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Modelled risk of Brolga collisions with turbines at the proposed Mortlake Wind Farm

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Report to Acciona Energy Oceania Pty. Ltd.

Modelled risk of Brolga collisions with turbines at the proposed Mortlake Wind Farm

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SUMMARY

Acciona Energy Oceania Pty. Ltd. is in the process of developing the Mortlake Wind Farm, near Mortlake in Victoria. Modelling has been undertaken using the Biosis Research Deterministic Collision Risk Model, to assess potential risk to Brolgas of collisions with turbines at the wind farm. This report details the modelling processes and predictions.

The annual cycle of the Brolga includes seasonal periods of residence at breeding and flocking sites and movements between them. The birds' behaviours differ according to this annual cycle and, where applicable, modelling has thus been undertaken for each of the seasonal components and results have then been summed to provide average annual predictions of Brolga mortality.

On the basis of a likely mean avoidance capacity of Brolgas, the annual average number collisions with turbines are predicted to be 0.108 or fewer.

A Population Viability Analysis, specifically developed for the south-western Victorian population of Brolgas, will be used to assess the effects on of mortality predicted to result from turbine collisions.

1.0 INTRODUCTION

Acciona Energy Oceania Pty. Ltd. is in the process of developing a wind energy facility near Mortlake in Victoria. The development comprises two geographically distinct parts, Mortlake South and Mortlake East Wind Farms. The Mortlake South Wind Farm is outside the present range of the Brolga *Grus rubicundus* and is not considered further in this assessment. There are multiple records of Brolgas in and around the Mortlake East site. In order to better assess the potential risks of collisions with wind turbines to Brolgas, studies have collected data about the birds' utilisation of the Mortlake East wind farm area and the local region during 2007 and 2008. Contextual and historical information about Brolga use of the area has also been made available from databases held by the Department of Sustainability and environment.

Biosis Research has been commissioned to use available information from those sources to provide modelled predictions of the potential risks to Brolgas of collisions with turbines proposed to be installed at the site.

Breeding season activity of Brolgas relevant to the Mortlake East Wind Farm was investigated in late 2007 as reported by Brett Lane and Associates (2008).

Brolga migration and flocking in the area has been the subject of investigation by Ecology Partners Pty Ltd in December 2007 (Ecology Partners 2008a) and in April 2008 (I. Veltheim pers. comm.). In order to provide an improved understanding of the migration and flocking season activities of the south-west Victorian Brolga population, Ecology Partners has also assessed historical data found in DSE's Atlas of Victorian Wildlife and South West Victoria Brolga Flocking Database (Ecology Partners 2008b). This compiled relevant information for each of the past ten years.

Modelling has been undertaken using the Biosis Research Deterministic Collision Risk Model.

The annual cycle of Brolgas in south-western Victoria encompasses the breeding season, and, for most birds, a period of 'migration' to flocking locations where they reside for a period, and subsequent return 'migration' to breeding sites. Breeding and flocking occurs at discrete locations within relatively local regions where distances between them may be measured in tens of kilometres or less. Breeding, and especially flocking, sites used by Brolgas in a given season are dependant on local conditions and thus movements between sites are not predictable year to year. In this respect, annual movements between flocking and breeding sites are not true migrations, but the term is widely applied to these movements and is used here for convenience.

Behaviour of Brolgas is different during breeding, migration and flocking. Flight frequency, height and distance have been documented to be different for these activities. For this reason, evaluation of collision risks for the regional Brolga population requires separate modelling for each of these activities. The annual predicted risk is the sum of the predictions for the seasonal activities comprising the birds' annual cycle.

A Population Viability Analysis (PVA) has been developed as a means to assess potential effects of wind farms on the viability of the south-western Victorian Brolga population (McCarthy 2008). PVA modelling also provides a mechanism to evaluate positive effects of various mitigation options against predicted negative effects on the population. Results of collision risk modelling will provide inputs to the PVA model.

The following background section provides an introduction to modelling as a tool in risk evaluation and how it is applied to the risks of bird collisions with wind turbines.

2.0 BACKGROUND TO COLLISION RISK MODELLING

The fundamental objective of modelling of risk is to provide a rigorous process by which probability can be assessed and to do so in a manner that can be replicated.

When making predictions of risk using a model, the rationale behind the predictions is explicitly stated in the mathematics of a model, which means that the logical consistency of the predictions can be readily evaluated. This is the case regardless of the type of model used.

The only real alternative to the use of a model is the use of subjective judgement to predict risks. Compared to subjective judgement, the explicit nature of inputs and rigour entailed in modelling makes models more open to analysis, review or modification when new information becomes available. Although there may be assumptions used and some arbitrary choices made when deciding on the structure and parameters of a model, these choices are stated explicitly when using a model but this is difficult to do when making subjective judgements. The assumptions underlying a model can be tested. Models can be used to help design data collection strategies. They can also help to resolve and avoid inconsistencies, and the rigorous analysis of data provides clarity.

Models are often also valuable for their heuristic capacities, by focussing attention on the important processes and parameters when assessing risks (Brook *et al.* 2002). All risk assessment must incorporate processes for refinement and improvement as data come to hand. It is vital that there is a feedback loop allowing this to occur (Burgman 2005). This should be expected of a model and the use of a model explicitly facilitates that process.

All of these benefits are difficult, if not impossible to achieve with subjective judgement. Another drawback of subjective judgement is that it may lead to biased predictions of risk, and the biases vary unpredictably among people (Tversky and Kahneman 1974; Ayton and Wright 1994; Gigerenzer and Hoffrage 1995; Anderson 1998). The predictions of models tend to be less biased (Brook *et al.* 2000, McCarthy *et al.* 2004).

It is important to recognise that while a model such as the one used here attempts to quantify risks, it makes no assessment of the 'value' of its subject. Whether predicted risks to Brolgas are 'acceptable' or not, is a further evaluation that must be made. Use of a model allows a clear distinction to be made between potential risks and subsequent judgements about those risks. Using subjective assessment of risk it is almost impossible to distinguish between these aspects.

For the purposes of determining impacts on fauna, criteria should evaluate effects on the viability of populations, rather than on individuals, since populations are the key units of conservation.

3.0 METHODS

3.1 Brolga Utilisation Studies

Investigations of Brolga utilisation for Mortlake East Wind Farm are detailed in Brett Lane and Associates (2008) and Ecology Partners (2008a).

3.2 Data Analysis

Estimates of annual numbers of Brolga movements that might interact with turbines were provided by Brett Lane and Associates (2008) and by Ecology Partners (2008a, b).

Since empirical data for Brolga activity in and near the site have been obtained only during 2007 and 2008, it is possible that they are not truly representative of longer timeframes encompassing different conditions. With this in mind, confidence limits have been placed on values derived from the Brolga movement data (Symbolix 2008a) and the 80% confidence bound has been applied to data to determine input values used for modelling. This is considered appropriate to cover a range of realistic variables that might occur.

3.3 Risk Model

Biosis Research Pty. Ltd. developed a model for the assessment of avian collision risk with wind turbines, initially for the Woolnorth Wind Farm (the name formerly applied to the combined Bluff Point and Studland Bay wind farms). This Deterministic Collision Risk Model has been refined over time, to incorporate new data and knowledge, and has been applied at a wide range of proposed wind farm sites in Australia.

Generally, results of modelling are expressed in terms of the expected number of flights by particular bird species that pose a risk of collision with turbines per annum. Where an estimate is available for the number of individuals that have potential to interact with turbines, movements-at-risk may be converted into a number of individuals-at-risk by incorporating the population estimate for the site into calculations. This is the case for the Brolga population modelled here.

Results are provided for three avoidance rates. Avoidance rate quantifies the capacity of birds to avoid a collision, whether that occurs due to a cognitive (behavioural) response on the part of a bird or not. A 95% avoidance rate equates to one flight in 20 in which a bird does not avoid a turbine, 98% avoidance rate equates to one flight in 50 in which a bird does not avoid a turbine, and 99% avoidance rate equates to one flight in 100 in which a bird does not avoid a turbine. Based on experience with a wide range of bird species, it is assumed that virtually all species have high capacity to avoid collision with the static components of turbines. Avoidance rate for these components is thus consistently considered to be 99% in all modelling. Various avoidance rates are modelled for the dynamic turbine components because it is not certain how adept Brolgas might be at evading collision. For this reason results are provided for 95%, 98% and 99% avoidance rates for the dynamic components of turbines.

Since the turbine tower below rotor swept height is always a static component and poses minimal collision risk, the model takes this into account by dividing flights into those below turbine rotor height, and those within the height zone swept by turbine rotors.

AWP77 turbines are proposed to be installed at the Mortlake Wind Farm. Dimensions and other specifications of these turbines, used for the modelling, are as supplied by Acciona Energy Oceania Pty. Ltd.

In the model, the turbine is decomposed into its static and dynamic components. The static components are the nacelle, tower structure and the body of the blades. The dynamic component is the volume swept by the leading edge of the blade in the time it takes the species of interest to pass safely across the depth of the swept disk. It is thus calculated from an interaction between the size and speed of the rotor blades and the length and flight speed of the bird in question.

The risk assessment accounts for a combination of variables that are specific to the Mortlake East Wind Farm and to data for Brolgas from the vicinity of the farm. They include the following:

a) The numbers of Brolga flights below rotor height, and for which just the lower portion of turbine towers present a collision risk.

b) The numbers of Brolga flights at heights within the zone swept by turbine rotors, and for which the upper portion of towers, nacelles and rotors present a collision risk.

c) The numbers of bird movements-at-risk, as recorded Brolgas during timed point counts, are extrapolated to determine an estimated number of movements-at-risk the species makes in an entire year. Account is taken of the portion of the year that birds are within proximity of the wind farm site and that they may thus be at risk.

d) The mean area (m^2 per turbine), of tower nacelle and stationary rotor blades of a wind generator that present a risk to birds. Thus, the mean area presented by a turbine is between the maximum (where the direction of the bird is perpendicular to the plane of the rotor sweep) and the minimum (where the direction of the bird is parallel to the plane of the rotor sweep). The mean presented area is determined from turbine specifications supplied to Biosis Research. It represents the area presented to an incoming flight from a random direction.

e) The additional area (m^2 per turbine) presented by the movement of rotors during the potential flight of a bird through a turbine. This information is determined via a calculation involving species specific, independent parameters of flight speed and body length and supplied turbine specifications.

f) A calculation, based on the total number of turbines proposed for the wind farm, of the number of turbines likely to be encountered by a bird in any one flight. This involves a two step process. Two possible extremes exist depending on the way that turbines are arrayed in the landscape. In the first, the turbines are clustered or scattered. The alternative is that there is a single linear array of turbines. Analytic expectations for the number of turbines with which the flight of a bird might interact are generated for each of these alternatives and the model then uses a weighted average of the two values to generate a site specific value of risk.

Wherever bird utilisation data are available from point count surveys, these provide values for Brolga movements for use in the modelling process. However, where empirical data are not available, informed scenarios can be used. In the case of Brolgas at Mortlake East, empirical data were available from the 2007 breeding season and from 2007/08 migration activity. During 2007/08 the closest flocking site to the Mortlake East Wind Farm was in the vicinity of Lake Barnie Bolac to the north of the wind farm and flocking behaviour is not considered to pose risks of turbine collisions. During the period of monitoring at the wind farm in April 2008 two pairs of Brolgas were consistently within the wind farm area, and, at times one or two single additional adult birds were there. This behaviour, in which some birds remain at certain locations year-round, is not entirely unusual and raises the possibility that birds may remain within the wind farm area routinely. To account for this possibility, a risk for such birds was modelled on the basis that their flight behaviours remain similar to those documented during the breeding season.

The rationale and input values used for each element of the Brolga's annual cycle are outlined below.

3.4 Rationale and input values

3.4.1 Breeding season

Breeding season duration

The annual breeding season for Brolgas in south-western Victoria spans approximately 130 days and this period has been used for the model.

Information suggests that this period may be longer for occasional birds in some seasons, but in the absence of data for this, 130 days seems reasonable for the population.

Number of individuals at risk

Seven pairs of Brolgas (14 adults) were documented within 3 km of Mortlake East Wind Farm during the 2007 breeding season (Brett Lane & Assoc. 2008)

The number of juveniles has been derived as follows. Chicks of a given breeding season are at minimal risk in that season because they generally are not fledged until late in the breeding season. However, many fledged juveniles remain with parents for up to 11 months (Marchant & Higgins 1993) and thus may be at risk in a substantial portion of their second season. Population ratio of juveniles to adults is estimated at 0.05 (Herring 2001 *in* McCarthy 2008). There is thus an expected average of 0.7 juveniles with 14 adults per annum.

Thus we have modelled for an average total of 14.7 birds at risk per annum.

We have no basis on which to differentiate risk to adults and first-year juveniles, so risk prediction for the two age-classes is directly proportional to ratio of adults to juveniles in the population.

Numbers of movements at risk

Numbers of Brolga flights of sufficient length to reach, and thus potentially to interact with, turbines are 413 within rotor-swept height and 382 below rotor-swept height. Numbers are derived from records of Brolga flights provided by Brett Lane & Assoc. (2008) and factored by Symbolix to an 80% confidence bound. Since data for a single season only are available, this factoring provides a conservative probability distribution to account for potential variables that might influence these values over a range of years and environmental conditions.

The total number of flights is the combination of 413 routine movements during breeding season and 18 'migratory' flights in and out of the site (2 flights per annum x 9.2 birds, based on an annual average of 14.7 birds using the site, 9.2 of which seasonally leave the site (see 3.4.3 *Non-breeding season* below)).

Number of turbines

It is assumed that it is possible for Brolgas to interact with the complement of 46 turbines proposed for the entire wind farm during the breeding season.

3.4.2 Migration season

Historical data confirms that the site is at the southern extremity of the Brolga's distributional range, which means that any migration will simply be of birds moving out, and back into, the site, but that there is almost no likelihood of numbers of birds moving through the site in passage between locations outside of the site. Since flights by birds out of the site, and back into it, when they move between breeding and flocking locations, simply constitute a single additional flight in and a single flight out by each bird, those flights have been added to the number of flights modelled as part of the breeding season for the number of individuals which do not remain year-round (see 3.4.1 *Breeding Season*).

3.4.3 Non-breeding season

Flocking

A minimum of 5 km will be maintained between the nearest site where flocking events are known to occur and any turbine. Five kilometres is considered to be greater than the maximum distance that flocking birds might fly to foraging locations (i.e. all records of such movements are of less than five km). Flocking is thus not considered to entail any risk of turbine collision.

Non-breeding season resident Brolgas

A small number of adult Brolgas were recorded as resident at the site during the non-breeding period in 2008. Flights during this behaviour constitute a collision risk and modelling has been undertaken to account for this addition to the risks posed during the annual breeding season.

Modelling has been undertaken for birds residing within the wind farm site for the entire year as a simple continuum of birds that are on-site during the breeding season. Monitoring in subsequent years will further inform this and allow adjustment to the model if results suggest that is warranted.

Non-breeding season duration

The annual non-breeding season for Brolgas in south-western Victoria spans approximately 235 days and this period has been used for the model.

Number of individuals at risk

Two pairs (4 adults), and variably one or two additional single adults, were documented within 3 km of Mortlake East Wind Farm (I. Veltheim pers. comm. Oct 2008). A total of 5.5 individuals was thus used for modelling this element of risk.

Numbers of movements at risk

Numbers of Brolga flights of sufficient length to reach, and thus potentially to interact with, turbines are split into those within rotor-swept height (34 – 109 metres above the ground) and those lower than 34 metres. The numbers of flights were, respectively, 747 within rotor-swept height and 690 below rotor-swept height. For the purposes of this exercise, and in the absence of flight data for resident Brolgas during the non-breeding period, it is considered reasonable to assume that flight activity of Brolgas that remain close to breeding sites for the non-breeding portion of the year will be similar to that of the breeding season. Therefore numbers of flights are derived from records provided by Brett Lane & Associates (2008) for the breeding season and factored by SymboliX to an 80% confidence bound. Since data for a single breeding season only are available, the 80% factoring provides a conservative probability distribution to account for potential variables that might influence these values over a range of years.

Number of turbines

It is assumed that it is possible for resident Brolgas to interact with the complement of 46 turbines proposed for the entire wind farm during the non-breeding season.

3.5 Reporting Measures

Model predictions are in terms of mean number of collisions per annum. It is assumed that a collision results in a mortality. In the real event, deaths are measured in whole birds (not fractions of birds). The model provides a predicted annual average number of collisions, but the number of actual collisions that might occur in a given year can obviously vary in a distribution around an average, from zero to some maximum.

3.6 Qualifications

Input values to collision risk modelling are derived from empirical data provided by others, wherever that was available. Empirical data for Brolga activity in and near the Mortlake East site have been obtained only during 2007 and 2008. It is possible that those data are not truly representative of longer timeframes encompassing different environmental conditions. Where input values were required and empirical data were not available, values are informed assumptions based on relevant available information.

4.0 RESULTS

4.1 Breeding season

Modelled estimates of mean annual number of Brolga collisions during annual breeding seasons with turbines at the Mortlake East Wind Farm are:

95% avoidance rate: 0.040

98% avoidance rate: 0.019

99% avoidance rate: 0.013

4.2 Non-breeding season

Modelled estimates of mean annual number of Brolga collisions during annual non-breeding seasons with turbines at the Mortlake East Wind Farm are:

95% avoidance rate: 0.068

98% avoidance rate: 0.034

99% avoidance rate: 0.022

4.3 Annual risk predictions

The estimated mean number of Brolga collisions at Mortlake East Wind Farm for the entire annual cycle is the sum of modelled estimates for the annual breeding and non-breeding periods. These estimates are provided in Table 1.

Table 1 Estimated number of Brolga collisions with turbines at Mortlake East Wind Farm

Avoidance rate	**95%**	**98%**	**99%**
Breeding season	0.040	0.019	0.013
Non-breeding season	0.068	0.034	0.022
Annual total	**0.108**	**0.053**	**0.035**

5.0 CONCLUSION

This report provides results of collision risk modelling as estimates of annual average numbers of Brolga collisions with turbines at the proposed Mortlake East Wind Farm. Results are based on behaviours of Brolgas in the absence of turbines as there are currently no data available for actual interactions between the species and wind turbines.

Depending on mean avoidance capacity of Brolgas, predictions range from an annual average maximum of 0.108 collisions per annum to an annual average minimum of 0.035 collisions per annum. If Brolgas have an avoidance rate that is greater than 99%, then fewer than0.035 collisions per annum can be expected. Overall, the modelling suggests that relatively few collisions are likely to occur. Potential effects of the predicted levels of mortality on the south-western Victorian Brolga population will be assessed using a Population Viability Analysis specifically developed for the population.

Turbine collision avoidance rates for a wide variety of bird taxa are virtually all above 90%, with many being above 98%. Brolgas are known to collide with powerlines, which demonstrates that their capacity to avoid man-made obstacles is not perfect. We consider that avoidance capacity of Brolgas is likely to be above 95%, however other than that, we do not consider that there is, as yet, any basis for suggesting an appropriate avoidance rate for the Brolga in south-western Victoria.

On the assumption that the species' capacity to avoid collisions is 95% or higher, the annual average number collisions with turbines is predicted to be 0.108 or fewer. This equates to an approximate average of less than one Brolga collision in ten years. As noted above, the model cannot forecast the frequency of collisions around the predicted annual average and it should be expected that, if collisions actually occur, the number may vary from year to year in a fashion that cannot be predicted. This is particularly the case because real collisions entail whole birds and, since Brolgas frequently fly in flocks, more than one individual may be involved in a particular collision event.

We are aware that a body of experience with the European or Common Crane *Grus grus* suggests that they rarely collide with wind turbines in Europe and may have high avoidance capacity. Nonetheless, we are cautious about direct application of that experience to Brolgas because of substantial differences between the ecologies of the two species. These include the long, international annual migrations of European Cranes, for which there appears to be the most knowledge in Europe about their interactions with wind farms. The south-western Victorian Brolga population makes short-distance 'migrations' between breeding and flocking sites within a regional context and does not undertake long-distance migrations similar to those of the European Crane. In addition, movements by Brolgas are responsive to quite variable local conditions. In these respects ‘migratory’ movements by Brolgas are likely to be much less predictable than are the long-distance migrations of European Cranes. At the Mortlake East Wind Farm it seems likely that ‘migratory’ flights by Brolgas will entail only the departure and arrival of birds, rather than passage of birds during longer distance flights.

REFERENCES

Alonso, J.A., Alonso, J.C., Cantos, F.J. & Bautista, L.M. 1990. *Spring Crane Grus grus migration through Gallocanta, Spain. II. Timing and pattern of daily departures.* Ardea, 78: 379-388.

Anderson, J. L., 1998. *Embracing uncertainty: the interface of Bayesian statistics and cognitive psychology.* online, URL.

Ayton, P., Wright, G., 1994. *Subjective probability: what should we believe?* In: Wright, G., Ayton, P. (Eds), Subjective Probability. Wiley, New York, pp. 163-184.

Brett Lane & Associates 2008. *Proposed Mortlake Wind Farms: Brolga Breeding Season Study*. Report to Acciona Energy Oceania Pty Ltd Sinclair Knight Merz.

Brook, B.W., Burgman, M.A., Akçakaya, H.R., O'Grady, J.J., Frankham, R., 2002. *Critiques of PVA ask the wrong questions: throwing the heuristic baby out with the numerical bath water*. Conserv. Biol. 16, 262 - 263.

Burgman, M. 2005. Risks & Decisions for Conservation & Environmental Management. Cambridge University Press. Cambridge.

Ecology Partners 2008a. *Brolga Migration Season Impact Assessment, Mortlake Wind Farm, Victoria.* Report to Acciona Energy Oceania Pty Ltd.

Ecology Partners 2008b. *Historical data analysis for migration and flocking season collision risk modelling.* Letter to Acciona Energy Oceania Pty Ltd 18th September 2008.

Gigerenzer, G., Hoffrage, U., 1995. *How to improve Bayesian reasoning without instruction: frequency formats.* Psychological Review 102, 684-704.

Herring, M.W. 2001. *The Brolga (Grus rubicunda) in the New South Wales and Victorian Riverina: Distribution, Breeding Habitat and Potential Role as an Umbrella Species.* Honours Thesis. Charles Sturt University, Albury.

Marchant, S. & Higgins, P. 1993. Handbook of Australian, New Zealand & Antarctic Birds Volume 2 Raptors to Lapwings. Oxford University Press, Melbourne.

McCarthy, M. 2008. *A model of population viability to assess impacts of windfarms on the Victorian Brolga population.* Final Report June 24, 2008

McCarthy, M.A., Keith, D., Tietjen, J., Burgman, M.A., Maunder, M., Master, L., Brook, B.W., Mace, G., Possingham, H.P., Medellin, R., Andelman, S., Regan, H., Regan, T. & Ruckelshaus, M., 2004. *Comparing predictions of extinction risk using models and subjective judgement.* Acta Oecologica. 26: 67 – 74.

Symbolix Pty. Ltd. (2008). *Mortlake East Brolga - Windfarm interactions: Adjusting the Observed to the Potential.* Report to Biosis Research Pty. Ltd.

Tversky, A. & Kahneman, D., 1974. *Judgment under uncertainty: heuristics and biases*. Science 185