ADDENDUM TO THE AVIFAUNAL IMPACT ASSESSMENT CONDUCTED FOR THE PROPOSED MAINSTREAM ITHEMBA WIND ENERGY FACILITY NEAR LOERIESFONTEIN IN THE NORTHERN CAPE PROVINCE

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EXECUTIVE SUMMARY

The purpose of this addendum report is to assess whether the conclusions and recommendations of the Bird Impact Assessment Report compiled in December 2016 will be affected by a change in the proposed turbine dimensions from a hub height of up to 150m and rotor diameter of up to 150m, to a hub height of up to 160m and a rotor diameter of up to 160m. Assuming a 160m blade diametre and a 160m hub height, it means maximum height of the blade will be 240m (previously 225m) and minimum height will be 80m (previously 75m).

The conclusions and recommendations of the original Bird Impact Assessment Report remains unchanged by the proposed change in turbine dimensions. The reason for that are as follows:

- While the risk rating for Martial Eagle has increased with the new turbine dimensions, it is still below the average risk rating for priority species;
- The overall risk rating for priority species has increased by only 7.45%;
- The weight of published findings indicate that rotor swept area as a stand-alone issue is not a key factor in determining collision risk.

1. Background

The proposed Mainstream Leeuwberg renewable energy development will consist of four wind farms and associated infrastructure, namely !Xha Boom wind farm, Graskoppies wind farm, Hartebeest Leegte wind farm and Ithemba wind farm. Each wind farm will have a capacity of up to 235MW and consist of up to 70 turbines between 3MW and 5MW.

The original turbine dimensions on which the collision risk index for the four development areas was calculated were a hub height of up to 150m and a rotor diametre of up to 150m. Mainstream has subsequently decided to change the turbine dimensions to a hub height of up to 160m and a rotor diametre of up to 160m.

The purpose of this addendum report is to assess whether the conclusions and recommendations of the original Bird Impact Assessment Report compiled for the Ithemba Wind Energy Facility (WEF) in December 2016 will be affected by the proposed change in the turbine dimensions.

2. Potential impact of revised turbine dimensions

The new turbine dimensions necessitate a re-assessment of the potential risk of collisions due to the increased rotor swept area, and taller hub height. Assuming a 160m blade diametre and a 160m hub height, it means that the maximum height of the blade will be 240m (previously 225m) and the minimum height will be 80m (previously 75m).

An elementary site-specific collisions risk rating for each priority species recorded during VP watches was calculated in December 2016, based on the original turbine dimensions, to give an indication of the likelihood of an individual of the specific species to collide with the turbines at this site. This was calculated taking into account the following factors:

- The duration of potential rotor height flights;
- the susceptibility to collisions, based on morphology (size) and behaviour (soaring, predatory, ranging behaviour, flocking behaviour, night flying, aerial display and habitat preference) using the ratings for priority species in the Avian Wind Farm Sensitivity Map of South Africa (Retief *et al.* 2012); and
- the number of planned turbines.

Due to the uncertainty with regard to final turbine dimensions at the start of the pre-construction monitoring, a precautionary approach was followed in order to cover as many potential turbine sizes as possible. The following dimensions were used:

- <30m below rotor height (low altitude)
- 30 – 220m within rotor height (medium altitude)

- >220 above rotor height (high altitude)

The formula used were as follows:

Duration of medium altitude flights x collision susceptibility calculated as the sum of morphology and behaviour ratings x number of planned turbines ÷100:

Figure 1 below shows the risk index for priority species, based on recorded medium altitude flights.

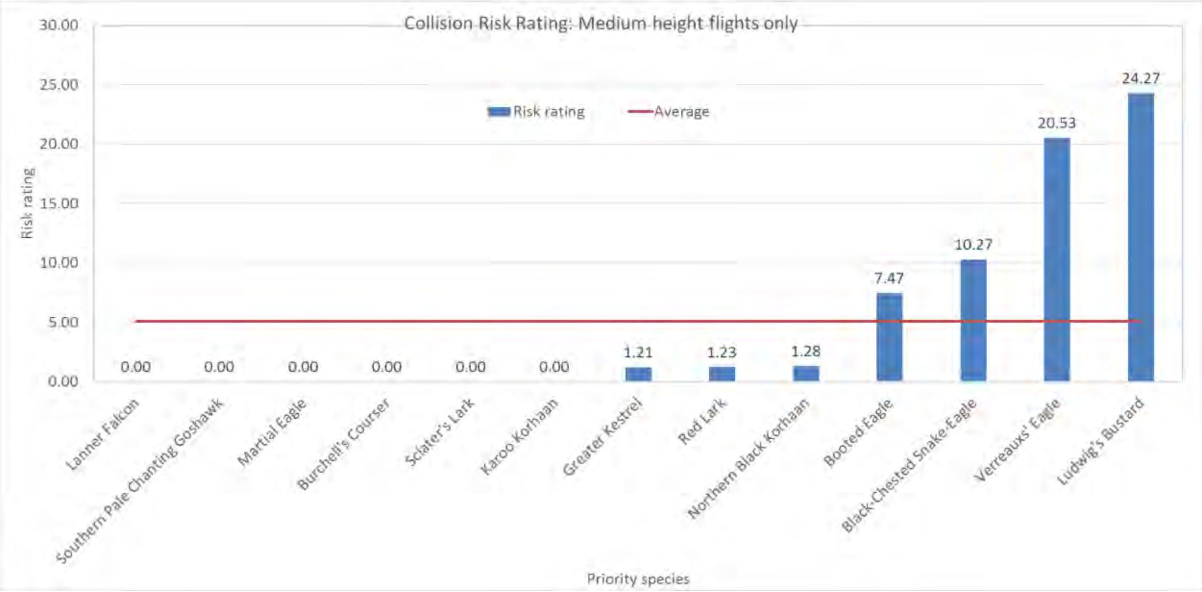

Figure 1: The site-specific collision risk rating for priority species based on medium altitude flights only.

The change in the potential turbine size necessitates a re-calculation of the risk index. As a pre-cautionary measure, all flights originally classified as above rotor height need to be included in the new calculation, as the maximum rotor height has now increased to 240m.

The formula used to calculate the revised collision risk index is as follows:

*Duration of medium **and high** altitude flights x collision susceptibility calculated as the sum of morphology and behaviour ratings x number of planned turbines ÷100:*

Figure 2 below shows the revised risk index for priority species, based on recorded medium and high altitude flights.

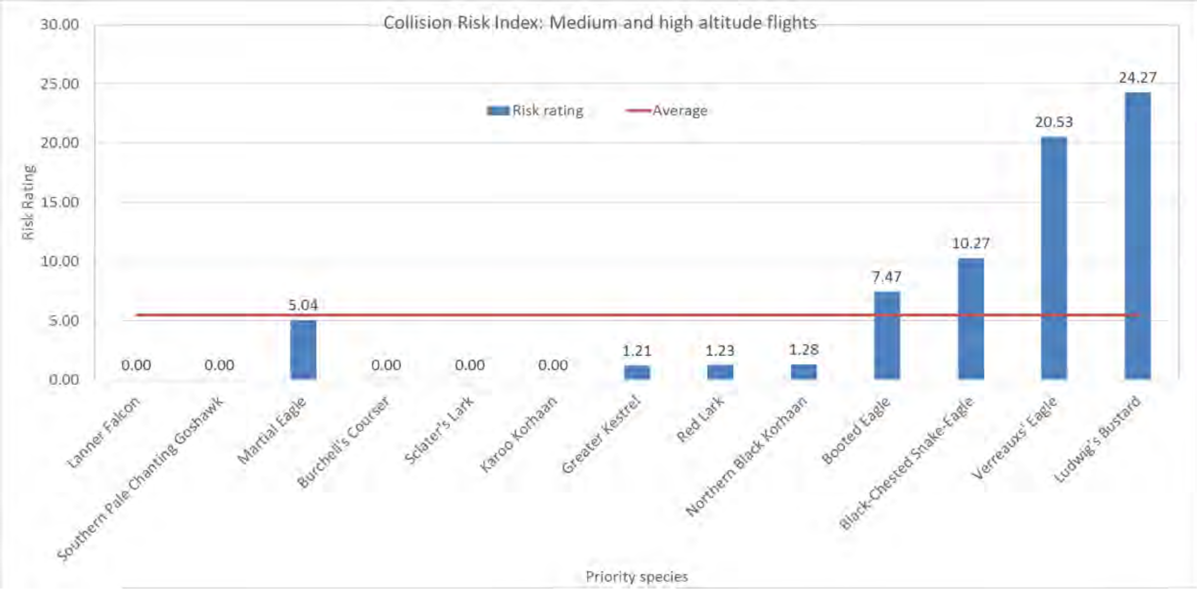

Figure 2: The revised site specific collision risk rating for priority species based on medium and high altitude flights.

The re-calculation of the risk index has resulted in an increase in the individual risk rating for Martial Eagle from 0 to 5.04 as a result of the inclusion of high altitude flights in the risk zone, and an increase in the average collision risk rating for priority species from 5.10 for the original turbine dimensions to 5.48 for the new turbine dimensions, which is an increase of 7.45%. However, the individual risk rating for Martial Eagle is still below the average risk rating for priority species. The individual risk ratings for the other priority species remained the same, as no high altitude flights were recorded for those species.

The inclusion of all the high altitude flights in the re-calculation is based on the assumption that a larger rotor-swept area will automatically increase the risk of collision. While this makes intuitive sense, it should be noted that the majority of published scientific studies indicate that an increase in rotor swept area do not automatically translate into a larger collision risk. Turbine dimensions seem to play an insignificant role in the magnitude of the collision risk in general, relative to other factors such as topography, turbine location, morphology and a species' inherent ability to avoid the turbines, and may only be relevant in combination with other factors, particularly wind strength and topography. While two studies found a correlation between turbine hub height and mortality (De Lucas *et al.* 2008; Loss *et al.* 2013), the majority did not (see Howell 1997, Barrios & Rodriguez 2004; Barclay *et al.* 2007, Krijgsveld *et al.* 2009, Smallwood 2013; Everaert 2014).

See below a summary 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. that 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 indicates 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."

As can be seen from the above short literature survey, the weight of published findings indicate that rotor swept area as a stand-alone issue is not a key factor in the collision risk.

3. Conclusions

The conclusions and recommendations of the original Bird Impact Assessment Report remains unchanged by the proposed change in turbine dimensions. The reason for that are as follows:

- While the risk rating for Martial Eagle has increased with the new turbine dimensions, it is still below the average risk rating for priority species;
- The overall risk rating for priority species has increased by only 7.45%;
- The weight of published findings indicate that rotor swept area as a stand-alone issue is not a key factor in determining collision risk.

4. References

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