so as to ensure that the absolute minimum of surface area is impacted.
- Care should be taken not to introduce or propagate alien plant species/weeds during construction.
- No internal medium voltage power lines should be overhead. All such cables should be buried, and follow road verges at all times, unless specifically agreed to by the avifaunal specialist.
- Any overhead conductors or earth wires should be fitted with an Eskom approved anti-bird collision line-marking device to make cables more visible to birds in flight and reduce the likelihood of collisions.
- The pole design of any overhead power line should be approved by an ornithologist in terms of the electrocution risk it may pose to large birds such as eagles and vultures.
- The combination of turbine hub height and rotor diameter must be optimised to maximise the lower blade tip height above ground. Raising the lower turbine blade tip height from a typical 30m above ground to approximately 50m above ground will reduce collision risk for most species, as most flight is low over the ground.
- A post-construction site inspection must be conducted by an avifaunal specialist to confirm that all aspects have been appropriately handled and in particular that road and hard stand verges do not provide additional substrate for raptor prey species. It is essential that the new facility does not create favourable conditions for such mammals in high risk areas. We therefore recommend that within the first year of operations a full assessment of this aspect be made by the ornithologist contracted for post-construction monitoring. If such conditions have been created, case-specific solutions will need to be developed and implemented by the project operator.
- It is strongly recommended that rodenticides not be used at the newly established Operation and Maintenance (O&M) buildings or around auxiliary infrastructure on the project site. While pest control of this nature may be effective, even so-called “environmentally friendly” rodenticides are toxic and pose significant secondary poisoning risk to predatory avifauna, especially owls.
- A ‘Cape Vulture Food Management Programme’ must be implemented on site to ensure all dead livestock/wildlife on site are removed as soon as possible and made unavailable to vultures for feeding. This programme will reduce the amount of available vulture food on site

and reduce vulture-turbine collision risk. This programme will require the deployment of a dedicated (i.e. no other tasks) and adequately resourced (transport, binoculars, GPS, cameras, training) team of staff to patrol the full site and immediate surrounds during all daylight hours. The co-operation of landowners will also be essential to ensure that reported carcasses are disposed of effectively. This programme must be operational by the time the first turbine blades are turning on site and should not wait for Commercial Operations Date (COD). A full detailed method statement for this programme must be designed by an ornithologist prior to COD, and included in the EMPr.

- The landowner agreements should ensure specifically that any vulture feeding sites be stopped from the start of wind farm construction and not used for the full lifespan of the wind farm. Landowners should also be sensitised to the need to cooperate with the above Cape Vulture Food Management Programme.
- Cape Vultures will have to be effectively deterred from roosting on overhead power lines on site. This will need to be achieved well before turbines are operational and maintained through the project lifespan. Eskom Bird Guards (perch deterrents) must be installed on all pylons at the two roost sites, with full coverage of steel cross members (not just above live phases as per Eskom standard). In addition, the team of staff employed to implement the Cape Vulture Food Management Programme described above should also be tasked with patrolling the relevant sections of power line early morning and late evenings to scare any perching vultures away. This should first be trialled by in collaboration with an avifaunal specialist to ensure that such actions don't increase turbine collision risk in the short term by flushing vultures into turbines.
- An Observer-Led Turbine Shutdown on Demand (OLSDOD) programme must be implemented on site from COD. This is required in order to mitigate the risk of turbine collision for priority bird species. This programme must consist of a suitably qualified, trained, dedicated and resourced team of observers present on site for all daylight hours 365 days of the year. This team must be stationed at vantage points with full visible coverage of all turbine locations. The observers must detect incoming priority bird species, track their flights, judge when they enter a turbine proximity threshold, and alert the control room to shut down the relevant turbine/s until the risk has reduced. A full detailed method statement must be designed by an ornithologist prior to COD, and included in the EMPr. The effectiveness of this programme is highly dependent on hiring the correct staff and managing them appropriately. The project must pay careful attention to this aspect to minimise collision risk.
- All turbines must have one of their blades painted according to the approval to be obtained by the South African Civil Aviation Authority (SACAA) from the outset. Provision must be made by the developer for the resolution of any technical, warranty or supplier challenges that this may present.
- A bird fatality threshold and adaptive management plan must be designed by an ornithologist for the site prior to the Commercial Operation Date (COD) and included in the EMPr. This plan

should identify most importantly the number of bird fatalities of priority species which will trigger a management response, appropriate responses, and time lines for such responses. Fatalities of priority bird species are usually rare events (but with very high consequence) and it is difficult to analyse trends or statistics related to these fatalities as they occur. It is therefore important to have a threshold policy in place proactively to assist adaptive management.

- Any residual impacts recorded during operations by operational phase bird monitoring after all possible mitigation measures have been implemented will need to be mitigated off site. The facility will need to address other sources of mortality of priority species in a measurable way so as to compensate for residual effects on the facility itself. This will need to be detailed in a Biodiversity Action Plan to be developed as part of the operational phase bird monitoring programme.
- The "during construction" and "post-construction" monitoring programme outlined in Appendix 10 should be implemented according to the latest available version of the Best Practice Guidelines at the time. The findings from Operational Phase monitoring should inform the adaptive management programme to mitigate any impacts on avifauna to acceptable levels.
- This is a rapidly evolving field and as more wind farms become operational, the learning curve steepens in terms of mitigation of risks to birds. A number of new technology options are possibly on the horizon, including: blade illumination; radar technology; and acoustic deterrents. The project must keep abreast of these developments and implement if deemed necessary and reasonable as per the projects' adaptive management plan.

The proposed project is in a highly sensitive area for avifauna. The applicant has applied a substantial amount of risk avoidance through the application of No-Go areas and the reduction in the number of turbines (from 77 to 70 in the EIA phase – Alternative 1) and more so through the presentation of Alternative 2 which includes a further reduction to 44 wind turbines (plus solar PV). We recommend strongly against the selection of Alternative 1, given that Alternative 2 has far fewer wind turbines. Alternative 2 is strongly preferred from an avifaunal perspective, since fewer turbines should cause fewer turbine collision bird fatalities. However, 44 turbines (Alternative 2) is still a large wind farm in a highly sensitive area, and the estimated number of bird fatalities pre-mitigation are still high for priority species. The significance of the turbine collision risk for multiple Red Listed (including Critically Endangered & Endangered) bird species is judged to be Very High pre-mitigation and High post-mitigation for Alternative 2.

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Appendix 1. Bird species data (pre-construction monitoring & SABAP2).

Common Name	Scientific Name	Red Data*: Regional, Global (Endemism)**	SABAP 2 Reporting Rate (%)†	Collision Risk (Retief *et al.* 2014)	Site Visit									
					1	2	3	4	5	6	7	8	9	10
Wattled Crane	*Grus carunculata*	CR, VU	5	15.0	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*		*1*
White-backed Vulture	*Gyps africanus*	CR, CR	23		*1*									
Grey Crowned Crane	*Balearica regulorum*	EN, EN	15	3.8			*1*	*1*	*1*	*1*				
African Marsh Harrier	*Circus ranivorus*	EN, LC	25	0.5						*1*				*1*
Cape Vulture	*Gyps coprotheres*	EN, EN	1	18.8	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Yellow-billed Stork	*Mycteria ibis*	EN, LC	9											
Martial Eagle	*Polemaetus bellicosus*	EN, VU	4	1.9	*1*	*1*		*1*	*1*	*1*			*1*	
Black-rumped Buttonquail	*Turnix nanus*	EN, LC	107	5.6	*1*			*1*	*1*				*1*	
Short-tailed Pipit	*Anthus brachyurus*	VU, LC		0.9										
Yellow-breasted Pipit	*Anthus chloris*	VU, LC, E	46	0.5										
Verreaux's Eagle	*Aquila verreauxii*	VU, LC	2	0.9										
White-bellied Korhaan (Bustard)	*Eupodotis senegalensis*	VU, LC	36	23.0	*1*	*1*	*1*	*1*	*1*	*1*	*1*		*1*	*1*
Lanner Falcon	*Falco biarmicus*	VU, LC	24	6.6	*1*	*1*	*1*	*1*	*1*		*1*	*1*	*1*	*1*
Southern Bald Ibis	*Geronticus calvus*	VU, VU, SLS	8	31.9	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Denham's Bustard	*Neotis denhami*	VU, NT	21	2.3	*1*	*1*				*1*				
African Pygmy Goose	*Nettapus auritus*	VU, LC		0.9										
Secretarybird	*Sagittarius serpentarius*	VU, EN	13	11.3	*1*	*1*	*1*	*1*	*1*	*1*		*1*	*1*	
Crowned Eagle	*Stephanoaetus coronatus*	VU, NT	26	0.5				*1*			*1*			
Bush Blackcap	*Sylvia nigricapillus*	VU, VU, SLS		15.0										
Half-collared Kingfisher	*Alcedo semitorquata*	NT, LC	105	10.8										
Abdim's Stork	*Ciconia abdimii*	NT, LC		0.5										
Pallid Harrier	*Circus macrourus*	NT, NT	41	0.5									*1*	

European Roller	*Coracias garrulus*	NT, LC		0.5										
Red-footed Falcon	*Falco vespertinus*	NT, NT	96	1.4										
Blue Crane	*Grus paradisea*	NT, VU	11	9.9			*1*	*1*			*1*	*1*	*1*	*1*
Maccoa Duck	*Oxyura maccoa*	NT, VU		0.5										
Lesser Flamingo	*Phoeniconaias minor*	NT, NT	28	0.5										
Greater Flamingo	*Phoenicopterus roseus*	NT, LC	29	0.0										
Forest Buzzard	*Buteo trizonatus*	LC, NT, SLS	106									*1*		*1*
Curlew Sandpiper	*Calidris ferruginea*	LC, NT		0.5										
Blue Korhaan	*Eupodotis caerulescens*	LC, NT, SLS	35	4.2				*1*						
Jackal Buzzard	*Buteo rufofuscus*	NE	43	14.6	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Buff-streaked Chat	*Campicoloides bifasciatus*	SLS	87	36.6	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	
Eastern Long-billed Lark	*Certhilauda semitorquata*	SLS		33.3	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	
Greater Double-collared Sunbird	*Cinnyris afer*	SLS		33.3				*1*						
Southern Double-collared Sunbird	*Cinnyris chalybeus*	NE		0.0		*1*			*1*					
Cloud Cisticola	*Cisticola textrix*	NE		17.8			*1*	*1*			*1*			
Chorister Robin-Chat Robin-Chat	*Cossypha dichroa*	SLS		1.4										
Pied Starling	*Lamprotornis bicolor*	SLS		63.4	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Fiscal Flycatcher	*Melaenornis silens*	NE		18.3	*1*	*1*	*1*	*1*	*1*		*1*			*1*
Cape Rock Thrush	*Monticola rupestris*	SLS		20.7										
South African Cliff Swallow	*Petrochelidon spilodera*	BNE		6.6	*1*	*1*	*1*	*1*		*1*			*1*	
Cape Weaver	*Ploceus capensis*	NE		71.4	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Drakensberg Prinia	*Prinia hypoxantha*	SLS		51.2	*1*	*1*	*1*	*1*	*1*		*1*		*1*	
Grey-winged Francolin	*Scleroptila afra*	SLS	80	4.2					*1*	*1*			*1*	*1*
Cape Grassbird	*Sphenoeacus afer*	NE		47.9	*1*	*1*	*1*	*1*	*1*	*1*			*1*	
Fairy Flycatcher	*Stenostira scita*	NE		0.9										
Karoo Thrush	*Turdus smithi*	NE		6.6										
Cape White-eye	*Zosterops virens*	NE		58.2	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*

Black Sparrowhawk	*Accipiter melanoleucus*		102	14.1	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Rufous-breasted Sparrowhawk	*Accipiter rufiventris*		101	3.8									*1*	
African Goshawk	*Accipiter tachiro*			0.9	*1*	*1*	*1*							
Common Myna	*Acridotheres tristis*			26.8	*1*	*1*		*1*	*1*				*1*	
Great Reed Warbler	*Acrocephalus arundinaceus*			0.5										
African Reed Warbler	*Acrocephalus baeticatus*			9.4				*1*						
Lesser Swamp Warbler	*Acrocephalus gracilirostris*			54.9	*1*	*1*	*1*		*1*		*1*	*1*		*1*
Marsh Warbler	*Acrocephalus palustris*			3.3										
Sedge Warbler	*Acrocephalus schoenobaenus*			0.0				*1*						
Common Sandpiper	*Actitis hypoleucos*			0.5		*1*	*1*							
African Jacana	*Actophilornis africanus*			3.8										
Northern Black Korhaan	*Afrotis afraoides*		90							*1*				
Egyptian Goose	*Alopochen aegyptiaca*			65.3	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Orange-breasted Waxbill	*Amandava subflava*			2.3										
Black Crake	*Amaurornis flavirostra*			34.3	*1*	*1*	*1*	*1*	*1*	*1*	*1*			*1*
Thick-billed Weaver	*Amblyospiza albifrons*			5.6							*1*			
Cape Teal	*Anas capensis*			0.5										
Red-billed Teal	*Anas erythrorhyncha*			9.4	*1*			*1*	*1*		*1*			*1*
African Black Duck	*Anas sparsa*			14.1				*1*						
Yellow-billed Duck	*Anas undulata*			73.2	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
African Darter	*Anhinga rufa*			18.3	*1*			*1*	*1*				*1*	*1*
Cuckoo Finch	*Anomalospiza imberbis*			0.9										
African Pipit	*Anthus cinnamomeus*			64.3	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Plain-backed Pipit	*Anthus leucophrys*			5.6		*1*			*1*	*1*	*1*	*1*		
Striped Pipit	*Anthus lineiventris*			1.9										
Nicholson's Pipit	*Anthus similis*			34.7	*1*	*1*	*1*	*1*	*1*	*1*	*1*		*1*	
Buffy Pipit	*Anthus vaalensis*			3.8	*1*	*1*	*1*	*1*	*1*	*1*				*1*

Bar-throated Apalis	*Apalis thoracica*			31.9	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Little Swift	*Apus affinis*			14.6	*1*	*1*	*1*	*1*		*1*	*1*			*1*
Common Swift	*Apus apus*			2.8			*1*							
African Black Swift	*Apus barbatus*			14.6	*1*		*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
White-rumped Swift	*Apus caffer*			46.5	*1*	*1*	*1*	*1*		*1*		*1*	*1*	*1*
Horus Swift	*Apus horus*			1.9				*1*					*1*	
Great Egret	*Ardea alba*			5.2	*1*		*1*			*1*	*1*			
Grey Heron	*Ardea cinerea*			18.3	*1*	*1*	*1*	*1*	*1*				*1*	*1*
Goliath Heron	*Ardea goliath*			0.0				*1*		*1*				*1*
Yellow-billed (Intermediate) Egret	*Ardea intermedia*			16.9		*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Black-headed Heron	*Ardea melanocephala*			35.7	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Purple Heron	*Ardea purpurea*			31.5	*1*		*1*	*1*	*1*	*1*	*1*	*1*	*1*	
Squacco Heron	*Ardeola ralloides*			1.9										
Ruddy Turnstone	*Arenaria interpres*			0.0		*1*								
Marsh Owl	*Asio capensis*		79	2.8	*1*			*1*	*1*					*1*
African Cuckoo-Hawk	*Aviceda cuculoides*			0.9										
Cape Batis	*Batis capensis*			0.5		*1*								
Chinspot Batis	*Batis molitor*			0.0				*1*						
Hadeda (Hadada) Ibis	*Bostrychia hagedash*			85.4	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Little Rush Warbler	*Bradypterus baboecala*			15.5	*1*		*1*	*1*					*1*	
Spotted Eagle-Owl	*Bubo africanus*		98	8.0	*1*			*1*						*1*
Cape Eagle-Owl	*Bubo capensis*		42									*1*		
Western Cattle Egret	*Bubulcus ibis*			63.8	*1*		*1*	*1*	*1*		*1*	*1*	*1*	*1*
Red-billed Oxpecker	*Buphagus erythrorynchus*			1.4			*1*	*1*		*1*				
Spotted Thick-knee	*Burhinus capensis*			8.0			*1*	*1*	*1*					
Common (Steppe) Buzzard	*Buteo buteo*		67	43.7			*1*	*1*			*1*	*1*	*1*	*1*
Red-capped Lark	*Calandrella cinerea*			18.8	*1*	*1*	*1*	*1*		*1*	*1*	*1*	*1*	

Little Stint	*Calidris minuta*			0.5										
Ruff	*Calidris pugnax*			1.4						*1*				
Black Cuckooshrike	*Campephaga flava*			0.9										
Golden-tailed Woodpecker	*Campethera abingoni*			1.4										
European Nightjar	*Caprimulgus europaeus*			1.9										
Fiery-necked Nightjar	*Caprimulgus pectoralis*			11.3	*1*			*1*		*1*			*1*	*1*
Lesser Striped Swallow	*Cecropis abyssinica*			2.8			*1*	*1*				*1*	*1*	
Greater Striped Swallow	*Cecropis cucullata*			72.3	*1*		*1*	*1*	*1*		*1*	*1*	*1*	*1*
Red-breasted Swallow	*Cecropis semirufa*			0.5										
Burchell's Coucal	*Centropus burchellii*			0.5										
Pied Kingfisher	*Ceryle rudis*			20.7				*1*		*1*		*1*		
Amethyst Sunbird	*Chalcomitra amethystina*			47.4			*1*	*1*					*1*	
Kittlitz's Plover	*Charadrius pecuarius*			0.5										
Three-banded Plover	*Charadrius tricollaris*			15.0	*1*	*1*		*1*		*1*		*1*		
Spike-heeled Lark	*Chersomanes albofasciata*			24.4	*1*	*1*	*1*	*1*	*1*	*1*		*1*	*1*	*1*
Whiskered Tern	*Chlidonias hybrida*			38.0	*1*		*1*	*1*			*1*	*1*	*1*	
White-winged Tern	*Chlidonias leucopterus*			1.4				*1*	*1*					
Olive Bush-shrike	*Chlorophoneus olivaceus*			1.4			*1*							
Orange-breasted Bushshrike	*Chlorophoneus sulfureopectus*			0.9										
Grey-headed Gull	*Chroicocephalus cirrocephalus*			1.4										
Diederik Cuckoo	*Chrysococcyx caprius*			40.4			*1*	*1*				*1*		
Klaas's Cuckoo	*Chrysococcyx klaas*			3.3										
White Stork	*Ciconia ciconia*		61	12.7				*1*						
Violet-backed Starling	*Cinnyricinclus leucogaster*			3.3										
Brown Snake Eagle	*Circaetus cinereus*		92	4.2	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Black-chested Snake Eagle	*Circaetus pectoralis*		60	3.8	*1*	*1*	*1*	*1*	*1*	*1*	*1*		*1*	*1*
Western Marsh Harrier	*Circus aeruginosus*											*1*		*1*

Montagu's Harrier	*Circus pygargus*			0.9										
Lazy Cisticola	*Cisticola aberrans*			24.4	*1*		*1*	*1*	*1*		*1*	*1*	*1*	
Wing-snapping Cisticola	*Cisticola ayresii*			51.6	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Rattling Cisticola	*Cisticola chiniana*			0.5										
Pale-crowned Cisticola	*Cisticola cinnamomeus*			21.1			*1*	*1*					*1*	*1*
Neddicky	*Cisticola fulvicapilla*			31.5	*1*	*1*	*1*	*1*		*1*	*1*	*1*	*1*	*1*
Zitting Cisticola	*Cisticola juncidis*			61.5	*1*	*1*	*1*	*1*	*1*		*1*	*1*	*1*	
Wailing Cisticola	*Cisticola lais*			16.4		*1*	*1*	*1*					*1*	
Croaking Cisticola	*Cisticola natalensis*			1.4										
Levaillant's Cisticola	*Cisticola tinniens*			84.5	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Lesser Spotted Eagle	*Clanga pomarina*		104									*1*		
Speckled Mousebird	*Colius striatus*			55.4	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
African Olive Pigeon	*Columba arquatrix*			13.6			*1*	*1*		*1*				
Speckled Pigeon	*Columba guinea*			62.4	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Rock Dove	*Columba livia*			5.6	*1*	*1*								
Lilac-breasted Roller	*Coracias caudatus*			0.5										
White-necked Raven	*Corvus albicollis*			0.9							*1*			
Pied Crow	*Corvus albus*			13.1		*1*	*1*	*1*	*1*	*1*		*1*	*1*	
Cape Crow	*Corvus capensis*			27.2	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Malachite Kingfisher	*Corythornis cristatus*			23.5	*1*			*1*		*1*	*1*	*1*		
Cape Robin-chat	*Cossypha caffra*			73.7	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Common Quail	*Coturnix coturnix*			21.1	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Wattled Starling	*Creatophora cinerea*			1.9						*1*				
Corn Crake	*Crex crex*			0.5										
Black-throated Canary	*Crithagra atrogularis*			18.8			*1*	*1*				*1*	*1*	
Yellow Canary	*Crithagra flaviventris*											*1*		
Streaky-headed Seedeater	*Crithagra gularis*			63.8	*1*	*1*	*1*	*1*	*1*	*1*			*1*	

Yellow-fronted Canary	*Crithagra mozambica*			28.6	*1*	*1*	*1*	*1*					*1*	
Brimstone Canary	*Crithagra sulphurata*			0.0		*1*				*1*				
Black Cuckoo	*Cuculus clamosus*			17.8			*1*				*1*	*1*	*1*	
Red-chested Cuckoo	*Cuculus solitarius*			32.9			*1*				*1*	*1*		
Temminck's Courser	*Cursorius temminckii*			0.5	*1*		*1*							
African Palm Swift	*Cypsiurus parvus*			9.4			*1*	*1*					*1*	
Common House Martin	*Delichon urbicum*			10.3				*1*			*1*			
Fulvous Whistling Duck	*Dendrocygna bicolor*			0.9										
White-faced Whistling Duck	*Dendrocygna viduata*			2.8										
Cardinal Woodpecker	*Dendropicos fuscescens*			6.6			*1*				*1*			*1*
Olive Woodpecker	*Dendropicos griseocephalus*			2.3				*1*					*1*	
Fork-tailed Drongo	*Dicrurus adsimilis*			42.7	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	
Black-backed Puffback	*Dryoscopus cubla*			0.9										
Little Egret	*Egretta garzetta*			4.7		*1*	*1*			*1*				
Black-winged Kite	*Elanus caeruleus*		94	50.2	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*		*1*
Cape Bunting	*Emberiza capensis*			9.9	*1*	*1*		*1*	*1*					
Golden-breasted Bunting	*Emberiza flaviventris*			19.2			*1*	*1*	*1*	*1*	*1*		*1*	
Cinnamon-breasted Bunting	*Emberiza tahapisi*			19.7				*1*						
Common Waxbill	*Estrilda astrild*			63.8	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Yellow-crowned Bishop	*Euplectes afer*			24.9		*1*		*1*				*1*	*1*	*1*
White-winged Widowbird	*Euplectes albonotatus*			7.0			*1*	*1*						
Red-collared Widowbird	*Euplectes ardens*			26.3	*1*		*1*	*1*			*1*	*1*	*1*	
Fan-tailed Widowbird	*Euplectes axillaris*			47.4			*1*	*1*		*1*	*1*	*1*	*1*	*1*
Yellow Bishop	*Euplectes capensis*			0.5										
Southern Red Bishop	*Euplectes orix*			85.0	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Long-tailed Widowbird	*Euplectes progne*			77.0	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Southern White-crowned Shrike	*Eurocephalus anguitimens*													*1*

Amur Falcon	*Falco amurensis*		66	25.4				*1*				*1*	*1*	*1*
Lesser Kestrel	*Falco naumanni*		64	0.5										
Peregrine Falcon	*Falco peregrinus*		49	2.8		*1*	*1*							
Greater Kestrel	*Falco rupicoloides*		95	0.0		*1*								
Rock Kestrel	*Falco rupicolus*			2.8		*1*	*1*	*1*						
Eurasian Hobby	*Falco subbuteo*										*1*			
Red-knobbed coot	*Fulica cristata*			67.1	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
African Snipe	*Gallinago nigripennis*			14.6	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	
Common Moorhen	*Gallinula chloropus*			57.3	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Yellow-throated Bush Sparrow	*Gymnoris superciliaris*			9.4										
Brown-hooded Kingfisher	*Halcyon albiventris*			4.2										
African Fish Eagle	*Haliaeetus vocifer*		31	17.8	*1*	*1*	*1*	*1*		*1*	*1*		*1*	
Booted Eagle	*Hieraaetus pennatus*											*1*		
Black-winged Stilt	*Himantopus himantopus*			3.8		*1*				*1*				
White-throated Swallow	*Hirundo albigularis*			63.8	*1*		*1*	*1*	*1*	*1*	*1*	*1*	*1*	
Pearl-breasted Swallow	*Hirundo dimidiata*			0.0		*1*								
Barn Swallow	*Hirundo rustica*			64.8	*1*		*1*	*1*			*1*	*1*	*1*	*1*
Wire-tailed Swallow	*Hirundo smithii*			0.5										
Dark-capped (African) Yellow arbler	*Iduna natalensis*			16.4				*1*			*1*			
Greater Honeyguide	*Indicator indicator*			13.6	*1*	*1*	*1*					*1*		*1*
Lesser Honeyguide	*Indicator minor*			1.9										
African Pygmy Kingfisher	*Ispidina picta*			0.5										
Little Bittern	*Ixobrychus minutus*			24.9										
Red-throated Wryneck	*Jynx ruficollis*			53.1	*1*		*1*	*1*		*1*	*1*	*1*		*1*
African Firefinch	*Lagonosticta rubricata*			7.5	*1*				*1*					
Cape Starling	*Lamprotornis nitens*			1.9										
Southern Boubou	*Laniarius ferrugineus*			50.7	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*

Southern (Common) Fiscal	*Lanius collaris*			95.3	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Red-backed Shrike	*Lanius collurio*			1.9								*1*		
Lesser Grey Shrike	*Lanius minor*			0.9								*1*		
Long-crested Eagle	*Lophaetus occipitalis*		84	4.7			*1*	*1*		*1*	*1*			*1*
Black-collared Barbet	*Lybius torquatus*			26.8	*1*	*1*	*1*	*1*	*1*		*1*		*1*	
Cape Longclaw	*Macronyx capensis*			86.4	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Giant Kingfisher	*Megaceryle maxima*			26.3		*1*	*1*	*1*		*1*				
Southern Black Flycatcher	*Melaenornis pammelaina*			0.5				*1*						
Southern Black Tit	*Melaniparus niger*			0.9										
European Bee-eater	*Merops apiaster*			2.8			*1*				*1*			
White-fronted Bee-eater	*Merops bullockoides*			10.3	*1*	*1*	*1*	*1*	*1*	*1*		*1*	*1*	*1*
Little Bee-eater	*Merops pusillus*			0.9										
Reed Cormorant	*Microcarbo africanus*			75.6	*1*	*1*	*1*	*1*	*1*	*1*	*1*		*1*	*1*
Yellow-billed Kite	*Milvus aegyptius*			2.3				*1*		*1*		*1*	*1*	*1*
Rufous-naped Lark	*Mirafra africana*			39.9	*1*	*1*		*1*		*1*	*1*	*1*	*1*	
Eastern Clapper Lark	*Mirafra fasciolata*			7.0	*1*	*1*	*1*	*1*			*1*			
African Pied Wagtail	*Motacilla aguimp*			2.8										
Cape Wagtail	*Motacilla capensis*			76.5	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Mountain Wagtail	*Motacilla clara*			0.5										
African Dusky Flycatcher	*Muscicapa adusta*			5.6	*1*									
Ashy Flycatcher	*Muscicapa caerulescens*			0.5										
Spotted flycatcher	*Muscicapa striata*			10.3				*1*				*1*		*1*
Ant-eating Chat	*Myrmecocichla formicivora*			68.1	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Mountain Wheatear	*Myrmecocichla monticola*			32.9	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	
Malachite Sunbird	*Nectarinia famosa*			33.8	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Southern Pochard	*Netta erythrophthalma*			12.2						*1*		*1*		
Brubru	*Nilaus afer*			0.5										

Helmeted Guineafowl	*Numida meleagris*			39.4	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Black-crowned Night Heron	*Nycticorax nycticorax*			1.9										
Namaqua Dove	*Oena capensis*			2.8	*1*		*1*			*1*				
Capped Wheatear	*Oenanthe pileata*			5.2	*1*	*1*	*1*			*1*		*1*		
Familiar Chat	*Oenathe familiaris*			9.9		*1*								
Red-winged Starling	*Onychognathus morio*			43.7	*1*	*1*	*1*	*1*	*1*	*1*		*1*	*1*	*1*
Black-headed Oriole	*Oriolus larvatus*			41.8	*1*	*1*	*1*	*1*	*1*	*1*	*1*		*1*	*1*
African Quail-finch	*Ortygospiza atricollis*			37.6	*1*	*1*	*1*	*1*	*1*	*1*	*1*		*1*	
Western Osprey	*Pandion haliaetus*			0.5										
Southern Grey-headed Sparrow	*Passer diffusus*			46.9	*1*	*1*	*1*	*1*						
House Sparrow	*Passer domesticus*			30.0	*1*	*1*	*1*	*1*					*1*	
Cape Sparrow	*Passer melanurus*			51.2	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Coqui Francolin	*Peliperdix coqui*			0.9										
European Honey Buzzard	*Pernis apivorus*			0.9				*1*					*1*	
White-breasted Cormorant	*Phalacrocorax lucidus*			23.0		*1*	*1*				*1*	*1*	*1*	
Green Wood Hoopoe	*Phoeniculus purpureus*			1.9										
Willow Warbler	*Phylloscopus trochilus*			15.5			*1*	*1*					*1*	
African Spoonbill	*Platalea alba*			6.6			*1*		*1*	*1*	*1*	*1*		*1*
Spur-winged Goose	*Plectropterus gambensis*			25.8	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Glossy Ibis	*Plegadis falcinellus*			9.9		*1*	*1*	*1*		*1*	*1*		*1*	
Village Weaver	*Ploceus cucullatus*			12.7							*1*			
Spectacled Weaver	*Ploceus ocularis*			0.5							*1*			
Southern Masked Weaver	*Ploceus velatus*			84.5	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Golden Weaver	*Ploceus xanthops*			0.5										
Great Crested Grebe	*Podiceps cristatus*			1.9										
African Harrier-Hawk	*Polyboroides typus*		85	10.3	*1*	*1*	*1*	*1*						
African (Purple) Swamphen	*Porphyrio madagascariensis*			13.1	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	

Baillon's Crake	*Porzana pusilla*			0.0	*1*									
Black-chested Prinia	*Prinia flavicans*			10.8				*1*		*1*	*1*		*1*	
Tawny-flanked Prinia	*Prinia subflava*			8.0						*1*				*1*
Brown-backed Honeybird	*Prodotiscus regulus*			11.3	*1*	*1*	*1*							
Black Saw-wing	*Psalidoprocne pristoptera*			27.2				*1*						*1*
Natal Spurfowl	*Pternistis natalensis*			25.4	*1*	*1*	*1*	*1*	*1*			*1*	*1*	
Swainson's Spurfowl	*Pternistis swainsonii*			41.8	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Rock Martin	*Ptyonoprogne fuligula*			40.4	*1*	*1*		*1*	*1*	*1*		*1*	*1*	*1*
Dark-capped Bulbul	*Pycnonotus tricolor*			83.1	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Red-billed Quelea	*Quelea quelea*			21.6	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	
African Rail	*Rallus caerulescens*			21.6	*1*		*1*	*1*		*1*	*1*			
Banded Martin	*Riparia cincta*			54.0	*1*			*1*			*1*	*1*	*1*	*1*
Brown-throated Martin	*Riparia paludicola*			40.8	*1*		*1*	*1*	*1*	*1*			*1*	
Sand Martin	*Riparia riparia*			1.4										
Knob-billed Duck	*Sarkidiornis melanotos*											*1*		
Red-chested Flufftail	*Sarothrura rufa*			14.1	*1*	*1*	*1*	*1*	*1*	*1*	*1*		*1*	
African Stonechat	*Saxicola torquatus*			78.4	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Red-winged Francolin	*Scleroptila levaillantii*			34.7	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Hamerkop	*Scopus umbretta*			31.9	*1*	*1*	*1*	*1*		*1*	*1*	*1*	*1*	*1*
Cape Canary	*Serinus canicollis*			70.0	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	
Blue-billed Teal	*Spatula hottentota*			1.9										
Cape Shoveler	*Spatula smithii*			4.7										
Bronze Mannikin	*Spermestes cucullata*			0.5										
Laughing Dove	*Spilopelia senegalensis*			46.0	*1*	*1*		*1*	*1*	*1*		*1*	*1*	*1*
Cape Turtle (Ring-necked) Dove	*Streptopelia capicola*			87.8	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Red-eyed Dove	*Streptopelia semitorquata*			65.3	*1*	*1*	*1*	*1*	*1*		*1*	*1*	*1*	*1*
Common Ostrich	*Struthio camelus*			3.3							*1*			

Little Grebe	*Tachybaptus ruficollis*			70.4	*1*	*1*	*1*	*1*	*1*	*1*		*1*	*1*	*1*
Alpine Swift	*Tachymarptis melba*			10.8	*1*		*1*	*1*	*1*	*1*		*1*		*1*
South African Shelduck	*Tadorna cana*			4.2	*1*	*1*			*1*	*1*			*1*	
Bokmakierie	*Telophorus zeylonus*			84.5	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
African Paradise Flycatcher	*Terpsiphone viridis*			31.0			*1*	*1*			*1*		*1*	
White-backed Duck	*Thalassornis leuconotus*			2.8										
Mocking Cliff Chat	*Thamnolaea cinnamomeiventris*			25.8				*1*	*1*	*1*		*1*	*1*	
African Sacred Ibis	*Threskiornis aethiopicus*			17.4	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*		
Crested Barbet	*Trachyphonus vaillantii*			5.2		*1*	*1*	*1*						
Wood Sandpiper	*Tringa glareola*			6.6				*1*						
Common Greenshank	*Tringa nebularia*			2.8										
Arrow-marked Babbler	*Turdoides jardineii*			0.5										
Kurrichane Thrush	*Turdus libonyana*			24.9					*1*					
Groundscraper Thrush	*Turdus litsitsirupa*			29.1	*1*	*1*		*1*	*1*					
Olive Thrush	*Turdus olivaceus*			11.7	*1*		*1*	*1*		*1*			*1*	
Common (Kurrichane) Buttonquail	*Turnix sylvaticus*			1.9	*1*		*1*		*1*					*1*
Emerald-spotted Wood Dove	*Turtur chalcospilos*			0.5										
Western Barn Owl	*Tyto alba*			0.9										
African Hoopoe	*Upupa africana*			21.6	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Blue Waxbill	*Uraeginthus angolensis*			0.5										
Red-faced Mousebird	*Urocolius indicus*			0.9	*1*									
Blacksmith Lapwing	*Vanellus armatus*			46.5	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Crowned Lapwing	*Vanellus coronatus*			31.9	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Black-winged Lapwing	*Vanellus melanopterus*		97	4.2	*1*	*1*	*1*	*1*	*1*	*1*		*1*		*1*
African Wattled Lapwing	*Vanellus senegallus*			29.1	*1*		*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Dusky Indigobird	*Vidua funerea*												*1*	
Pin-tailed Whydah	*Vidua macroura*			44.1	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*

'1' denotes presence, not abundance.

**Regional Red List status according to Taylor* et al*. 2015 – most recent regional conservation status for species*

**Global Red List status according to IUCN 2022*

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

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

E = Endemic; NE = Near-endemic; SLS = Endemic to South Africa, Lesotho & Swaziland; BNE = Breeding near endemic

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

(This key applies to all following species tables)

Appendix 2. Small Passerine Bird Species Recorded on the Site

	FULL 2 YEARS			S1		S2		S3		S4		S5		S6		S7		S8		S9	
Transect length (km)	**102**			12		12		12		12		9		9		9		9		9	
# Species	**134**			62		68		83		75		41		46		48		59		45	
Common Name	**Birds**	**Records**	**Birds/km**	**Birds**	**Records**	**Birds**	**Records**	**Birds**	**Records**	**Birds**	**Records**	**Birds**	**Records**	**Birds**	**Records**	**Birds**	**Records**	**Birds**	**Records**	**Birds**	**Records**
Southern Red Bishop	**1064**	**80**	**10.431**	279	10	324	13	169	15	45	8	24	6	3	3	32	2	69	13	90	6
Long-tailed Widowbird	**546**	**97**	**5.353**	7	3	271	14	52	13	61	17	22	5	19	7	43	12	45	21	24	4
Cape Longclaw	**428**	**225**	**4.196**	53	21	71	34	50	22	57	32	43	23	24	14	19	13	29	19	37	19
Wing-snapping Cisticola	**420**	**201**	**4.118**	25	12	15	10	76	28	118	56	23	14	11	9	55	27	26	13	50	21
Barn Swallow	**311**	**72**	**3.049**	4	1			86	15	107	19							12	8	75	17
Common Waxbill	**220**	**39**	**2.157**	4	1	9	2	31	5	41	10	46	2			8	1	28	8	12	3
Ring-necked Dove	**206**	**130**	**2.020**	16	9	36	19	26	13	35	25	15	10	13	12	14	13	9	6	4	2
Banded Martin	**187**	**63**	**1.833**					15	7	21	11					4	2	34	16	10	6
African Pipit	**171**	**84**	**1.676**	11	7	40	14	40	16	17	10	3	2	3	3	12	9	34	19	1	1
Levaillant's Cisticola	**137**	**77**	**1.343**	14	5	14	9	15	7	16	10	9	6	8	6	9	6	24	14	18	8
Alpine Swift	**125**	**2**	**1.225**	50	1					75	1										
Cape Canary	**113**	**39**	**1.108**	25	7	5	1	36	12			19	2	6	5	17	9			5	3
Cape Crow	**113**	**25**	**1.108**	35	5	9	6			2	1	6	2	2	1						
Red-capped Lark	**111**	**38**	**1.088**	28	4	37	16	8	5	18	4	13	3			1	1	6	5		
Red-billed Quelea	**107**	**8**	**1.049**	60	1	2	1	5	1	17	2	1	1			10	1			12	1
African Stonechat	**101**	**72**	**0.990**	2	2	19	10	9	7	9	9	11	8	6	4	9	5	16	11	7	6
Fan-tailed Widowbird	**94**	**36**	**0.922**					5	2	5	3					3	2	23	14	33	7
Quailfinch	**92**	**55**	**0.902**	24	12	11	5	20	8	24	20	8	5	1	1					4	4

Zitting Cisticola	**89**	**68**	**0.873**	4	3			15	7	25	24							37	26	8	8
Southern Boubou	**84**	**58**	**0.824**	12	8	7	6	17	11	12	10	17	9	3	2	6	5			5	3
Hadada Ibis	**82**	**45**	**0.804**	11	3	14	9	8	4	6	6			6	6	1	1	31	13	3	2
Southern Masked Weaver	**81**	**29**	**0.794**	13	3	21	6	7	4	2	2	7	2	2	2	8	4	13	5	8	1
Dark-capped Bulbul	**76**	**51**	**0.745**	9	5	9	7	13	7	12	10	2	2	3	3	10	7	8	5	2	1
Ant-eating Chat	**70**	**38**	**0.686**	8	4	17	8	13	6	5	3	1	1	4	3	5	2	5	5	9	5
Blacksmith Lapwing	**65**	**10**	**0.637**	2	1	27	7	29	1	7	1										
Cape White-eye	**64**	**25**	**0.627**	6	2			22	5	4	4			4	2	6	3	6	2	2	1
Spur-winged Goose	**64**	**14**	**0.627**	2	2	48	2	2	1									6	5	3	2
Southern Fiscal	**63**	**56**	**0.618**	10	9	10	9	3	2	8	8	3	3	5	3	2	2	5	4	3	3
Cape Weaver	**62**	**11**	**0.608**	4	2	16	3	9	1					3	3						
Crowned Lapwing	**53**	**14**	**0.520**	20	3	14	4	8	2	4	1			3	2	1	1			3	1
Common Swift	**53**	**2**	**0.520**																		
African Black Swift	**51**	**6**	**0.500**	36	2					15	4										
Cape Robin-Chat	**50**	**48**	**0.490**	5	5	6	6	4	4	4	4	2	2	4	4	6	6	8	7		
Greater Striped Swallow	**48**	**22**	**0.471**	12	2			11	4	14	10					1	1			2	1
Nicholson's Pipit	**47**	**33**	**0.461**	5	4	5	4	14	9	5	4	10	5	4	4	1	1			3	2
Egyptian Goose	**39**	**18**	**0.382**	17	4	10	7	3	2	4	1	4	3	1	1						
Rufous-naped Lark	**38**	**32**	**0.373**			1	1	12	10	7	7			3	3	12	8	2	2	1	1
Pin-tailed Whydah	**37**	**19**	**0.363**					4	3	2	1					2	1	12	8	5	2
Red-eyed Dove	**36**	**31**	**0.353**	2	2	6	6	3	1	3	3	8	7	3	3	1	1	2	2		
Yellow-billed Duck	**36**	**12**	**0.353**	6	2	2	1	14	3	7	3							7	3		
Bokmakierie	**35**	**24**	**0.343**	7	6					3	2	5	3	1	1	2	1	4	3	1	1
Spike-heeled Lark	**35**	**16**	**0.343**	5	2	12	5	5	3	8	4			1	1					4	1
Eastern Long-billed Lark	**30**	**25**	**0.294**			2	2	14	12	6	6					5	3			3	2
African Wattled Lapwing	**30**	**9**	**0.294**					2	1	3	1			3	2			22	5		
Cape Wagtail	**28**	**26**	**0.275**	3	3	6	5	1	1	4	4	3	2	2	2	4	4	3	3	2	2

White-throated Swallow	**23**	**16**	**0.225**					4	2	2	2	2	1	2	2	1	1	3	3	9	5
Capped Wheatear	**22**	**12**	**0.216**			19	10	2	1					1	1						
Cape Sparrow	**22**	**11**	**0.216**	1	1	4	1	8	2	4	3			4	3						
Black-winged Lapwing	**22**	**8**	**0.216**	1	1	11	5	10	2												
Bar-throated Apalis	**21**	**18**	**0.206**	2	2	4	3	3	3	3	3	5	3	2	2			2	2		
Common Quail	**20**	**16**	**0.196**					6	5	2	2			2	1	2	2	4	4		
African Olive Pigeon	**20**	**1**	**0.196**											20	1						
Red-winged Francolin	**19**	**12**	**0.186**			5	2			2	2	6	3							3	3
Streaky-headed Seedeater	**19**	**12**	**0.186**	7	4	1	1	5	3	6	4										
Black-headed Heron	**18**	**15**	**0.176**			5	4			2	2			1	1	3	2	5	5	2	1
White-fronted Bee-eater	**18**	**2**	**0.176**									8	1							10	1
Speckled Pigeon	**17**	**9**	**0.167**			1	1			10	3	2	2	1	1	2	1	1	1		
Red-chested Flufftail	**17**	**7**	**0.167**	11	2	1	1			1	1	1	1	1	1	2	1				
Fork-tailed Drongo	**16**	**10**	**0.157**			1	1	9	4	2	2	4	3								
Yellow-crowned Bishop	**16**	**7**	**0.157**							8	3							8	4		
African Snipe	**15**	**7**	**0.147**	4	1	1	1	5	2	3	1					1	1	1	1		
Black-headed Oriole	**14**	**14**	**0.137**	1	1	2	2	3	3	1	1	3	3	2	2	1	1			1	1
Drakensberg Prinia	**14**	**13**	**0.137**	3	3	3	3	1	1	4	4	1	1			2	1				
Whiskered Tern	**14**	**5**	**0.137**					6	2	5	1							3	2		
Red-chested Cuckoo	**12**	**11**	**0.118**					6	6							1	1	5	4		
Red-throated Wryneck	**12**	**11**	**0.118**	2	2	2	2			1	1	2	2			1	1	2	2	2	1
Mountain Wheatear	**12**	**9**	**0.118**	2	1	2	2	1	1	1	1	1	1			2	1			3	2
Swainson's Spurfowl	**12**	**9**	**0.118**	7	4	2	2					2	2			1	1				
Red-knobbed Coot	**12**	**5**	**0.118**	3	2	2	1			7	2										
African Hoopoe	**11**	**8**	**0.108**	2	2	3	2	2	1									4	3		
Pied Starling	**11**	**5**	**0.108**	4	1			2	1									5	3		
Yellow Canary	**11**	**2**	**0.108**															11	2		

Pale-crowned Cisticola	**9**	**7**	**0.088**					1	1	2	2									4	3
Buff-streaked Chat	**9**	**6**	**0.088**	4	2	3	2	1	1					1	1						
Little Grebe	**9**	**6**	**0.088**	2	2	2	1	1	1	4	2										
African Sacred Ibis	**9**	**3**	**0.088**			2	1	7	2												
Reed Cormorant	**9**	**2**	**0.088**	8	1	1	1														
Neddicky	**8**	**7**	**0.078**	1	1			1	1	2	2							4	3		
Intermediate Egret	**8**	**5**	**0.078**			4	3	3	1	1	1										
Black Cuckoo	**7**	**7**	**0.069**					4	4									3	3		
Olive Thrush	**7**	**6**	**0.069**					6	5											1	1
African Swamphen	**7**	**5**	**0.069**			4	3	2	1	1	1										
Fiscal Flycatcher	**7**	**5**	**0.069**	1	1	3	2					1	1								
Malachite Sunbird	**7**	**5**	**0.069**					3	2					1	1			1	1		
Diederik Cuckoo	**6**	**6**	**0.059**					2	2									4	4		
Plain-backed Pipit	**6**	**5**	**0.059**			5	4											1	1		
Tawny-flanked Prinia	**6**	**5**	**0.059**											3	3						
Black-chested Prinia	**6**	**4**	**0.059**							1	1					5	3				
Golden-breasted Bunting	**6**	**3**	**0.059**					2	1	2	1					2	1				
Cape Grassbird	**5**	**5**	**0.049**					1	1			1	1	2	2					1	1
Willow Warbler	**5**	**5**	**0.049**					1	1	3	3									1	1
Spotted Flycatcher	**5**	**4**	**0.049**							2	2							2	1		
Lesser Swamp Warbler	**4**	**3**	**0.039**	2	1	1	1														
Black-collared Barbet	**4**	**2**	**0.039**			4	2														
Black-throated Canary	**4**	**2**	**0.039**															4	2		
Cardinal Woodpecker	**4**	**2**	**0.039**													3	1				
Groundscraper Thrush	**4**	**2**	**0.039**	2	1							2	1								
Lazy Cisticola	**4**	**2**	**0.039**			2	1									2	1				
South African Cliff Swallow	**4**	**2**	**0.039**	2	1					2	1										

Buffy Pipit	**3**	**3**	**0.029**			2	2											1	1		
Common Moorhen	**3**	**3**	**0.029**			2	2	1	1												
Grey-backed Cisticola	**3**	**3**	**0.029**															3	3		
Little Rush Warbler	**3**	**3**	**0.029**					1	1	1	1							1	1		
African Firefinch	**3**	**2**	**0.029**									1	1	2	1						
Brown-throated Martin	**3**	**2**	**0.029**	1	1									2	1						
Glossy Ibis	**3**	**2**	**0.029**					3	2												
Pied Crow	**3**	**2**	**0.029**					2	1					1	1						
Three-banded Plover	**3**	**2**	**0.029**			2	1			1	1										
Western Cattle Egret	**3**	**2**	**0.029**					1	1									2	1		
Malachite Kingfisher	**3**	**1**	**0.029**					3	1												
Red-necked Spurfowl	**3**	**1**	**0.029**																		
African Dusky Flycatcher	**2**	**2**	**0.020**															2	2		
African Paradise Flycatcher	**2**	**2**	**0.020**					2	2												
Black Saw-wing	**2**	**2**	**0.020**																		
Common Buttonquail	**2**	**2**	**0.020**					1	1												
Eastern Clapper Lark	**2**	**2**	**0.020**													2	2				
Greater Honeyguide	**2**	**2**	**0.020**			1	1	1	1												
European Bee-eater	**2**	**1**	**0.020**					2	1												
Lesser Striped Swallow	**2**	**1**	**0.020**															2	1		
Ruddy Turnstone	**2**	**1**	**0.020**			2	1														
Spotted Thick-knee	**2**	**1**	**0.020**					2	1												
White-throated Bee-eater	**2**	**1**	**0.020**															2	1		
African Spoonbill	**1**	**1**	**0.010**															1	1		
Black Sparrowhawk	**1**	**1**	**0.010**					1	1												
Cloud Cisticola	**1**	**1**	**0.010**							1	1										
Lesser Grey Shrike	**1**	**1**	**0.010**															1	1		

Marico Flycatcher	**1**	**1**	**0.010**															1	1		
Olive Bushshrike	**1**	**1**	**0.010**					1	1												
Purple Heron	**1**	**1**	**0.010**							1	1										
Red-billed Teal	**1**	**1**	**0.010**							1	1										
Southern Grey-headed Sparrow	**1**	**1**	**0.010**	1	1																
Wailing Cisticola	**1**	**1**	**0.010**							1	1										
White-rumped Swift	**1**	**1**	**0.010**																	1	1
Cape Batis	**1**	**1**	**0.000**			1	1														

Appendix 3. Large Terrestrial & Raptor Data from Drive Transects

	FULL 2 YEARS			S1		S2		S3		S4		S5		S6		S7		S8		S9		S10	
Transect length (km)	400			40		40		40		40		40		40		40		40		40		40	
# Species	23			4		3		7		6		6		3		6		7		6		7	
Common Name	**Birds**	**Records**	**Birds/km**	**Birds**	**Records**	**Birds**	**Records**	**Birds**	**Records**	**Birds**	**Records**	**Birds**	**Records**	**Birds**	**Records**	**Birds**	**Records**	**Birds**	**Records**	**Birds**	**Records**	**Birds**	**Records**
Amur Falcon	**90**	**26**	**0.225**							29	11									53	12	8	3
Cape Vulture	**36**	**9**	**0.090**					2	2	1	1	8	2					1	1	15	1	9	2
Black-winged Kite	**12**	**10**	**0.030**			1	1	1	1	1	1	1	1			3	3	2	1	2	1	1	1
Southern Bald Ibis	**12**	**6**	**0.030**					4	3					6	1	1	1	1	1				
Common Buzzard	**11**	**11**	**0.028**					2	2	4	4							1	1	4	4		
South African Shelduck	**10**	**3**	**0.025**									2	1	8	2								
Grey-crowned Crane	**6**	**2**	**0.015**					2	1			4	1										
Brown Snake Eagle	**5**	**4**	**0.013**			1	1			1	1			1	1	2	1						
Black-chested Snake Eagle	**4**	**4**	**0.010**	1	1					1	1					1	1			1	1		
Jackal Buzzard	**4**	**3**	**0.010**	1	1													1	1			2	1
Forest Buzzard	**3**	**3**	**0.008**															2	2			1	1
Black-headed Heron	**2**	**2**	**0.005**													2	2						
Secretarybird	**2**	**1**	**0.005**									2	1										
Wattled Crane	**2**	**2**	**0.005**	1	1	1	1																
White-backed Vulture	**2**	**1**	**0.005**	2	1																		
African Fish Eagle	**1**	**1**	**0.003**													1	1						
African Sparrowhawk	**1**	**1**	**0.003**					1	1														
Black Sparrowhawk	**1**	**1**	**0.003**									1	1										

Booted Eagle	**1**	**1**	**0.003**															1	1				
Lanner Falcon	**1**	**1**	**0.003**																			1	1
Long-crested Eagle	**1**	**1**	**0.003**																			1	1
Peregrine Falcon	**1**	**1**	**0.003**					1	1														
Rufous-breasted Sparrowhawk	**1**	**1**	**0.003**																	1	1		

Appendix 4. Focal Site Photographs

Example of a Focal Site dam on site

FS 6: Southern Bald Ibis roost on site

Appendix 5. Incidental Observation Data

	FULL 2 YEARS		S1		S2		S3		S4		S5		S6		S7		S8		S9		S10	
# Species	35		19		12		13		19		13		11		9		14		12		14	
Common Name	**Birds**	**Records**	**Birds**	**Records**	**Birds**	**Records**	**Birds**	**Records**	**Birds**	**Records**	**Birds**	**Records**	**Birds**	**Records**	**Birds**	**Records**	**Birds**	**Records**	**Birds**	**Records**	**Birds**	**Records**
Cape Vulture	**292**	**44**	5	3	28	3	9	2	101	15	69	7			3	1			70	12	7	1
Common Buzzard	**179**	**17**					2	2	167	7					2	2			6	4	2	2
Southern Bald Ibis	**148**	**21**	12	2	1	1	4	2	3	1			24	5	19	3	20	3	56	2	9	2
Amur Falcon	**103**	**10**							21	6							1	1	11	2	70	1
Red-winged Francolin	**82**	**37**	3	3	1	1	11	6	11	6	16	8	30	8	8	3	2	2				
White-bellied Bustard	**69**	**29**	9	3	4	2	10	4	10	5	2	1	13	5	11	5			2	1	8	3
Black-winged Kite	**37**	**32**	1	1	2	2	3	2	1	1	3	3	9	8	3	3	3	2	6	5	6	5
Grey-winged Francolin	**30**	**9**									2	1	8	2			7	3	4	2	9	1
Blue Crane	**19**	**9**					6	3	3	1					4	2	4	2	2	1		
Lanner Falcon	**16**	**7**	2	1					2	1	4	2							7	2	1	1
Secretarybird	**14**	**12**	1	1	1	1	5	4	5	4	1	1					1	1				
Brown Snake Eagle	**13**	**11**			1	1	1	1	4	2	1	1					4	4	1	1	1	1
Jackal Buzzard	**11**	**11**	1	1	1	1	1	1	1	1	4	4					1	1			2	2
Black Sparrowhawk	**10**	**7**	3	2					2	1			1	1	2	1			1	1	1	1
Grey Crowned Crane	**10**	**3**									6	2	4	1								
Hamerkop	**10**	**5**	1	1	2	2			6	1			1	1								
Black-rumped Buttonquail	**9**	**8**	2	1					5	5	1	1							1	1		
Lesser Spotted Eagle	**9**	**2**															9	2				
Blue Korhaan	**7**	**3**	3	1					4	2												
South African Shelduck	**6**	**3**	2	1	2	1					2	1										

Wattled Crane	**6**	**6**			1	1	1	1	1	1	2	2									1	1
Spotted Eagle-Owl	**4**	**4**	1	1													2	2			1	1
Denham's Bustard	**3**	**2**	1	1	2	1																
Forest Buzzard	**3**	**3**															1	1			2	2
Temminck's Courser	**3**	**2**	2	1			1	1														
African Marsh Harrier	**2**	**1**											2	1								
Marsh Owl	**2**	**2**	1	1					1	1												
Yellow-billed Kite	**2**	**2**							1	1			1	1								
African Goshawk	**1**	**1**					1	1														
African Harrier Hawk	**1**	**1**	1	1																		
Black-chested Snake Eagle	**1**	**1**	1	1																		
Cape Eagle-Owl	**1**	**1**															1	1				
Eurasian Hobby	**1**	**1**													1	1						
Long-crested Eagle	**1**	**1**											1	1								
Western Marsh Harrier	**1**	**1**															1	1				

Appendix 6. Bird Flight Activity Data

	FULL 2 YEARS			S1		S2		S3		S4		S5		S6		S7		S8		S9		
Number of hours	**768**			**84**		**84**		**84**		**84**		**72**		**72**		**72**		**72**		**72**		
# Species	**32**			**14**		**11**		**15**		**18**		**11**		**14**		**15**		**13**		**13**		
Common Name	**Birds**	**Records**	**Birds/hr**	**Birds**	**Records**	**Birds**	**Records**	**Birds**	**Records**	**Birds**	**Records**	**Birds**	**Records**	**Birds**	**Records**	**Birds**	**Records**	**Birds**	**Records**	**Birds**	**Records**	**Birds**
Cape Vulture	554	224	0.721	66	12	35	12	27	16	79	42	34	18	34	16	34	11	50	14	141	65	54
Common Buzzard	342	67	0.445					7	7	72	27					7	6	2	2	254	25	
Black-winged Kite	114	105	0.148	4	4	8	8	7	7	13	13	7	7	9	8	12	12	31	28	3	2	20
Amur Falcon	102	38	0.133							31	7							12	2			59
Southern Bald Ibis	75	33	0.098			7	1	3	2	9	6	14	3	8	3	5	2	25	12	2	2	2
Black-chested Snake Eagle	44	42	0.057	1	1			3	3	3	3			3	3	1	1			11	10	22
Blue Crane	38	11	0.049					8	3							9	3	2	1	6	3	13
White-bellied Bustard	32	17	0.042	3	2	3	2	3	2	9	5	3	1	7	3	2	1					2
Black Sparrowhawk	25	25	0.033	5	5	1	1	3	3			1	1	7	7	5	5	1	1	2	2	
Jackal Buzzard	24	21	0.031	5	4			3	3	2	2	1	1	1	1	3	2	4	4	1	1	4
Lanner Falcon	24	19	0.031	1	1	1	1	4	2	3	2	2	1	1	1	1	1	1	1	4	4	6
Brown Snake Eagle	21	21	0.027	1	1			3	3	9	9	5	5	1	1							2
Marsh Owl	13	8	0.017	6	4			1	1			1	1									5
Hamerkop	9	9	0.012			2	2	2	2	2	2			1	1	2	2					
White-backed Vulture	9	5	0.012	9	5																	
White Stork	7	3	0.009							2	2											5
African Harrier-hawk	6	5	0.008	1	1			5	4													
European Honey Buzzard	6	6	0.008							4	4									2	2	

Long-crested Eagle	6	6	0.008							1	1					1	1					4
Secretarybird	6	5	0.008					1	1	1	1			2	1					2	2	
Denham's Bustard	5	3	0.007	1	1	3	1							1	1							
Martial Eagle	5	5	0.007			1	1			1	1	1	1	1	1					1	1	
Wattled Crane	5	5	0.007											1	1	3	3	1	1			
Yellow-billed Kite	5	4	0.007							2	2							1	1			2
African Fish Eagle	4	4	0.005													4	4					
Peregrine Falcon	4	3	0.005			1	1											3	2			
South African Shelduck	4	2	0.005	2	1							2	1									
Western Marsh Harrier	3	3	0.004															1	1			2
Crowned Eagle	2	2	0.003							1	1					1	1					
Pallid Harrier	2	2	0.003																	2	2	
African Goshawk	1	1	0.001	1	1																	
Greater Kestrel	1	1	0.001			1	1															

Appendix 7. Site sensitivity verification report.

Government Notice No. 320, dated 20 March 2020, includes the requirement that an Initial Site Sensitivity Verification Report must be produced for a development footprint. As per Part 1, Section 2.3, the outcome of the Initial Site Verification must be recorded in the form of a report that-

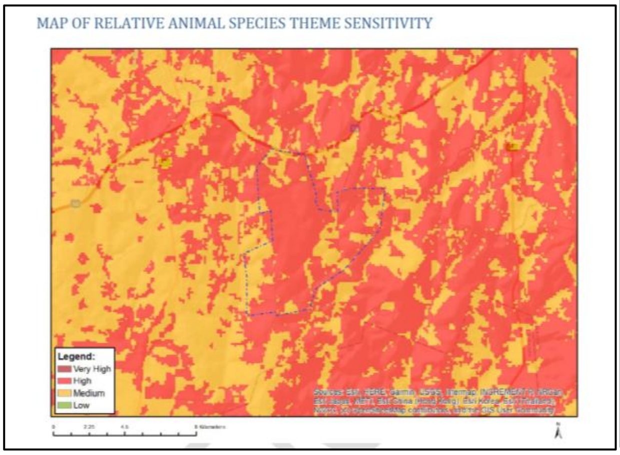
(a) Confirms or disputes the current use of the land and environmental sensitivity as identified by the national web based environmental screening tool;
(b) Contains a motivation and evidence of either the verified or different use of the land and environmental sensitivity;
(c) Is submitted together with the relevant reports prepared in accordance with the requirements of the Environmental Impact Assessment Regulations.

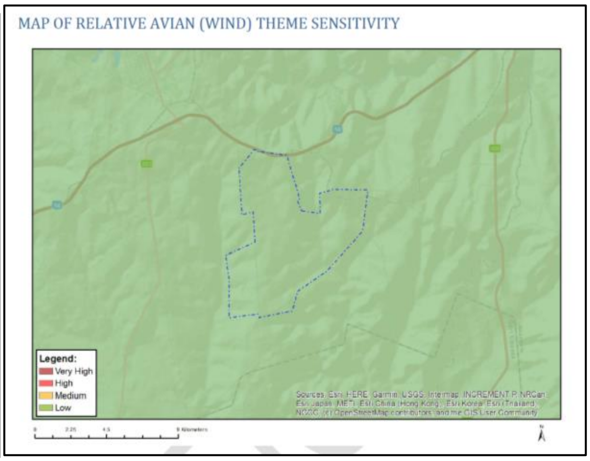
This report has been produced specifically to consider the avian theme and addresses the content requirements of (a) and (b) above.

The DFFE Screening Tool – classifies the site as follows:

<u>Dalmanutha North</u>

a. Animal theme – High. Mostly bird species are listed, including: Black-rumped Buttonquail; Southern Bald Ibis; Secretarybird; Wattled Crane; Denham's Bustard; Yellow-breasted Pipit; African Marsh-Harrier; and White-winged Flufftail.
b. Avian Theme – Low.
c. Terrestrial Biodiversity theme – Very high. Based on CBA1 and CBA2 and ESA areas.





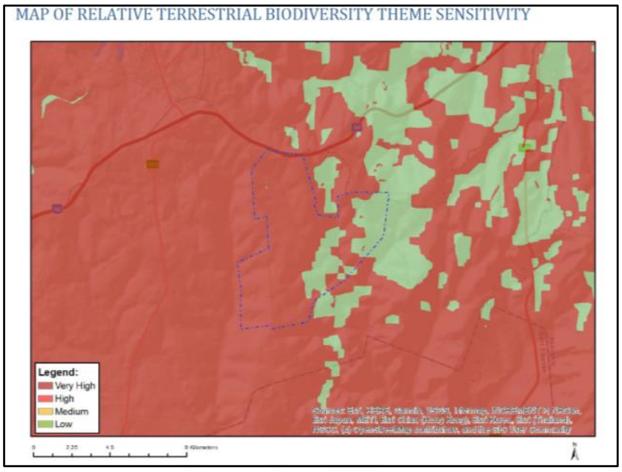


Figure 1. DFFE Screening Tool outcome for the three themes.

<u>Dalmanutha South</u>

d. Animal theme – High. Mostly bird species are listed, including: Bush Blackcap; Southern Bald Ibis; Black-rumped Buttonquail;; Denham's Bustard; Wattled Crane; Yellow-breasted Pipit; African Marsh-Harrier; and Secretarybird.

e. Avian Theme – Low.

f. Terrestrial Biodiversity theme – Very high. Based on CBA1 and CBA2 and ESA areas.

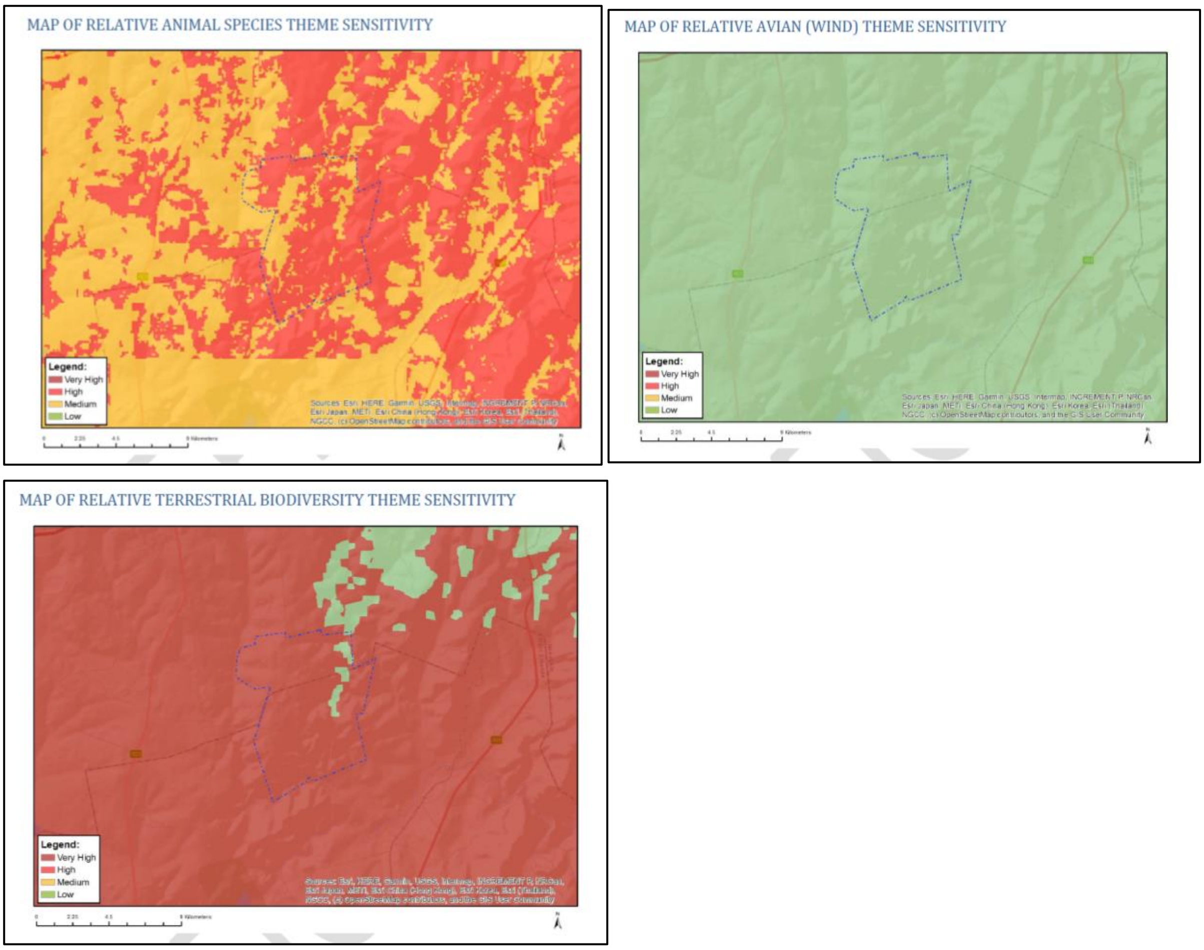


Figure 2. DFFE Screening Tool outcome for the three themes.

Our work on site confirms that the site is of High sensitivity for avifauna. We have confirmed the presence of most of the above listed bird species on site, exceptions being White-winged Flufftail.

Appendix 8. Stakeholder bird data input

From: Geoff Lockwood <geofflockwood609@gmail.com>
Sent: Friday, March 25, 2022 3:33:57 PM
To: Michael Barnes <Michael.Barnes@enertrag.co.za>
Subject: Re: Dalmanutha - ecology site visits

Good afternoon Michael

My apologies for taking so long to get back to you. I've been neck-deep in renovations! You are more than welcome to pass my contact details on to the specialists.

We were at the farm over New Year, and again in mid-February and had a number of Red Data bird sightings - including a Wattled Crane and a pair of White-bellied Bustards on the February visit. I have prepared a map of all sightings of the relevant species over the past 12 years for your information. We have tended to concentrate on the valley to the south of the Bergendal War Memorial and most of the sightings are from this area.

As you will see, there are four significant concerns:

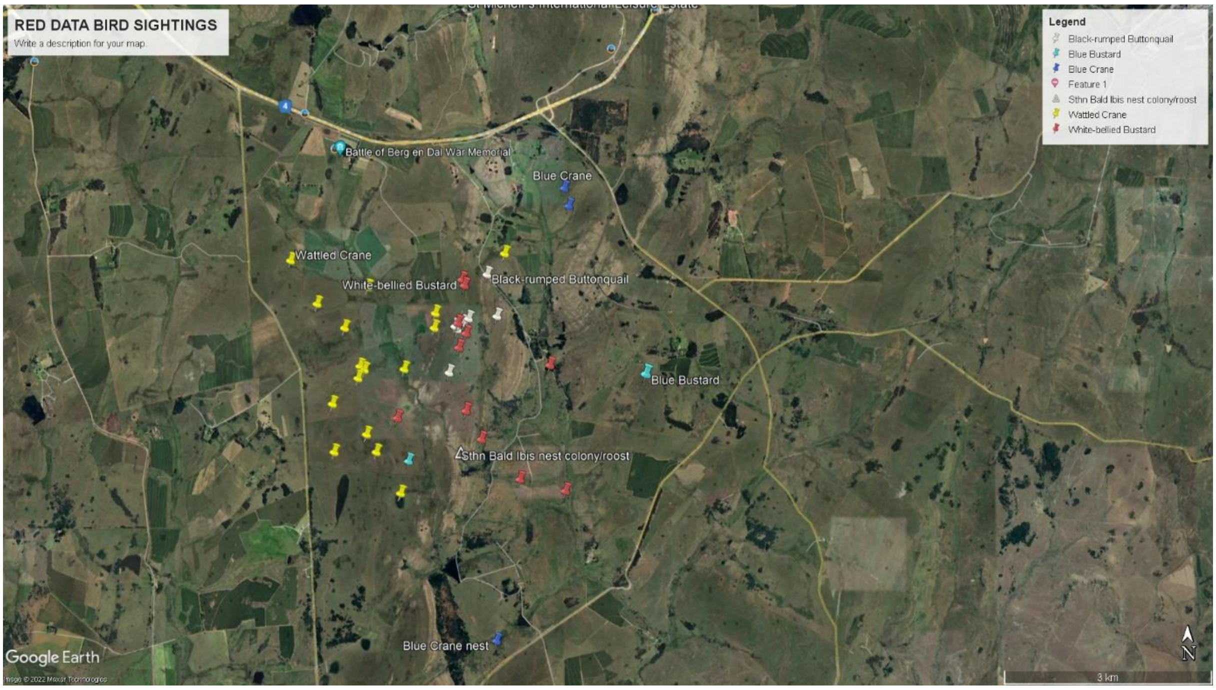
1. Over the past 8 years we have been regularly recording Wattled Cranes (up to 4 birds on one occasion) in the valley. At least some of the sightings are almost certainly of the birds from Lakenvlei but they have been joined by birds of unknown origin on several occasions. **THE VALLEY IS CLEARLY AN IMPORTANT FEEDING AREA FOR THESE BIRDS**
2. There is a small Southern Bald Ibis nesting colony at the site indicated. The highest number of roosting birds recorded has been 18, with up to 5 active nests.
3. We have recorded Yellow-breasted Pipit on three occasions
4. We have had fairly regular sightings of Black-rumped Buttonquail, Secretarybirds and White-bellied Bustard in the area

Added to this is the fact that sightings of Cape Vultures overhead have increased significantly in the last 15 years, with at least 43 birds roosting on the Dalmanutha power pylons and then heading north up the valley six or seven years ago.

Taken together, I would class the valley as extremely sensitive from an avifaunal perspective!

I am busy with a similar map showing the distribution of a number of orchid species on the site and will share this with you and the specialists when this is complete.

Kind regards
Geoff Lockwood - Resident Manager, Delta Environmental Centre


RED DATA BIRD SIGHTINGS
Write a description for your map.
Legend
Black-rumped Buttonquail
Blue Bustard
Blue Crane
Feature 1
Sthn Bald Ibis nest colony/roost
Wattled Crane
White-bellied Bustard
Battle of Berg en Dal War Memorial
Blue Crane
Wattled Crane
White-bellied Bustard
Black-rumped Buttonquail
Blue Bustard
Sthn Bald Ibis nest colony/roost
Blue Crane nest
Google Earth
Image © 2022 Maxar Technologies
3 km
N

Appendix 9. Specialist CV

JONATHAN JAMES SMALLIE

WildSkies Ecological Services (2011/131435/07)

Curriculum Vitae

Background

Date of birth: 20 October 1975

Qualifications: BSC – Agriculture (Hons) (completed 1998)

University of Natal – Pietermaritzburg

MSC – Environmental Science (completed 2011)

University of Witwaterstrand

Occupation: Specialist avifaunal consultant

Profession registration: South African Council for Natural Scientific Professions

Contact details

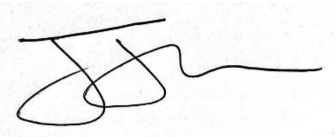
Cell number: 082 444 8919

Fax: 086 615 5654

Email: jon@wildskies.co.za

Postal: 36 Utrecht Avenue, Bonnie Doon, East London, 5210

ID #: 7510205119085



Professional experience

IFC PS6 experience:

Amakhala Emoyeni Wind Farm – in collaboration with Simon Hulka (IFC) designed and implemented an operational phase monitoring programme and Biodiversity Monitoring & Mitigation Plan; Golden Valley Wind Farm – in collaboration with Leon Bennun (The Biodiversity Consultancy - TBC) compiled a Critical Habitat Assessment and Biodiversity Action Plan for the wind farm; Jeffrey's Bay Wind Farm – in collaboration with TBC compiled a Biodiversity Management Plan for the wind farm.

Renewable energy:

Post construction bird monitoring for wind energy facilities:

Dassieklip (Caledon) –initiated in April 2014 (2yrs); Dorper Wind Farm (Molteno) – initiated in July 2014 (5yrs); Jeffreys Bay Wind Farm – initiated in August 2014 (4yrs); Kouga Wind Farm – started Feb 2015 (2yrs); Cookhouse Wind Farm – started March 2015 (1yr); Grassridge Wind Farm – initiated in April 2015 (2yrs); Chaba Wind Farm – initiated December 2015 (1yr); Amakhala Emoyeni 01 Wind Farm initiated August 2016 (5yrs) – IFC funded project; Gibson Bay Wind Farm – initiated March 2017 (4yrs); Nojoli Wind Farm initiated March 2017 (4yrs); Sere Wind Farm (2yrs); Golden Valley Wind Farm (started Sep 2021 – 1 yr).

Pre-construction bird monitoring & EIA for wind energy facilities:
Golden Valley 1; Middleton; Dorper; Qumbu; Ncora; Nqamakhwe; Ndakana; Thomas River; Peddie; Mossel Bay; Hluhluwe; Richards Bay; Garob; Outeniqua; Castle; Wolf; Inyanda-Roodeplaat; Dassiesridge; Great Kei; Bayview; Grahamstown; Bakenskop; Umsobomvu; Stormberg; Zingesele; Oasis; Gunstfontein; Naumanii; Golden Valley Phase 2; Ngxwabangu; Hlobo; Woodstock; Scarlet Ibis; Albany; Golden Valley 1 2nd monitoring; Umtathi Emoyeni; Serenje Zambia; Unika 1 Zambia; Impofu East, West, and North; Nuweveld East, West and North; Elands Wind Farm; Ingwe Wind Farm; Hoogland Wind Farm; Cradock Wind Farm Cluster; Canyon Springs Wind Farm; Loxton Wind Farm; Taaibos Wind Farm; Aberdeen Wind Farm.

Screening studies for wind energy facilities:
Tarkastad Wind Farm; Quanti Wind Farm; Ruitjies Wind Farm; Beaufort West Wind Farm; Success Wind Farm; Cradock Wind Farm; Britstown Wind Farm; Clanwilliam Wind Farm; Ebenhezer Wind Farm.

Avifaunal walk through for wind energy facilities:
Garob Wind Farm; Golden Valley 1 wind farm; Nxuba Wind Farm.

Pre-construction bird monitoring and EIA for Solar energy facilities:
Bonnievale Solar Energy Facility; Dealesville Solar Energy Facility; Rooipunt Solar Energy Facility; De Aar Solar Energy Facility; Noupoort Solar Energy Facility, Aggeneys Solar Energy Facility; Eskom Concentrated Solar Power Plant; Bronkhorstspruit Solar Photovoltaic Plant; De Aar Solar Energy Facility; Paulputs Solar Energy Facility; Kenhardt Solar Energy Facility; Wheatlands Solar Energy Facility; Nampower CSP project; Dwaalboom PV; Slurry PV; De Hoek PV; Suikerbekkie PV; Springhaas PV.

Other Electricity Generation:
Port of Nqura Power Barge EIA; Tugela Hydro-Electric Scheme; Mmamabula West Coal Power Station (Botswana).

Electricity transmission & distribution:
Overhead transmission power lines (>132 000 kilovolts):
Oranjemund Gromis 220kv; Perseus Gamma 765kv; Aries Kronos 765kv; Aries Helios 765kv; Perseus Kronos 765kv; Helios Juno 765kv; Borutho Nzelele 400kv; Foskor Merensky 275kv; Kimberley Strengthening; Mercury Perseus 400kV; Eros Neptune Grassridge 400kV; Kudu Juno 400kV; Garona Aries 400kV; Perseus Hydra 765Kv; Tabor Witkop 275kV; Tabor Spencer 400kV; Moropule Orapa 220kV (Botswana); Coega Electrification; Majuba Venus 765kV; Gamma Grassridge 765kV; Gourikwa Proteus

400KV; Koeberg Strengthening 400kV; Ariadne Eros 400kV; Hydra Gamma 765kV; Zizabona transmission – Botswana; Maphutha Witkop 400kv; Makala B 400kv; Aggeneis Paulputs 400kv; Northern Alignment 765kv; Kappa Omega 765kv; Isundu 400kv and Substation; Senakangwedi B Integration; Oranjemund Gromis;

Overhead distribution power lines (<132 000 kilovolts):
Kanoneiland 22KV; Hydra Gamma 765kV; Komani Manzana 132kV; Rockdale Middelburg 132kV; Irenedale 132 kV; Zandfontein 132kV; Venulu Makonde 132 kV; Spencer Makonde 132 kV; Dalkeith Jackal Creek 132Kv; Glen Austin 88kV; Bulgerivier 132kV; Ottawa Tongaat 132kV; Disselfontein 132kV; Voorspoed Mine 132kV; Wonderfontein 132kV; Kabokweni Hlau Hlau 132kV; Hazyview Kiepersol 132kV; Mayfern Delta 132kV; VAAL Vresap 88kV; Arthursview Modderkuil 88kV; Orapa, AK6, Lethakane substations and 66kV lines (Botswana); Dagbreek Hermon 66kV; Uitkoms Majuba 88kV; Pilanesberg Spitskop 132kV; Qumbu PG Bison 132kV; Louis Trichardt Venetia 132kV; Rockdale Middelburg Ferrochrome 132kV; New Continental Cement 132KV; Hillside 88kV; Marathon Delta 132kV; Malelane Boulder 132kV; Nondela Strengthening 132kV; Spitskop Northern Plats 132kV; West Acres Mataffin 132kV; Westgate Tarlton Kromdraai 132kV; Sappi Elliot Ugie 132kV; Melkhout Thyspunt 132kV; St Francis Bay 66kv; Etna Ennerdale 88kv; Kroonstad 66kv; Firham Platrand; Paradise Fondwe 132kv; Kraal Mafube 132kv; Loeriesfontein 132kv; Albany Mimosa 66kv; Zimanga 132kv; Grootpan Brakfontein; Mandini Mangethe; Valkfontein Substation; Sishen Saldanha; Corinth Mzongwana 132kv; Franklin Vlei 22kv; Simmerpan Strengthening; Ilanga Lethemba 132kv; Cuprum Burchell Mooidraai 132; Oliphantskop Grassridge 132;

Risk Assessments on existing power lines:
Hydra-Droerivier 1,2 & 3 400kV; Hydra-Poseidon 1,2 400kV; Butterworth Ncora 66kV; Nieu-Bethesda 22kV; Maclear 22kV (Joelshoek Valley Project); Wodehouse 22kV (Dordrecht district); Burgersdorp Aliwal North Jamestown 22kV; Cradock 22kV; Colesberg area 22kV; Loxton self build 11kV; Kanoneiland 22kV; Stutterheim Municipality 22kV; Majuba-Venus 400kV; Chivelston-Mersey 400kV; Marathon-Prairie 275kV; Delphi-Neptune 400kV; Ingagane – Bloukrans 275kV; Ingagane – Danskraal 275kV; Danskraal – Bloukrans 275kV

Avifaunal “walk through” (EMP’s):
Kappa Omega 765kv; Rockdale Marble Hall 400kv*;* Beta Delphi 400kV; Mercury Perseus 765kV; Perseus 765kV Substation; Beta Turn 765kV in lines; Spencer Tabor 400kV line; Kabokweni Hlau Hlau 132kV; Mayfern Delta 132Kv; Eros Mtata 400kV; Cennergi Grid connect 132kV; Melkhout Thyspunt 132kv; Imvubu Theta 400kv; Outeniqua Oudshoorn 132kv; Clocolan Ficksburg 88kv.

Strategic Environmental Assessments for Master Electrification Plans:
Northern Johannesburg area; Southern KZN and Northern Eastern Cape; Northern Pretoria; Western Cape Peninsula

Other electrical infrastructure work

Investigation into rotating Bird Flapper saga – Aberdeen 22Kv; Special investigation into faulting on Ariadne-Eros 132kV; Special investigation into Bald Ibis faulting on Tutuka Pegasus 275kV; Special investigation into bird related faulting on 22kV Geluk Hendrina line; Special investigation into bird related faulting on Camden Chivelston 400kV line

Water sector:

Umkhomazi Dam and associated tunnel and pipelines; Rosedale Waste Water Treatment Works; Lanseria Outfall Sewer; Lanseria Wastewater Treatment Works;

Wildlife airport hazards:

Kigali International Airport – Rwanda; Port Elizabeth Airport – specialist study as part of the EIA for the proposed Madiba Bay Leisure Park; Manzini International Airport (Swaziland); Polokwane International Airport; Mafekeng International Airport; Lanseria Airport. Namibia Airports Company – wildlife hazard management plans for three airports.

Conservation planning:

East Cape Biodiversity Strategy & Action Plan – avifaunal input; City of Ekurhuleni Biodiversity Plan – avifaunal input.

Other sectors:

Submarine telecommunications cables project; Lizzard Point Golf Estate – Vaaldam; Lever Creek Estates housing development; East Cape Biodiversity Strategy and Action Plan 2017; Cathedral Peak Road diversion; Dube Tradeport; East London Transnet Ports Authority Biodiversity Management Plan; Leazonia Feedlot; Carisbrooke Quarry; Senekal Sugar Development; Frankfort Paper Mill;

Employment positions held to date:

- August 1999 to May 2004: Eastern Cape field officer for the South African Crane Working Group of the Endangered Wildlife Trust
- May 2004 to November 2007: National Field officer for Eskom-EWT Strategic Partnership and Airports Company SA – EWT Strategic Partnership (both programmes of Endangered Wildlife Trust)
- November 2007 to August 2011: Programme Manager – Wildlife & Energy Programme – Endangered Wildlife Trust
- August 2011 to present: Independent avifaunal specialist – Director at WildSkies Ecological Sevices (Pty) Ltd

Relevant achievements:

- Recipient of BirdLife South Africa's Giant Eagle Owl in 2011 for outstanding contribution to bird conservation in SA
- Founded and chaired for first two years – the Birds and Wind Energy Specialist Group (BAWESG) of the Endangered Wildlife Trust & BirdLife South Africa.

Conferences attended & presented at:

- 2021. African Conference on Linear Infrastructure and Environment
- 2018. Raptor Research Foundation conference, Kruger National Park.
- 2019. Conference on Wind Energy and Wildlife, Stirling, Scotland.
- 2017. Conference on Wind Energy and Wildlife, Estoril, Portugal.
- 2012-2020. Windaba Conference. Various attendance.
- May 2011. Conference of Wind Energy and Wildlife, Trondheim, Norway.
- March 2011. Chair and facilitator at Endangered Wildlife Trust – Wildlife & Energy Programme – "2011 Wildlife & Energy Symposium", Howick, SA
- September 2010 – Raptor Research Foundation conference, Fort Collins, Colorado. Presented on the use of camera traps to investigate Cape Vulture roosting behaviour on transmission lines
- May 2010 - Wind Power Africa 2010. Presented on wind energy and birds
- October 2008. Session chair at Pan-African Ornithological Conference, Cape Town, South Africa
- March 27 – 30 2006: International Conference on Overhead Lines, Design, Construction, Inspection & Maintenance, Fort Collins Colorado USA. Presented a paper entitled "Assessing the power line network in the Kwa-Zulu Natal Province of South Africa from a vulture interaction perspective".
- June 2005: IASTED Conference at Benalmadena, Spain – presented a paper entitled "Impact of bird streamers on quality of supply on transmission lines: a case study"
- May 2005: International Bird Strike Committee 27th meeting – Athens, Greece. Presented a paper entitled Bird Strike Data analysis at SA airports 1999 to 2004.
- 2003: Presented a talk on "Birds & Power lines" at the 2003 AGM of the Amalgamated Municipal Electrical Unions – in Stutterheim - Eastern Cape
- September 2000: 5th World Conference on Birds of Prey in Seville, Spain.

Papers & publications:

- Jenkins, A.R., Van Rooyen, C.S., Smallie, J., Harrison, J.A., Diamond, M., Smit-Robbinson, H.A. & Ralston, S. 2015. "Best practice guidelines for assessing and monitoring the impact of wind energy facilities on birds in southern Africa" Unpublished guidelines
- Ralston-Paton, S., Smallie, J., Pearson, A., & Ramalho, R. 2017. 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. BirdLife South Africa Occasional Report Series No. 2. BirdLife South Africa, Johannesburg, South Africa.

- Prinsen, H.A.M., J.J. Smallie, G.C. Boere, & N. Pires. (compilers), 2011. Guidelines on how to avoid or mitigate impacts of electricity power grids on migratory birds in the African-Eurasian Region. CMS Technical Series Number XX. Bonn, Germany.
- Prinsen, H.A.M., J.J. Smallie, G.C. Boere, & N. Pires. (compilers), 2011. Review of the conflict between migratory birds and electricity power grids in the African-Eurasian region. CMS Technical Series Number XX, Bonn, Germany.
- Jenkins, A.R., van Rooyen, C.S, Smallie, J.J, Harrison, J.A., Diamond, M.D., Smit-Robinson, H.A & Ralston, S. 2014. Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa
- Jenkins, A.R., Shaw, J.M., Smallie, J.J., Gibbons, B., Visagie, R. & Ryan, P.G. 2011. Estimating the impacts of power line collisions on Ludwig's Bustards *Neotis ludwigii*. Bird Conservation International.
- Jordan, M., & Smallie, J. 2010. A briefing document on best practice for pre-construction assessment of the impacts of onshore wind farms on birds. Endangered Wildlife Trust , Unpublished report
- Smallie, J., & Virani, M.Z. 2010. A preliminary assessment of the potential risks from electrical infrastructure to large birds in Kenya. Scopus 30: p32-39
- Shaw, J.M., Jenkins, A.R., Ryan, P.G., & Smallie, J.J. 2010. A preliminary survey of avian mortality on power lines in the Overberg, South Africa. Ostrich 2010. 81 (2) p109-113
- Jenkins, A.R., Smallie, J.J., & Diamond, M. 2010. Avian collisions with power lines: a global review of causes and mitigation with a South African perspective. Bird Conservation International 2010. 20: 263-278.
- Shaw, J.M., Jenkins, A.R., Ryan, P.G., & Smallie, J.J. 2010. Modelling power line collision risk for the Blue Crane *Anthropoides paradiseus* in South Africa. Ibis 2010 (152) p590-599.
- Jenkins, A.R., Allan, D.G., & Smallie, J.J. 2009. Does electrification of the Lesotho Highlands pose a threat to that countries unique montane raptor fauna? Dubious evidence from surveys of three existing power lines. Gabar 20 (2).
- Smallie, J.J., Diamond, M., & Jenkins, A.R. 2008. Lighting up the African continent – what does this mean for our birds? Pp 38-43. In Harebottle, D.M., Craig, A.J.F.K., Anderson, M.D., Rakotomanana, H., & Muchai. (eds). Proceedings of the 12th Pan-african Ornithological Congress. 2008. Cape Town. Animal Demography Unit. ISBN (978-0-7992-2361-3)
- Van Rooyen, C., & Smallie, J.J. 2006. The Eskom –EWT Strategic Partnership in South Africa: a brief summary. Nature & Faunae Vol 21: Issue 2, p25
- Smallie, J. & Froneman, A. 2005. Bird Strike data analysis at South African Airports 1999 to 2004. Proceedings of the 27th Conference of the International Bird Strike Committee, Athens Greece.

- Smallie, J. & Van Rooyen, C. 2005. Impact of bird streamers on quality of supply on transmission lines: a case study. Proceedings of the Fifth IASTED International Conference on Power and Energy Systems, Benalmadena, Spain.
- Smallie, J. & Van Rooyen, C. 2003. Risk assessment of bird interaction on the Hydra-Droërivier 1 and 2 400kV. Unpublished report to Eskom Transmission Group. Endangered Wildlife Trust. Johannesburg. South Africa
- Van Rooyen, C. Jenkins, A. De Goede, J. & Smallie J. 2003. Environmentally acceptable ways to minimise the incidence of power outages associated with large raptor nests on Eskom pylons in the Karoo: Lessons learnt to date. Project number 9RE-00005 / R1127 Technology Services International. Johannesburg. South Africa
- Smallie, J. J. & O'Connor, T. G. (2000) Elephant utilization of *Colophospermum mopane*: possible benefits of hedging. African Journal of Ecology 38 (4), 352-359.

Courses & training:

- Successfully completed a 5 day course in High Voltage Regulations (modules 1 to 10) conducted by Eskom – Southern Region
- Successfully completed training on, and obtained authorization for, live line installation of Bird Flappers

Appendix 10. Construction & post-construction bird monitoring framework

The work done to date on the proposed site has established a baseline understanding of the distribution, abundance and movement of key bird species on and near the site. However this is purely the 'before' baseline and aside from providing input into turbine micro-siting, it is not very informative until compared to post-construction data. The following programme has therefore been developed to meet these needs. It is recommended that this programme be implemented by the wind farm if constructed. The findings from operational phase monitoring should inform an adaptive management programme to mitigate any impacts on avifauna to acceptable levels.

During construction monitoring

It will be necessary to monitor the breeding status and productivity of the nesting Grey Crowned Crane, and the status of roosting Cape Vultures (and their response to roost deterrence methods). This can be done by a number of short specialist visits to the site in the relevant seasons.

Operational phase monitoring

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

Note that this framework is an interim draft. The most up-to-date version of the Best Practice Guidelines (Jenkins *et al.* 2015, update in prep) should inform the programme design at the time.

Live bird monitoring

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

- The walked transects of 1km each that have been done during pre-construction monitoring on the site should be continued.
- The vehicle-based road count routes on the site should be continued, and conducted once on each Site Visit.
- The Focal Sites on the site 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 Vantage Points already established on the overall site should be used to continue data collection post-construction. The exact positioning of these may need to be refined based on the presence of new turbines and roads. A total of 72 hours direct observation per Vantage Point should be conducted per year.
- The activities at the Control Site should be continued

Bird Fatality estimates

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

Fatality searches should be conducted as follows:

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

The most up to date version of the Best Practice Guidelines (Jenkins *et al*. 2015) should inform the programme design at the time.

The above programme should be reported on, quarterly, to the wind farm operator, who should submit these reports to the DEA and BirdLife South Africa. These reports should include a comparison of actual measured fatality rates with those predicted by this study.

Appendix 11. Specialist declaration.

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

Dalmanutha Wind Energy Facility

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
3. A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
4. All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
5. All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

Postal address:

Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

SPECIALIST INFORMATION

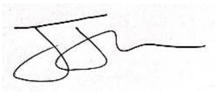
Specialist Company Name:	WildSkies Ecological Services Pty Ltd				
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	4	Percentage Procurement recognition	100	
Specialist name:	Jon Smallie				
Specialist Qualifications:	BSC MSC				
Professional affiliation/registration:	SACNASP 400020/06				
Physical address:	36 Utrecht Avenue, East London				
Postal address:					
Postal code:	5241	Cell:	0824448919		
Telephone:		Fax:			
E-mail:	jon@wildskies.co.za				

DECLARATION BY THE SPECIALIST

I, ___________J SMALLIE_______________________, declare that –

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

- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.



Signature of the Specialist

WildSkies Ecological Services Pty Ltd

Name of Company:

31 April 2023

Date

UNDERTAKING UNDER OATH/ AFFIRMATION

I, __________J SMALLIE________________________, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

WildSkies Ecological Services Pty Ltd

Name of Company

31 April 2023

Date

Signature of the Commissioner of Oaths

Date