Stockyard Hill Wind Farm

Impact Assessment

Risks of Brolga collisions with external powerline

Prepared for Origin Energy

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Contents

Executive summary

Stockyard Hill Wind Farm Pty Ltd (SHWFPL) (a subsidiary of Origin Energy) is developing a wind farm project in south-west Victoria, known as the Stockyard Hill Wind Farm (SHWF).

The project has three components - a wind energy facility (WEF), a grid connection (overhead powerlines and terminal station) and a quarry. This document relates to the overhead powerlines component of the project.

132kV overhead powerlines are proposed to extend approximately 75 km (in total length) between the WEF and the terminal station. The overhead powerline alignment crosses land in the Shire of Pyrenees and Shire of Corangamite.

The Brolga is listed as a threatened species under the Flora and Fauna Guarantee Act 1988 and as vulnerable on the *Advisory List of Threatened Fauna in Victoria* (DSE 2013). This document provides an assessment of the potential risk of Brolga collisions with the overhead powerline proposed to connect the SHWF WEF with the external electricity grid. Collision risks for Brolgas associated with turbines and internal powerlines within the SHWF WEF are assessed separately in Biosis (2016).

Approach

Assessment of powerline collision risk for Brolgas has been undertaken as a desktop evaluation. This included review and consideration of current available information about occurrence of the species within 10 kilometres of the powerline route. The assessment is made in relation to relevant legislation and government policies aimed at conservation of the Brolga.

Regulatory requirements

A summary of the results of the assessment of powerline collision risk for Brolgas provided here in relation to key biodiversity legislation and policy is set out in Table 1, below.

Table 1 - Summary of legislation and policies relevant to this assessment

Legislation / policy	Relevant ecological feature on site	Permit / approval required	Notes
EE Act	FFG Act-listed threatened bird & bat species; defined habitats for those species	Referral under EE Act not considered warranted	Significant effect criteria not triggered.
FFG Act	Listed threatened bird & bat species	No permit requirements or other regulatory implications for fauna	
Victorian Brolga Guideline	Brolga		Brolga Guidelines stipulate achievement of no net impact on Victorian population of Brolgas

Assessment findings

For scenarios modelled for potential Brolga mortality due to collisions with the proposed SHWF external overhead powerline, this assessment found there was potential for a very low impact. The modelled estimate is for an annual average of 0.020 Brolga collisions. This estimate means that the level of effect on the Brolga population would be completely within natural variation and would thus not represent a measurable impact on the Victorian Brolga population. It is considered that implementation of mitigation and offset mechanisms recommended in Biosis (2016) to account for potential effects of Brolga collisions with turbines and internal powerlines at the SHWF WEF (and in accordance with conditions of Planning Permit No. PL-SP/05/0548) will fully address any effects of the low likely impact of collisions with the external powerline on the Victorian Brolga population.

1. Introduction

1.1 The Project

Stockyard Hill Wind Farm Pty Ltd (SHWFPL) (a subsidiary of Origin Energy) is developing a wind farm project in south-west Victoria, known as the Stockyard Hill Wind Farm (SHWF).

The project has three components - a wind energy facility (WEF), a grid connection (approximately 75km of overhead powerlines and terminal station) and a quarry. This document relates to the overhead powerlines component of the project. Collision risks for Brolgas associated with turbines and internal powerlines within the SHWF WEF are assessed separately in Biosis (2016).

132kV overhead powerlines are proposed to extend approximately 75 km (in total length) between the WEF and the terminal station. The overhead powerline alignment crosses land in the Shire of Pyrenees and Shire of Corangamite. The design of the powerline varies along the total alignment and further detail is provided in Figure 1 and Figure 2 below.

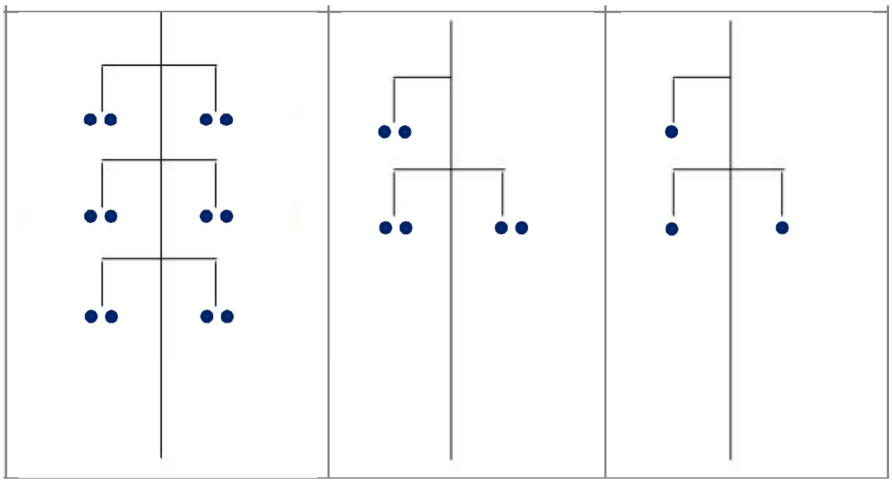


Figure 1 – Overhead Powerlines Cross Sections (left – double circuit twin conductor, centre – single circuit twin conductor, right – single circuit single conductor)

1.2 Purpose of document

This document provides an assessment of potential risk of Brolgas colliding with an overhead powerline connecting the SHWF WEF to the external electricity grid.

2. Approach to powerline collision risk assessment for Brolga

This assessment addresses potential risk of Brolgas colliding with the proposed SHWF overhead powerlines proposed to connect the SHWF WEF with the electricity grid.

The Brolga is listed as a threatened species under the Flora and Fauna Guarantee Act 1988 and as vulnerable on the *Advisory List of Threatened Fauna in Victoria* (DSE 2013). The requirement for assessment of the risk of Brolgas colliding with overhead powerlines associated with wind energy developments is stipulated in the Brolga Guidelines (DSE 2012). This report provides quantitative assessment of that risk by modelling potential collisions by the species.

2.1 Comparison with previously proposed powerlines

Assessment of collision risk for Brolgas was undertaken for powerlines associated with SHWF as planned in 2009 (Biosis Research (2009), and subsequently permitted in 2010[1]. The 2009 assessment was combined for all overhead powerlines associated with the SHWF WEF as then proposed, including those within the wind farm and the alignment from the wind farm to the external electricity grid. During the latter half of 2011, the 'permitted' overhead powerline route and terminal station site were reviewed and it was determined that a site closer to the crossover of the 500kV and 220kV lines was preferable and that a site to the south of Lismore on Lower Darlington Road was identified as suitable[2]. This report considers the external powerline only. Overhead powerlines internal to the SHWF WEF are considered in a separate report (Biosis 2016).

The majority of the proposed external overhead powerline uses a different route from the alignment permitted in 2010. The current alignment has been selected using a multi-criteria analysis, in which greater distance from sites known to be used by Brolgas was an important factor. The combination of the distinction between internal and external powerlines and changes to their alignments means that Brolga collision risks predicted for the 2010 and proposed overhead powerlines are not readily comparable. However, the average distance from Brolga breeding sites to the current internal and external powerline routes is greater than it was for the previous alignments and, on balance, the risk of powerline collisions is thus reduced.

[1] Planning Permit Nos. 2009/104 and 2009/105 were issued by the Minister for Planning on 26 October 2010 to enable the construction of a 132kV/500kV terminal station near Berrybank and for the removal of native vegetation associated with the construction of a 132kV overhead powerline between the SHWF and the terminal station..

2.2 Background to quantitative risk modelling

Collisions of birds with powerlines have been documented to occur at various frequencies around the world. However, quantification of this risk has not often been attempted and numerical modelling to estimate the number of powerline collision mortalities of threatened taxa has not been widely applied.

The impact of any collisions on the viability of threatened fauna populations is more important than determination of simple numbers of mortalities and, where applicable, population models can be used in combination with results of collision risk models to evaluate such impacts.

Mathematical modelling of risk is intended to provide an articulated, transparent and replicable evaluation of what may occur in the real world. The rationale behind predictions is explicitly stated in the mathematics of a model, which means that the logical consistency of the predictions can be easily evaluated. The explicit nature of inputs and rigour entailed in modelling means that the process is replicable and consistent and it is open to analysis, criticism or modification when new information becomes available. Although it is necessary to include some assumptions and arbitrary choices when deciding on the structure and parameters of a model, these choices are stated explicitly.

Models are also valuable for their heuristic capacities as they focus attention on important processes and parameters entailed in risk (Brook *et al.* 2002). Their very nature facilitates incorporation of information as it is learnt (Burgman 2005) and refinements should thus be expected of any model.

The only alternative to this quantitative approach is one of qualitative subjective judgement. All the benefits of using mathematical modelling outlined above are difficult, if not impossible to achieve with a qualitative assessment.

2.2.1 Purposes of collision risk & population models

There are two fundamental questions that any assessment of bird collisions with man-made structures should attempt to address.

The first asks, *'how many individual animals are likely to be killed in collisions?'*

The second asks, *'what impact will the expected number of mortalities have on the viability of the species or population?'*

Collision risk models are designed to address the first question and this report outlines collision risk modelling for the proposed external powerline for the amended SHWF WEF. Depending on the results of collision modelling, a population model may have capacity to address the second question.

2.3 Background to collision impact assessment for Brolgas at SHWF overhead powerlines

The Victorian Brolga population is estimated at between 400 and 600 birds with the great majority of the population centred on the south-western volcanic plains. Habitat suitable for Brolgas has quite specific characteristics including shallow wetlands and meadows traditionally used for breeding and flocking. The birds also forage out from wetlands into low-lying pasture and cropped agricultural land. Availability of suitable wetlands is heavily influenced by annual rainfall and, more permanently, by drainage of wetlands. Outside of the flocking season pairs of Brolgas are

territorial and do not tolerant close proximity of other Brolgas. As a result of these factors Brolgas are relatively scarce and, for much of the year are widely dispersed even in suitable areas of their range. During the annual flocking season they congregate at a few key sites where they roost and undertake important social activities. During this period of the year they also disperse out into the local landscape to feed.

Brolgas spend significant portions of their time on the ground. They obtain their food on the ground and walking occupies a large part of their activity cycle. Flights are relatively infrequent and are undertaken primarily when moving between locations of concentrated terrestrial activity, such as between a nest site and preferred foraging areas, between foraging areas and during displays. Thus long periods of field observation generally document few flights.

Martin & Shaw (2010) investigated the question of why birds collide with powerlines and determined that the forward vision of cranes is such that it may significantly limit their ability to detect powerlines. That is likely because, amongst other things, they have evolved to fly in the open sky where there are few obstacles to avoid. The authors showed that the visual fields of such birds are very different from those of humans.

Brolga collisions with powerlines have been reported from Victoria (Goldstraw & Du Guesclin 1991) and marking of powerlines has been demonstrated to reduce collisions by cranes in some overseas studies (e.g. Brown & Drewien 1995, see also review in Barrientos *et al.* 2011).

In a study of Sarus Cranes *Antigone antigone* (the most closely related species of crane to the Brolga) by Sundar & Choudhury (2005), collisions with low voltage distribution lines occurred more frequently per unit of powerline length than they did with larger, higher voltage lines.

Quantified assessment of the potential for Brolga mortalities to occur as a result of collisions with overhead powerlines was first undertaken as a component of impact assessment in 2009 for the then proposed SHWF overhead powerlines (Biosis Research 2009). That assessment was undertaken on the basis of scenario modelling. The scenarios were informed by general ornithological knowledge and published information about the biology of the south-western Victorian Brolga population; previous database records of Brolgas from the relevant area; and specific information about frequency and heights of Brolga flights obtained from field observations recorded by Brett Lane & Associates (2009).

Algorithms and mathematical computations for some key inputs to collision risk modelling, such as for the lengths and heights of Brolga flights, were determined by Symbolix (2008) on the basis of data provided by Brett Lane & Associates (2009). Due to uncertainties and the likelihood of variables that were not encompassed by the available field data, a level of conservatism was introduced by the use of an 80 percentile confidence boundary on values obtained from the field data. The 2009 collision risk modelling used scenarios for likely interactions by Brolgas with the proposed overhead powerlines that then included alignments within the overall wind farm area and a longer section connecting to the external electricity grid (Biosis Research 2009).

Risks associated with the 2016 proposed external overhead powerlines connecting SHWF WEF with the electricity grid are assessed using the methodology developed in 2009, with a similar set of informed scenarios.

Potential for Brolga collisions with wind turbines and powerlines within the WEF itself are considered separately (Biosis 2016).

For the purpose of this assessment it is assumed that Brolga flights to and from focal locations including breeding sites and one identified intermittent flocking site within a given proximity of the powerline are at some risk of collision and, since no quantified rate for such collisions is available

for Brolgas, a rate was determined from published rates for powerline collisions by other species of cranes overseas.

Population viability analysis (PVA) uses information about the demographic functioning of a wildlife population, including rates of survival, mortality, fecundity, immigration and emigration to evaluate the threats faced by the species in terms of its risks of extinction or decline. As outlined in the Brolga Guidelines (DSE 2012) a PVA model has been prepared specifically for assessment of effects on the Victorian Brolga population. This demographic model evaluates the effect of predicted mortalities on extinction risk for the population.

In the present case the capacity of PVA to evaluate the modelled rate of mortalities due to Brolga collisions with the external powerline has been considered.

The collision risk model and PVA are predictive mathematical models. All such models are mathematical tools designed to represent what might occur in reality. Modelling for scenarios necessarily incorporates various well-informed assumptions and it should be understood that the results of modelling are reliant on the assumptions used. However, the assumptions and modelling processes are transparent in that every parameter and value used as an input to the models is defined and explicit.

2.3.1 Seasonal activities of Brolgas

As described above, the activities of Brolgas that may place them at some risk of interaction with the external powerline fall into distinct seasonal categories:

1. breeding season
2. non-breeding season flocking aggregation

Due to differences in the frequency and other characters of Brolga flights and of the number of birds that may be involved, a scenario has been modelled for each of these seasonal behaviours. An annual estimate of risk has been determined as the sum of the results for these three modelled seasonal activities.

2.3.2 Brolga utilization & data analyses

A measure of the number and frequency of bird flights is termed the 'utilization rate' for the particular species at the site in question. Brolga utilization data were collected during field investigations in the area of SHWF WEF and are detailed in Brett Lane & Associates (2009). The utilization data from this geographic area is suitable for consideration of potential Brolga collisions with wind turbines or powerlines for the revised external powerline. No additional Brolga utilization data have been collected since 2009 and estimates of annual numbers of Brolga movements that might interact with powerlines were determined on the basis of the available Brolga utilization data.

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 entirely representative of longer timeframes encompassing different conditions. Algorithms and mathematical computations for some key inputs to collision risk modelling, such as for the lengths and heights of Brolga flights, were determined by Symbolix (2008) on the basis of data provided by Brett Lane & Associates (2009). Due to uncertainties and the likelihood of variables that were not encompassed by the available field data, a level of conservatism was introduced by the use of an 80 percentile confidence boundary on values derived from the field data. This mechanism substantially increases the potential number of Brolga flights incorporated into the modelling.

2.3.3 Powerline collision risk model

The risk of Brolgas colliding with overhead powerlines at SHWF WEF has been evaluated using the principles and methods used in 2009 (Biosis Research 2009) as set out below.

Brolgas are known to occasionally fatally collide with powerlines in Victoria, although published documentation of this is limited and is not recent (White 1987; Goldstraw and du Guesclin 1991). There are no empirical data about Brolga collisions with powerlines in south-western Victoria that might provide a basis for quantifying them. While there is a substantial international literature about bird collisions with powerlines, there are relatively few rigorous studies that have attempted to quantify rates of collision and fewer still of them have investigated effects on cranes. In the absence of empirical data for Brolgas, the approach to assess potential risk is based on the annual cycle of Brolga activities and behaviours and specific information including the following:

- Alignment location information for proposed SHWF overhead powerlines.
- Distances from core of breeding territories and one intermittently used flocking site to the nearest location of the proposed powerline for all Brolga sites within five kilometres of the powerline (Brett Lane pers. comm. 2008).
- Data from the local Brolga population quantifying numbers of flights made by individual Brolgas per annum at breeding sites and one known intermittent flocking site and the lengths of those flights (Brett Lane and Associates 2009).
- Data from the local Brolga population quantifying the number of birds using Brolga sites per annum (Brett Lane and Associates 2009).
- A collision rate for powerline crossings, based on studies of other crane species reported in the international literature. Two published studies provide calculated rates or values from which rates could be derived for the number of powerline crossings that resulted in collisions. Janss and Ferrer (2000) studied the Common Crane and Morkill and Anderson (1991) studied the Sandhill Crane. Those investigations were both substantial and encompassed thousands of potential interactions by cranes with powerlines. Those studies of cranes that provide quantified rates of collision with powerlines have been used to provide 'benchmark' values for the purposes of evaluating possible collision rates for Brolgas.

2.3.4 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.

The model cannot forecast the frequency of collisions around the predicted annual average and it is important to recognize that the number of any actual collisions that might occur can be expected to vary from year to year.

2.3.5 Qualifications

Empirical data quantifying rates of Brolga flight activity and heights and lengths of flights near the SHWF overhead powerlines were obtained by Brett Lane & Associates during 2007 and 2008. Specific input values required for collision risk modelling are derived from that empirical data. Consultation with DELWP in 2015 indicated their satisfaction with this approach, for the purposes of assessing the impact of the proposed overhead powerlines. It is possible that this data is not representative of longer timeframes encompassing different environmental conditions and, as noted above, values used in the modeling accounted by this by the use of an 80 percentile confidence boundary on values derived from the field data. Where input values were required and empirical data was not available, values are informed by assumptions based on relevant available information.

2.4 Approach to external powerline collision risk modelling for Brolgas

Brolga utilization rates; analyses of the numbers of Brolgas occupying breeding and flocking sites; numbers of flights made by individual Brolgas at breeding sites; and the lengths of flights used for modelling of Brolga powerline collision risk are set out below and are consistent with those used for collision risks associated with turbines and internal powerlines for the amended SHWF WEF in Biosis (2016).

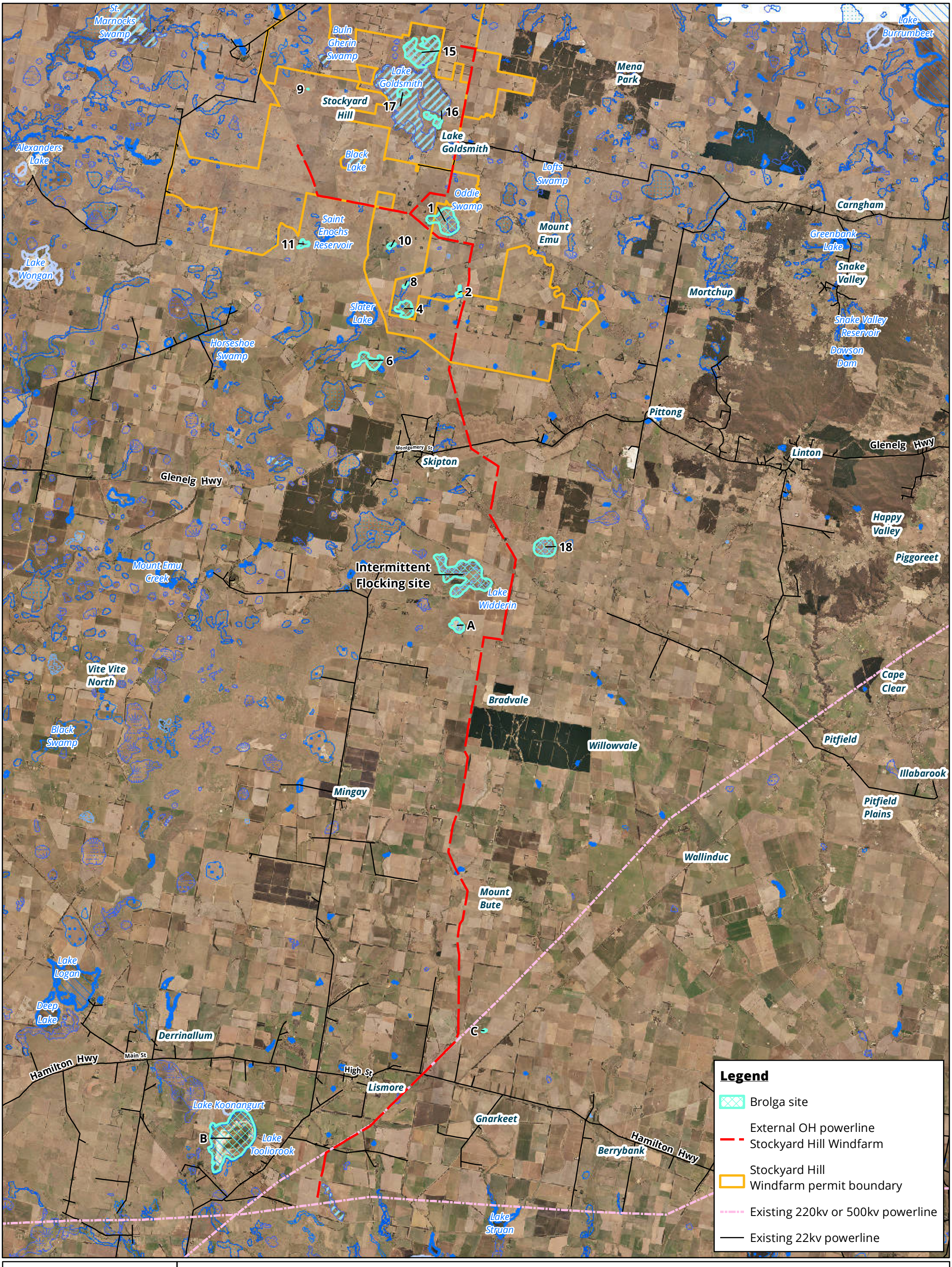
The proposed external powerline indicates that Brolga flights to and from up to 15 breeding sites have potential to encounter, and potentially to collide with, the powerlines. In addition, Widderin Swamp is occasionally used by flocking Brolgas outside the breeding season and is with 5 kilometres of the proposed powerline route. Brolga flights to and from that location have been included in the powerline collision assessment here. The external powerline route and documented Brolga sites within 5 kilometres of it are shown in Figure 2, below.

Data for the lengths of Brolga flights was used to calculate the mean percentage of all flights that would be long enough to reach or cross the powerline, given it runs in a straight line past a breeding or flocking site at a specified minimum distance. While the longest flight recorded during the field investigation was 3.2 kilometres, this may have been limited by the capacity of observers to record movements of Brolgas beyond a certain distance (Brett Lane pers. comm.) and longer flights may occur. However the data for the numbers of flights of all distances recorded during breeding periods allow extrapolation using a 'decay curve' which indicates that flights rarely exceeded 5 kilometres in length.

The average number of individual Brolgas present in breeding territories and that had capacity to fly far enough to reach or cross the powerline was multiplied by the mean number of flights made by an individual bird per breeding season or flocking period, as supplied from Brolga movement data collected and provided by Brett Lane & Associates (2009). This provided an average total for the number of Brolga flights per annum.

While there are records of a total of 15 Brolga breeding territories within five kilometres of the proposed external powerline, database records indicate that few of them are occupied in any given year. For the purposes of modelling risk, we consider that an average of 8 identified breeding sites may be occupied by Brolgas in any given year and hence we have modelled for an annual average of 8 occupied breeding sites.

Locations of Brolga sites relative to external powerline, Stockyard Hill Wind Farm



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The mean annual breeding population for 8 breeding sites would be 16.8 birds. This is comprised of 16 adult birds and an annual average of 0.8 juveniles. 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). There is thus an expected average of 0.8 juveniles that are likely to be in company with 16 adults per annum. We have no basis on which to differentiate risk for 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.

Records of Brolga movements indicate that, on average each bird makes 220 flights during a breeding season.

For Widderin Swamp intermittent flocking site, we have used the same rationale as used in 2009, which is that it may be used on average once every 5 years by 12 Brolgas for an average of 21 days during the flocking season. While using the site each bird will make an average of 4 flights per day and thus a total of 84 flights over the 21 days. During such a use of the site there will thus be an overall total of 1008 Brolga flights.

The percentage of Brolga flights that might reach or cross the powerline for each territory and during a flocking event at Widderin Swamp is shown in the right hand column of Table 3, below.

Table 3 – Distances from centrepoint of breeding sites & one flocking site showing percentages of Brolga flights with potential to encounter overhead powerlines external to SHWF WEF

Breeding site	Distance to powerline from territory centre (kilometres)	% of flights crossing the powerline route
1	0.45	16%
2	0.42	17%
4	2.65	2%
6	3.70	1%
8	2.95	2%
9	2.36	2%
10	0.59	14%
11	2.41	2%
15	1.59	5%
16	1.25	7%
17	4.29	1%
18	1.71	5%
A	2.36	3%
B	3.37	1%
C	2.64	2%
Widderin Swamp intermittent flocking site	1.82	4%

2.4.1 Calculation of flights at risk

The total number of Brolga flights per annum was multiplied by the percentage of flights that are of sufficient length to reach or cross the mean distance to the powerline, given that it runs in a straight line past a breeding site at a specified minimum distance. The mean percentage of flights for the 15 breeding sites is 5.3%.

This calculation provides an annual average number of Brolga flights that might cross the powerline route. Table 4 shows the derived number of flights to and from each of 15 breeding sites and Widderin Swamp intermittent flocking site that are at risk of encountering the external powerline under the modelled scenario.

Table 4 - Modelled number of Brolga flights at risk of encountering the external powerline.

Breeding site	Estimated number of flights that may reach or cross powerline during a season in which site is occupied
1	74
2	79
4	9
6	5
8	9
9	9
10	65
11	9
15	23
16	32
17	5
18	23
A	14
B	5
C	9
	370
Widderin Swamp intermittent flocking site	40

As we consider that a maximum of 8 identified breeding sites may be occupied by Brolgas in any given year, we have modelled for an annual average of 197 flights that may encounter the powerline. On the basis that Widderin Swamp intermittent flocking site may be used on average once every 5 years there is an annual average of 8 flights to and from that site per annum that may encounter the powerline.

Finally, the annual average number of Brolga flights that might cross the powerline route was multiplied by a proportion of powerline crossings that might result in a collision.

On the assumption that every powerline collision results in a fatality, the final value is considered to represent a potential number of Brolga mortalities that could occur per annum.

Based on values provided by Morkill and Anderson (1991), we have calculated that they recorded 2.5 collisions per 100,000 powerline crossings by Sandhill Cranes (2.5 x 10-5 collisions per crossing). Janss and Ferrer (2000) provide estimate values ranging from 1.9 to 4.76 collisions per 100,000 powerline crossings by Common Cranes (from 1.9 x 10^{-5} to 4.76 x 10^{-5} collisions per crossing). These published studies of cranes are the closest comparable information available for

evaluation of the situation for Brolgas. However, we do not know how closely Brolga behaviour conforms to that of these other species. In order to provide a conservation approach we have chosen to use 1 collision per 10,000 powerline crossings (1.0×10^{-4} collisions per crossing) for our evaluation of risk to Brolgas.

Following the methods outlined above we have the following equations to determine a potential annual number of Brolga fatalities that might occur as a result of collisions with the proposed internal overhead powerlines:

For breeding sites:

- 16.8 birds in the population x 220 flights per bird x 5.3% (percentage of flights for all 15 breeding sites that could cross the powerline route) x 1.0×10^{-4} collisions per powerline crossing.

For the one intermittent flocking site:

- 12 birds in the population x 84 flights per bird x 4.0% (percentage of flights that could cross the powerline route) x 1.0×10^{-4} collisions per powerline crossing. The result of this equation is divided by 5 for the average number of years in which the site is used.

3. Assessment of collision risk for Brolga

The modelled equation for potential annual collision risk for Brolgas with the proposed powerline during the breeding season is:

- 16.8 birds in the population x 220 flights per bird x mean 5.3% flights that could cross the powerline route (= 196) x 1.0 x 10^{-4} collisions per powerline crossing.

The result is an estimated annual average of 0.020 Brolga collisions during the breeding season.

The modelled equation for potential annual collision risk for Brolgas with the proposed powerline during use of the one intermittent flocking site is:

- 12 birds in the population x 84 flights per bird x 4.0% of flights that could cross the powerline route (= 40) x 1.0 x 10^{-4} collisions per powerline crossing.

This provides an estimated average of 0.004 Brolga collisions which is divided by 5 for the average number of years in which the site is used, giving an annual average 0.0008 Brolga collisions during the flocking season.

The ultimate result of the modelling indicates a potential for an annual average of about 0.021 Brolga collisions with the proposed external powerline.

3.1 Management of potential impacts

It is intended that any reduction of the Brolga population resulting from development of the SHWF WEF will be mitigated by management actions to be implemented through the preparation of a Bat and Avifauna Management Plan, so that there will be, at most, a zero net impact on the population (DSE 2012). The Brolga Guidelines set out a process whereby potential effects of the predicted levels of mortality on the south-western Victorian Brolga population can be assessed on the basis of population viability analysis using demographic information for the Victorian Brolga population (DSE 2012; McCarthy 2008). However, the mortality rate due to collisions with the external powerline, under the assumptions modelled here, is so low that it would be completely masked by natural variation in the Victorian population of approximately 400 - 600 birds and the rate is too low to provide a meaningful result using PVA.

A separate analysis of Brolga collision risk for turbines and internal overhead powerlines has been prepared for the amended SHWF (Biosis 2016). The PVA undertaken for estimated mortality for that assessment has incorporated increased rates of predicted mortality to account for both uncertainty and upward rounding of results. Those factors are substantially greater than the very small rate of collision mortalities predicted here for the external powerline and more than account for them. As a consequence, we consider that mitigation and offset measures recommended in Biosis (2016) to achieve a zero net impact on the Victorian Brolga population will fully mitigate and offset any collision mortalities that might occur due to the external powerline and thus that no additional measures are necessary.

4. Biodiversity legislation and government policy

This section provides an assessment of the proposed external overhead powerlines in relation to key biodiversity legislation and government policy. This section does not describe the legislation and policy in detail.

4.1 Commonwealth

4.1.1 Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act applies to actions that have the potential to significantly impact on Matters of National Environmental Significance protected under the Act. The Brolga is not a species listed as threatened or migratory under provisions of the EPBC Act and it is thus not a Matter of National Environmental Significance and the Act does not apply to it.

4.2 State

4.2.1 Flora and Fauna Guarantee Act 1988

The FFG Act is the key piece of Victorian legislation for the conservation of threatened species and communities and for the management of potentially threatening processes. However, there is no applicable permit requirement under the Act for impacts on species of fauna listed as threatened under the Act on any land tenure. Decision-makers are recommended to give consideration to requirements of listed threatened species when assessing development proposals.

4.2.2 Environment Effects Act 1978

The Environment Effects Act 1978 (EE Act) provides for assessment of proposed projects (works) that are capable of having a significant effect on the environment. The Act does this by enabling the Minister administering the Act to decide whether an Environment Effects Statement (EES) should be prepared. Criteria for what may constitute a significant effect, and hence whether an EES may be required, are provided in *Ministerial guidelines for assessment of environmental effects under the Environment Effects Act 1978* (DSE 2006). The following criteria are relevant to the present assessment of Brolgas:

- Potential long term loss of a significant proportion (e.g. 1 to 5 percent depending on the conservation status of the species) of known remaining habitat or population of a threatened species within Victoria
- Matters listed under the Flora and Fauna Guarantee Act 1988:
  - potential loss of a significant area of a listed ecological community; or
  - potential loss of a genetically important population of an endangered or threatened species (listed or nominated for listing), including as a result of loss or fragmentation of habitats; or
  - potential loss of critical habitat; or,
  - potential significant effects on habitat values of a wetland supporting migratory bird species.

On the basis of these criteria and the results of the modelled collision risk it is considered unlikely that a significant impact on the Victorian Brolga population will result from development or operation of the external powerline for the amended SHWF WEF.

5. Conclusion and recommendations

Collision risk modelling for scenarios encompassing potential activities of Brolgas that may represent a risk of collisions with the proposed SHWF external overhead powerline has been undertaken. The results indicate low risk of collisions. The estimated rate of Brolga mortalities due to collisions with the powerline is considered too low to obtain a meaningful result from Population Viability Analysis.

Results of the collision risk assessment here indicate there is little likelihood of the external powerline resulting in a significant impact on the Victorian Brolga population.

Mitigation and offset measures designed to achieve zero net impact on the Victorian Brolga population have been recommended separately for potential Brolga mortalities due to collisions with turbines and internal powerlines for the SHWF WEF (Biosis 2016). Results of the modelling of collision risks for the external powerline indicate that those measures will fully cover the likely effects of this powerline. We recommend that they should be implemented.

Glossary

	Description
BAM Plan	Bird and Bat Management Plan
Brolga Guideline	*Interim Guidelines for assessment, avoidance mitigation and offsetting of potential wind farm impacts on the Victorian Brolga Population 2011* (Revised 1 February 2012)
DELWP	Department of Environment, Land, Water and Planning (formally, Department of Planning and Community Development, and Department of Sustainability and Environment)
DoE	Commonwealth Department of the Environment
DSE	(former) Department of Sustainability and Environment
EE Act	Environment Effects Act 1978
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999 (Cth)
EPBC Act Approval	Decision (2009/4719) to approve the WEF (as a controlled action) was made under the *EPBC Act 1999*
FFG Act	Flora and Fauna Guarantee Act 1988
P&E Act	Planning and Environment Act 1987
Permit conditions	Conditions 15 and 16 of Planning Permit No. PL-SP/05/0548 (Pyrenees Planning Scheme)
PVA	Population Viability Analysis, a quantitative process for modelling change in natural populations.
SHWF	Stockyard Hill Wind Farm
SHWFPL	Stockyard Hill Wind Farm Pty Ltd
WEF	Wind Energy Facility

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