ADDENDUM TO THE AVIFAUNAL IMPACT ASSESSMENT CONDUCTED FOR THE PROPOSED KORANA WIND ENERGY FACILTY (WEF) NEAR POFADDER, NORTHERN CAPE PROVINCE

APPLICATION FOR AMENDMENT OF ENVIRONMENTAL AUTHORISATION

Addendum report compiled by:

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EXECUTIVE SUMMARY

The purpose of this addendum report is to revisit the avifaunal impact assessment for the proposed Korana Wind Energy Facility (WEF) near Pofadder in the Northern Cape (Van Rooyen *et al*. 2014), based on a proposed amendment application to the environmental authorisation in June 2019.

The proposed changes are as follows:

Aspect	Authorised	Proposed amendment
Hub height	140m	Up to 200m
Rotor diameter	150m	Up to 200m
Individual turbine capacity	1.5MW - 4MW	2MW – 7MW
Number of turbines	70	Up to 42

Given the potential changes to the turbine specifications, a re-assessment of the potential turbine collision impact was carried out in light of the proposed amendment, in order to establish if the original pre-mitigation assessment by Van Rooyen *et al*. (2014) should be revised and if the original mitigation measures need to be revised.

Given the significant proposed increase in rotor swept area, it is concluded that the original pre-mitigation impact significance rating of -36 (medium) for potential collision mortality will not be valid anymore, should the proposed change in the turbine dimensions be applied to the current layout of 70 turbines. In that case, the collision risk rating would increase to -56 (medium) which is marginally below a high rating (>60). However, should the number of turbines reduce significantly, it will result in the collision rating remaining unchanged, depending on the extent of the reduction in the number of turbines.

The proposed amendment would be advantageous from a bird impact perspective if the number of turbines is reduced as a result of the amendment, and a revised buffer is implemented around the Martial Eagle nest on Tower 147 of the Aries – Aggeneys 400kV 1 transmission line. Should the turbine dimensions increase as proposed, and the number of turbines remain unchanged at 70, it would increase the risk of collisions and it would then be a disadvantage from the bird impact perspective.

In view of new knowledge gained since the original studies were completed, and the increased risk brought about by the proposed changes in the turbine dimensions, the original mitigation measures as formulated by Van Rooyen et al. (2014) need to be revised to retain a post-mitigation impact significance of “low”. This entails that the 1.5km turbine-free buffer zone around the Martial Eagle nest on Tower 147 of the Aries – Aggeneys 400kV 1 transmission line should be converted to a 4.5km turbine-free zone, and the number of turbines beyond the 4.5km turbine-free zone, up to a radius of 6km from the nest, should be restricted to no more than 13. In addition, the total number of turbines should be restricted to a maximum of 42. As an absolute minimum, post-construction monitoring should be undertaken for the first three years of operation, and then repeated again in year 5, and again every five years thereafter. The exact scope and nature of the post-construction monitoring will be informed on an ongoing basis by the result of the monitoring through a process of adaptive management.

The revised mitigation measures are subject to a walk-through survey by the avifaunal specialist prior to the construction commencing, to confirm the location and status of all priority species nests within the area of influence of the wind farm.

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1 Background

The purpose of this addendum report is to revisit the avifaunal impact assessment for the proposed Korana Wind Energy Facility (WEF) near Pofadder in the Northern Cape (Van Rooyen *et al*. 2014), based on a proposed amendment application to the environmental authorisation in 2019. The proposed changes are provided in **Table 1** below.

Table 1: Proposed turbine dimensions amendments

Aspect	Authorised	Proposed amendment
Hub height	140m	Up to 200m
Rotor diameter	150m	Up to 200m
Individual turbine capacity	1.5MW - 4MW	2MW – 7MW
Number of turbines	70	Up to 42

2 Terms of reference

Due to the proposed changes in **Table 1**, and in accordance with the National Environmental Management Act, 1998 (No. 107 of 1998) (NEMA), a re-assessment of potential impacts on the associated avifauna is required to be undertaken before an Amendment to Environmental Authorisation can be granted for the revised WEF development. **The sole impact which is specifically relevant in this instance is the risk of priority species mortality due to collisions with the turbines.**

The Terms of Reference (ToR) for this addendum report are as follows:

- Assess the impacts related to the proposed change from the authorised turbine specifications (if any);
- Assess advantages or disadvantageous of the proposed change in turbine specifications (comparative assessment between the authorised hub height and rotor diameter, versus the proposed specifications); and
- Identify additional or changes to the mitigation measures required to avoid, manage or mitigate the impacts associated with the proposed turbine specifications (if any).

3 The findings of the original bird impact assessment reports

The original Bird Specialist Study (Van Rooyen *et al*. 2014) identified risks (**Table 2**) of bird collisions with the wind turbines.

Table 2: Original bird collision risk

Environmental parameter	Impact	Rating prior to mitigation	Rating post mitigation
Avifauna	Priority species mortality due to collision with the turbines	-36 (medium negative)	-20 (low negative)

4 The relevance of turbine numbers and dimensions in avifaunal mortality risk

Most of the studies to date found turbine dimensions to play a relatively unimportant role in the magnitude of the collision risk relative to other factors such as topography, turbine location, morphology, behaviour and a species' inherent ability to avoid the turbines, and may only be relevant in combination with other factors, particularly wind strength and topography (see Howell 1997, Barrios & Rodriguez 2004; Barclay *et al.* 2007, Krijgsveld *et al.* 2009, Smallwood 2013; Everaert 2014). Three (3) studies found a correlation between hub height and mortality (De Lucas *et al.* 2008; Loss *et al.* 2013 and Thaxter *et al*. 2017).

The Summary below provides a list of published findings on the topic:

- Howell *et al.* 1997 states on p.9: "*The evidence to date from the Altamont Pass does not support the hypothesis that the larger rotor swept area (RSA) of the KVS–33 turbines contributes proportionally to avian mortality, i.e. larger area results in more mortalities. On the contrary, the ratio of K-56 turbines to KVS-33 turbines rather than RSA was approximately 3.4:1 which as consistent with the 4.1:1 mortality ratio. It appears that the mortality occurred on a per-turbine basis, i.e. each turbine simply presented an obstacle."*
- Barrios & Rodriguez 2004 states on p. 80: "*Most deaths and risk situations occurred in two rows at PESUR with little space between consecutive turbines. This windwall configuration (Orloff & Flannery 1992) might force birds that cross at the blade level to take a risk greater than in less closely spaced settings. However, little or no risk was recorded for five turbine rows at PESUR having exactly the same windwall spatial arrangement of turbines. Therefore, we conclude that physical structures had little effect on bird mortality unless in combination with other factors*."
- Barclay *et al.* 2007 states on p. 384: "*Our analysis of the data available from North America indicates that this has had different consequences for the fatality rates of birds and bats at wind energy facilities. It might be expected that as rotor swept area increased, more animals would be killed per turbine, but our analyses indicate that this is not the case. Rotor-swept area was not a significant factor in our analyses. In addition, there is no evidence that taller turbines are associated with increased bird fatalities. The per turbine fatality rate for birds was constant with tower height*."
- De Lucas *et al.* 2008 states on p. 1702: "*All else being equal, more lift is required by a griffon vulture over a taller turbine at a higher elevation and we found that such turbines killed more vultures compared to shorter turbines at lower elevations*."
- Krijgsveld *et al.* 2009 states on p. 365: "*The results reported in this paper indicate that collision risk of birds with larger multi-MW wind turbines is similar to that with smaller earlier-generation turbines, and much lower than expected based on the large rotor surface and high altitude-range of modern turbines. Clearly, more studies of collision victims are needed before we can confidently predict the relationship between size and configuration of wind turbines and the risk for birds to collide with a turbine.*"
- Smallwood *et al*. 2013 states on p.26 – 27 (see also Fig 9 on p.30): "*Red-tailed hawk (Buteo jamaicensis) and all raptor fatality rates correlated inversely with increasing wind-turbine size (Figs. 9A, B). Thousands of additional MW of capacity were planned or under construction in 2012, meaning that the annual toll on birds and bats will increase. However, the expected increase of raptor fatalities could be offset by reductions of raptor fatalities as older wind projects are repowered to new, larger wind turbines, especially if the opportunity is taken to carefully site the new wind turbines (Smallwood and Karas 2009, Smallwood et al. 2009).*"
- Loss *et al.* 2014 states on p. 208: "*The projected trend for a continued increase in turbine size coupled with our finding of greater bird collision mortality at taller turbines suggests that precaution must be taken to reduce adverse impacts to wildlife populations when making decisions about the type of wind turbines to install*."

- Everaert, 2014 states on p. 228: "*Combined with the mortality rates of several wind farms in the Netherlands (in similar European lowland conditions near wetlands or other areas with water), no significant relationship could be found between the number of collision fatalities and the rotor swept area of the turbines (Fig. 4). In contrast to more common landscapes, Hötker (2006) also found no significant relationship between mortality rate and the size of wind turbines near wetlands and mountain ridges.*"
- In the most recent paper on the subject by Thaxter *et al*. (2017), the authors conducted a systematic literature review of recorded collisions between birds and wind turbines within developed countries. They related collision rate to species-level traits and turbine characteristics to quantify the potential vulnerability of 9 538 bird species globally. For birds, larger turbine capacity (megawatts) increased collision rates; however, deploying a smaller number of large turbines with greater energy output reduced total collision risk per unit energy output. In other words, although there was a positive relationship between wind turbine capacity and collision rate per turbine, the strength of this relationship was insufficient to offset the reduced number of turbines required per unit energy generation with larger turbines. *Therefore, to minimize bird collisions, wind farm electricity generation capacity should be met through deploying fewer, large turbines, rather than many, smaller ones*.

The authorised rotor diameter of 150m for the Korana WEF translates into a rotor swept area of approximately 17 671m² per turbine. An increase of the rotor diameter to 200m will result in a rotor swept area of approximately 31 415m² ² (utilising the same number of turbines as approved). This amounts to an increase of 77.7% in the rotor swept area per turbine should the number of turbines not be reduced simultaneously.

5 Re-assessment of collision mortality impact

Given the proposed changes to the turbine specifications, a re-assessment of the potential collision impact was carried out for the proposed amendment, in order to establish if the original pre-mitigation assessment of by Van Rooyen *et al*. (2014) should be revised. The increase of 77.7% in rotor swept area per turbine is significant, and unless the number of turbines is reduced, it will result in a significant increase in the overall collision risk. However, should the number of turbines reduce significantly, it will result in the collision rating remaining unchanged, depending on the extent of the reduction in the number of turbines (see also Table 3 below).

Given the significant proposed increase in rotor swept area, it is concluded that the original pre-mitigation impact significance rating of -36 (medium) for potential collision mortality will not be valid anymore, should the proposed change in the turbine dimensions be applied to the current layout of 70 turbines. In that case, the collision risk rating would increase to -56 (medium) which is marginally below a high rating (>60) (see **Table 3** below). Additional mitigation measures recommended as a result of the proposed amendment have been underlined in the table below, where applicable.

Table 3: Impact and ratings table 3

Nature of impact: **Bird collisions of priority avifauna with the wind turbines.**				
	Authorised		**Proposed amendment**	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**

Extent	Low (2)	Low (2)	Low (2)	Low (2)
Duration	Long-term (4)	Long-term (4)	Long-term (4)	Long-term (4)
Magnitude	Moderate (6)	Low (4)	High (8)	Low (4)
Probability	Probable (3)	Improbable (2)	Highly probable (4)	Improbable (2)
Significance	**36 (Medium)**	**20 (Low)**	**56 (Medium)**	**20 (Low)**
Status (positive or negative)	Negative	Negative	Negative	Negative
Reversibility	Low	High	Low	High
Irreplaceable loss of resources?	No	No	No	No
Can impacts be mitigated?	Yes		Yes	

Mitigation measures due to the proposed amendment:

- <u>The number of turbines should be reduced to a maximum of 42 turbines (i.e. 60% of the original authorised 70).</u>
- <u>The 1.5km turbine-free buffer zone around the Martial Eagle nest on the Aries – Aggeneys 400kV 1 transmission line should be converted to a 4.5km turbine-free zone, and the number of turbines beyond the 4.5km turbine-free zone, up to a radius of 6km from the nest, should be restricted to no more than 13.</u>
- <u>As an absolute minimum, post-construction monitoring should be undertaken for the first three years of operation, and then repeated again in year 5, and again every five years thereafter. The exact scope and nature of the post-construction monitoring will be informed on an ongoing basis by the result of the monitoring through a process of adaptive management.</u>

Mitigation measures as per the original EIA

- A 200m no-go buffer is proposed around water points as they serve as focal points for raptor activity.
- Formal monitoring should be resumed once the turbines have been constructed, as per the most recent edition of the best practice guidelines (Jenkins *et al.* 2011). The exact scope and nature of the post-construction monitoring will be informed on an ongoing basis by the result of the monitoring through a process of adaptive management. The purpose of this would be (a) to establish if and to what extent displacement of priority species has occurred through the altering of flight patterns post-construction, and (b) to search for carcasses at turbines.
- As an absolute minimum, post-construction monitoring should be undertaken for the first two (preferably three) years of operation, and then repeated again in year 5, and again every five years thereafter. The exact scope and nature of the post-construction monitoring will be informed on an ongoing basis by the result of the monitoring through a process of adaptive management.

- The environmental management plan should provide for the on-going inputs of a suitable experienced ornithological consultant to oversee the post-construction monitoring and assist with the on-going management of bird impacts that may emerge as the post-construction monitoring programme progresses.
- Depending on the results of the carcass searches, a range of mitigation measures will have to be considered if mortality levels turn out to be significant, including selective curtailment of problem turbines during high risk periods.
- If turbines are to be lit at night, lighting should be kept to a minimum and should preferably not be white light. Flashing strobe-like lights should be used where possible (provided this complies with Civil Aviation Authority regulations).
- Lighting of the wind farm (for example security lights) should be kept to a minimum. Lights should be directed downwards (provided this complies with Civil Aviation Authority regulations).

Cumulative impacts:

"Cumulative Impact", in relation to an activity, 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 become significant when added to existing and reasonably foreseeable impacts eventuating from similar or diverse activities.

Site specific

Currently there is no agreed method for determining significant adverse cumulative impacts on ornithological receptors, although clearly a more strategic approach should be followed than is currently the case (Jenkins *et al.* 2011). The Scottish Natural Heritage (2005) guidance on cumulative effects of wind farms on birds recommends a five-stage process to aid in the ornithological assessment:

- Define the species/habitat to be considered;
- Consider the limits or 'search area' of the study;
- Decide the methods to be employed;
- Review the findings of existing studies; and
- Draw conclusions of cumulative effects within the study area.

There is currently a total of up to 140 turbines planned for a land parcel area of approximately 175km², namely up to 70 turbines for Korana WEF and up to 70 turbines for Kai-Ma WEF, although this number is likely to be considerably less given the proposed use of newer, larger turbines. In the current instance, not all the above criteria can be met in assessing the cumulative impact of potential mortality due to collisions with the proposed turbines at a study area level. The main reason is that no other studies have been done within this area with regard to avifaunal mortality levels, therefore there are no existing studies to review as far as existing impacts on the avifauna is concerned.

In the absence of any scientifically verified data, general knowledge and experience will have to suffice. Given the extensive farming practices which are currently used in the study area, it can be surmised that the existing anthropogenic impacts on avifauna in the study area is relatively low. Although it cannot be confirmed, interviews with the landowners indicate that active persecution of large raptors for alleged stock killing is not commonly practised. Hunting of priority species is also not a major impact, although the hunting of some species has been confirmed by landowners. Overall, the very low human population in the study area is definitely advantageous to avifauna in general.

All of these assertions should ideally be tested empirically in order to make comparisons possible, but a study of that proportions falls outside the scope of this project. The one impact that has been

empirically confirmed is the mortality of Ludwig's Bustard due to collisions with the existing Aries - Aggeneys 400kV transmission line. The extent of this mortality factor in the study area is unknown, but it can be assumed that it is a regular occurrence (Shaw 2013), and it was confirmed by a landowner. The key question therefore is to what extent turbine collisions will contribute to this existing and potentially significant mortality factor.

All in all, it is envisaged that collisions of Ludwig's Bustard with the turbines will not be a major impact, based on mortality figures at operational wind farms to date (BLSA 2018). **Provided the recommendations in this report are implemented, it is envisaged that the cumulative impact of mortality of priority species in the study area due to collisions with the turbines is likely to be low**.

Regional

There are currently four applications for wind energy facilities within a 100km radius around Pofadder. It is difficult to guess at this stage how severe the cumulative collision impact of all these proposed wind developments will be on priority species on a regional basis, firstly because for many species no or inaccurate baseline population and mortality data exists, and secondly because the extent of actual impacts will only become known if the wind farms are actually developed and post-construction monitoring is implemented.

It is therefore imperative that post-construction monitoring is implemented at all the proposed sites, in accordance with best practice. This will provide the data necessary to improve the assessment of the cumulative impact of wind development on priority species, especially for future developments in the region. Within the context of the previous statement and without detracting from it in any way, it could be speculated that because the priority species that occur (or are likely to occur) at the proposed site all have large distribution ranges (possible exceptions are Red Lark and Sclater's Lark which are more range restricted but are not likely to be significantly impacted by turbine collisions), the potential cumulative impact of turbine collisions on priority species on a regional scale should be relatively minor.

It should be borne in mind that power lines kill many bustards in the Karoo (Shaw 2013), therefore any additional mortality even on a small scale, may well have a more significant cumulative impact than what is evident at first glance. However, it is envisaged that collisions of Ludwig's Bustard with the turbines will not be a major impact. Provided the recommendations in this report and presumably similar ones at all the other developments are implemented, it is envisaged that the **cumulative impact of mortality of priority species due to collisions with the turbines is likely to be low, even on a regional level.**

Residual Risks:

It is envisaged that mitigation will reduce but not entirely eliminate collision mortality.

6 Revised mitigation measures

The mitigation measures originally proposed for the Korana WEF by Van Rooyen *et al.* (2014) need to be revisited in light of two (2) factors:

- The proposed increase in the rotor diameter will result in an increased risk of collisions for priority species (see Section 5 above).
- The "Best Practice Guidelines for Avian Monitoring and Impact Mitigation at Proposed Wind Energy Development Sites in Southern Africa", (Jenkins *et al*. 2011) revised in 2015, requires that either all, or part of the pre-construction monitoring is repeated if there is a time period of three (3) years or more between the data collection and the construction of the wind farm. This re-assessment is

necessary in order to take cognisance of any changes in the environment which may affect the risk to avifauna, and to incorporate the latest available knowledge into the assessment of the risks. In order to give effect to this requirement, nest searches were repeated in July 2019 to ensure current information on the breeding status of priority species at the proposed Korana WEF is recorded.

Since the original Bird Specialist Study was completed in 2014, the local knowledge with regard to the impacts of wind turbines on avifauna has increased significantly with the experienced gained from operational wind farms, see for example (Ralston-Patton *et al*. 2017). This has also resulted in the publication of two (2) new sets of guidelines, one (1) for Cape Vultures (Pfeiffer *et al*. 2018) and one (1) for Verreaux's Eagles (Ralston-Patton 2017), while work is almost finished for Black Harriers. Guidelines for a range of other sensitive species are also planned, including Martial Eagles, as they have proven to be highly vulnerable to wind turbine collisions.

The nest searches conducted in July 2019 confirmed the presence of a Martial Eagle nest on Tower 147 of the Aries – Aggeneys 400kV 1 transmission line, which runs north of the project area. The average territory size of a large eagle represents an important area which can contribute to conservation planning and should be considered the absolute minimum area for conservation (Ralston-Patton 2017). Global Positioning System (GPS) tracking of Martial Eagles in the Kruger National Park indicates average territory sizes of 110km² (Percy Fitzpatrick Institute 2015), which equates to a 6km circular zone around the nest. Given the proven vulnerability of the species to wind turbine collisions which is now firmly established, 5-6km should ideally be taken as the desired turbine-free buffer zone around a Martial Eagle nest[1].

The following revised and additional mitigation measures are proposed to ensure that the post-mitigation significance remains at a **"low"** level:

- The number of turbines should be reduced to a maximum of 42 turbines (i.e. 60% of the original authorised 70).
- The 1.5km turbine-free buffer zone around the Martial Eagle nest on the Aries – Aggeneys 400kV 1 transmission line should be converted to a 4.5km turbine-free zone, and the number of turbines beyond the 4.5km turbine-free zone, up to a radius of 6km from the nest, should be restricted to no more than 13.
- As an absolute minimum, post-construction monitoring should be undertaken for the first three years of operation, and then repeated again in year 5, and again every five years thereafter. The exact scope and nature of the post-construction monitoring will be informed on an ongoing basis by the result of the monitoring through a process of adaptive management.

Should the above buffer zones and associated mitigation measures be implemented the post mitigation impact rating would remain unchanged.

7 Conclusions

Given the potential changes to the turbine specifications, a re-assessment of the potential turbine collision impact was carried out in light of the proposed amendment, in order to establish if the original pre-mitigation assessment by Van Rooyen *et al*. (2014) should be revised and if the original mitigation measures need to be revised.

Given the significant proposed increase in rotor swept area, it is concluded that the original pre-mitigation impact significance rating of -36 (medium) for potential collision mortality will not be valid anymore, should the proposed change in the turbine dimensions be applied to the current layout of 70

[1] It should be recognised that Martial Eagle territories in an arid environment like Bushmanland are likely to be much larger than in the mesic Lowveld of the Kruger National Park, therefore a 5-6km turbine free buffer should be seen as an absolute minimum.

turbines. In that case, the collision risk rating would increase to -56 (medium) which is marginally below a high rating (>60). However, should the number of turbines reduce significantly, it will result in the collision rating remaining unchanged, depending on the extent of the reduction in the number of turbines.

The proposed amendment would be advantageous from a bird impact perspective if the number of turbines is reduced as a result of the amendment, and a revised buffer is implemented around the Martial Eagle nest on Tower 147 of the Aries – Aggeneys 400kV 1 transmission line. Should the turbine dimensions increase as proposed, and the number of turbines remain unchanged at 70, it would increase the risk of collisions and it would then be a disadvantage from the bird impact perspective.

In view of new knowledge gained since the original studies were completed, and the increased risk brought about by the proposed changes in the turbine dimensions, the original mitigation measures as formulated by Van Rooyen et al. (2014) need to be revised to retain a post-mitigation impact significance of “low”. This entails additionally implementing that the 1.5km turbine-free buffer zone around the Martial Eagle nest on Tower 147 of the Aries – Aggeneys 400kV 1 transmission line should be converted to a 4.5km turbine-free zone, and the number of turbines beyond the 4.5km turbine-free zone, up to a radius of 6km from the nest, should be restricted to no more than 13. In addition, the number of turbines should be restricted to a maximum of 42. As an absolute minimum, post-construction monitoring should be undertaken for the first three years of operation, and then repeated again in year 5, and again every five years thereafter. The exact scope and nature of the post-construction monitoring will be informed on an ongoing basis by the result of the monitoring through a process of adaptive management.

These revised mitigation measures are subject to a walk-through survey by the avifaunal specialist prior to the construction commencing, to confirm the location and status of all priority species nests within the area of influence of the wind farm.

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