APPENDIX D COLLISION RISK ASSESSMENTS

A Collision Risk Assessment (CRA) has been used to evaluate the risk that the operational wind farm may pose to birds and bats. It focusses on potential for fatal collision. It does not consider barrier effects or behavioural displacement (these effects are discussed in Section 7.2 of the addendum as well as the original biodiversity assessments and are not repeated in this assessment; NGH Environmental 2013a and b).

A CRA has been undertaken for 13 birds and bats, in accordance with the evaluation in Section 5.3:

- Eastern Cave Bat
- Corben's Long-eared Bat
- Barking Owl
- Powerful Owl
- Masked Owl
- Spotted Harrier
- Regent Honeyeater
- Swift Parrot
- Large-eared Pied Bat
- Dusky Woodswallow
- Square-tailed Kite
- Eastern Bentwing Bat
- Yellow-bellied Sheathtail Bat

Methodology

The qualitative risk assessment matrix (Table D-ITable D-I R) and descriptors below have been used to assess the overall risk of the windfarm to the species in terms of potential mortalities to individuals from collision, based on the discussions that follow. As can be seen from Table D-IITable D-II, this risk assessment incorporates population considerations.

Table D-I Risk matrix with three risk levels: Low, Moderate and High, assigned based on the likelihood

Likelihood	Consequence			
	Insignificant	**Minor**	**Moderate**	**Significant**
Rare	Low	Low	Moderate	High
Unlikely	Low	Low	Moderate	High
Possible	Low	Moderate	High	High
Probable	Moderate	High	High	High

Table D-II Descriptions of likelihood and consequence ratings.

Likelihood	Description	Consequence	Description
Rare	An impact may occur only in unusual circumstances	**Insignificant**	Impact on species not detectable in the short term
Unlikely	An impact might occur at some time	**Minor**	Impact may cause non-significant changes to local abundance of species
Possible	An impact could occur during most circumstances	**Moderate**	Impacts may cause significant changes to local abundance of species
Probable	An impact is expected to occur in most circumstances	**Significant**	Impacts may be significant at a population scale

Eastern Cave Bat

The Eastern Cave Bat was recorded in the LRWF project area in open forest with grassy understorey, sandstone forest and woodland in both the TLSA and the WFSA. Little information is available about the population and ecology of the Eastern Cave Bat.

The Eastern Cave Bat roosts in colonies of 50 – 240 in sandstone overhang caves with specific characteristics, with occasional roost sites in buildings, culverts and disused mines (Churchill 2008; Law *et al.* 2005; van Dyck & Strahan 2008). Small groups (of 2-3 individuals) are also recorded roosting in Fairy Martin (*Hirundo ariel*) nests beneath bridges and culverts (Shultz 1998, Churchill 2008). They have low roost fidelity (Churchill 2008), except for maternity roosts. Females congregate in maternity colonies of up to 500 individuals during November (Van Dyck & Strahan 2008).

They are not known to be migratory. Roost sites tend to be an average of 1.5 km apart, although some are further, with one female moving 3.75 km (Law *et al.* 2005). Roosts at LRWF are far more likely to be located on the sandstone geology of the lower slopes and transmission line areas, rather than the basalt-dominated hills of the upper slopes of the Liverpool Range.

Observations indicate that the species forages over small areas flying low within the vegetation canopy (Churchill 2008), and crossing up to 500m of open paddock between stands of trees (Law *et al.* 2005).

The likelihood of turbine interaction is judged as rare (an impact may occur only in unusual circumstances) based on:

- Observations suggest this is a mostly low flying species.
- A non-migratory species with nightly movements between roosts and foraging habitat within a relatively small area.
- Roost habitat is likely to be concentrated in discreet locations rather than abundant throughout the Project Area and is unlikely to coincide with the WFSA.

The consequence of any interactions is considered moderate (impacts may cause significant changes to local abundance of the species), due to:

- Very little information being available about populations (precautionary principle).

Therefore, the Eastern Cave Bat is at moderate risk from turbine interactions at LRWF.

Corben's Long-eared Bat

Corben's Long-eared Bat was recorded in WFSA and TLSA. There are also a number of historical records in the well-vegetated areas of the TLSA. This species has been commonly recorded at the Ulan Mine site (near the southern end of the TLSA) (Glenn Hoye, pers. comm. 11/03/2015).

Whilst little is known about Corben's Long-eared Bats, it is thought that they roost solitarily under exfoliated bark and in crevices on trees, with females forming small maternity colonies in larger tree cavities during the warmer months (van Dyck & Strahan 2008). As for other *Nyctophilus* spp., Corben's Long-eared Bats probably reproduce between autumn (when copulation occurs) to summer (lactation and weaning) (van Dyck & Strahan 2008).

Despite a lack of studies confirming speculative data, it is thought that Corben's Long-eared Bats forage within a few kilometres of their roosting area (van Dyck & Strahan 2008), with larger, intact remnants of suitably forested habitat needed to sustain viable population densities.

Foraging is concentrated around and within patches of trees (SPRAT 2016, Chuchill 2008), with the highly manoeuvrable species weaving through the canopy (Churchill 2008). Corben's Long-eared Bats have undulating flight patterns, whereby insects are taken both in flight and by gleaning from vegetation or the ground (van Dyck & Strahan 2008). The bats are known to travel an average of 2 km and up to 7 km between roosts and foraging areas, with low roost fidelity (SPRAT 2016)

The likelihood of turbine interactions for this species is considered rare (an impact may occur only in usual circumstances) and the consequence is minor (may cause non-significant changes to local abundance of species), given a risk of low. This is based on:

- Mostly low level flight.
- Highly manoeuvrable flight.
- Non-migratory.
- Relatively short distance travelled between roosts and foraging areas.
- While rare, the species appears to be locally common in the region.

Barking Owl

The Barking Owl was not recorded in LRWF but could occur on site as suitable habitat is present and it is known from the area (refer to NGH Environmental 2013a, b) for more information. It was originally considered at high collision risk. However, this has been reviewed. Although the Barking Owl uses open habitat and forest edge – farmland mosaic habitat, it is a sedentary species with foraging behaviour that makes it unlikely to encounter turbine blades. In a comprehensive study of Barking Owls in the Pilliga Forests, Stanton (2011) documented the following hunting techniques:

- Sally-strike or hawking: Barking Owl perches (in vegetation) and when observes flying prey, pursues and captures prey (e.g. beetle, microbat) within 20 metres of perch
- Low quartering in short bursts around forest edge at dusk to locate prey (birds) coming in to roost, which are then swooped upon and captured
- Flush-strike: Noisily making short movements between perches within canopy, with short stays with the aim of flushing prey (birds, insects) from roosts, with the prey taken on the wing.
- Ambush / pounce on arboreal and ground mammals using perch-pounce method.

Of these hunting behaviours, the flush-strike is the most likely behaviour that would see the Barking Owl fly above the tree canopy, however, it is considered that flying within the rotor-swept area would be rare, and a collision rarer still. The effect upon the population of a Barking Owl collision is likely to be minor, giving the Barking Owl a low risk of collision.

Powerful Owl

Powerful Owl was recorded on site. The Powerful Owl swoops upon prey (mostly arboreal mammals) within the canopy and sub-canopy of woodland and forest. It is unlikely to encounter the rotor-swept area during foraging. While dispersing, it is likely that the dispersing owls fly between patches of similar habitat along vegetated corridors. Thus, the likelihood of collision for Powerful Owl is rare.

Given that the Powerful Owl was recorded on site, on two occasions and there are gully systems in the project area that provide potential roosting (and perhaps breeding) sites (refer to AoS in NGH Environmental 2013b for more information), the consequence of any collision is considered moderate. This gives the Powerful Owl a collision risk rating of moderate.

Masked Owl

Masked Owl was not recorded on site and the wet forest habitat preferred by the species is considered is marginal or absent in the LRWF project area. Originally the collision risk for Masked Owl was assessed as moderate, based on the presence of suitable habitat near turbines. Masked Owl hunts by low quartering through forest or clearings or by perch-pounce from vegetation or the ground (Schodde & Tidemann 2007). The species is unlikely to encounter the rotor-swept area while foraging. Although little information is available about dispersal methods, it is likely that the dispersing owls fly between patches of similar habitat along vegetated corridors. Thus, the likelihood of collision for Masked Owl is rare.

In the event of a collision, the consequence is considered minor (may cause non-significant changes to the local abundance of species), as the species is not known to occur on site and breeding is not known to occur in the project area. This gives the Masked a low risk for collision at LRWF.

Spotted Harrier

The Spotted Harrier was not recorded in the LRWF project area, but records do occur in the locality and suitable habitat is present on site. The Spotted Harrier is nomadic and hunts by hedge-hopping, low soaring and low quartering over open vegetation, often within five metres of the ground (BirdLife 2017, Schodde & Tidemann 2007). They breed in response to prey availability and build a new nest. Display flights involve high soaring, spiralling and plummeting (Schodde & Tidemann 2007). The likelihood of collision is considered rare given that they may only encounter the rotor-swept area during breeding display flights. The consequence of collision is minor, considering that the semi-arid and arid parts of Australia are considered the species' stronghold and key breeding areas (BirdLife Australia 2017). This gives a risk rating of low for the Spotted Harrier.

Regent Honeyeater

The critically endangered Regent Honeyeater is strongly associated with the inland/eastern slopes of the Great Dividing Range, as well as several coastal regions, particularly the Hunter Valley and Central Coast of NSW (Bird Life Australia 2016). At present the Lower Hunter Valley represents one of the most important areas of habitat for the species throughout its entire range (Roderick 2010 in Roderick *et al.* 2013).

BioNet records for the Regent Honeyeater in NSW show that:

- Most records are from three main regions, including the Capertee Valley and surrounds, coastal forests, and the Bundarra-Barraba region north of Tamworth
- Most records outside of these areas are near major roads or well-forested reserves/forests
- Records outside of the three main areas appear haphazardly scattered throughout the range of the species.

Regent Honeyeaters were not observed during surveys in the Project Area in October 2012 and 2013, although survey timing was suitable for detecting the species (Bird Life Australia 2016). The species can be difficult to detect due to (Roderick et al 2013):

- Relatively cryptic plumage
- Low population numbers
- Dispersal patterns and key habitat sites are poorly known.

Figure D-I shows a snapshot of the likely current distribution of the species and known breeding areas, as well as the approximate location of the Proposal Area.

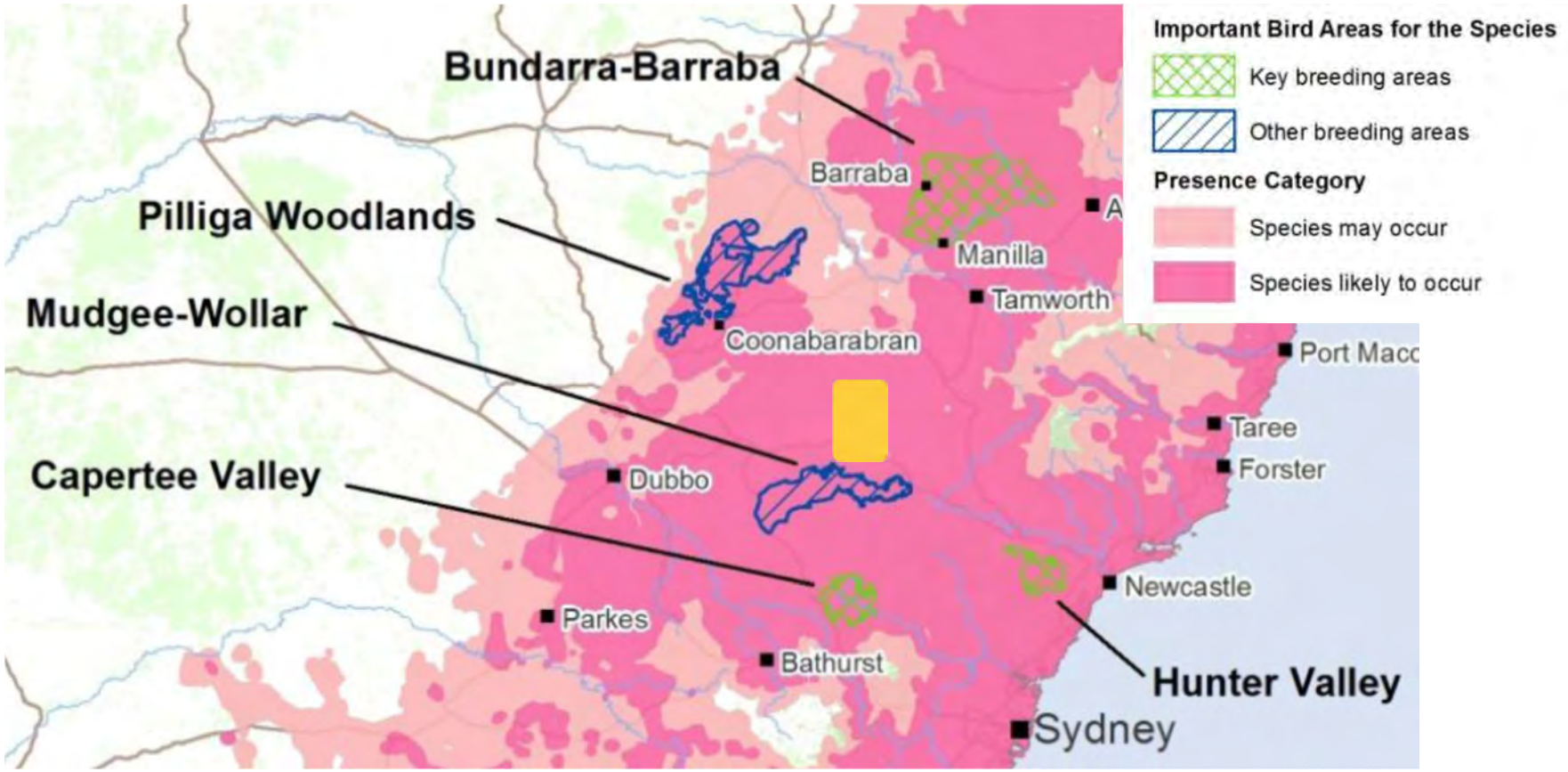


Figure D-I Presence and important areas for Regent Honeyeater (DoE 2016 p.12; only the relevant portion of map shown), with approximate location of Project Area (yellow rectangle) overlayed

The Regent Honeyeater is certainly present in the region. The Mudgee-Wollar Important Bird and Biodiversity Area (IBA) is located approximately 15 km south of the TLSA and was dedicated in part due to regular use by Regent Honeyeaters. Records nearby the proposed LRWF project are few. The closest BioNet records to the WFSA are north-east of the wind farm within Coolah Tops National Park. BioNet records also exist south and east of the southern portion of the TLSA near the Goulburn River National Park.

Regent Honeyeater habitat assessments have found (DoE 2016, Roderick *et al.* 2013, Roderick & Ingerwsen 2014):

- The species is a "rich patch specialist" > dependent on high-yielding habitats on fertile soils
- The species requires areas with high levels of tree diversity (four or more tree species)
- The probability of presence is driven by vegetation *coverage*, followed by elevation and humidity/soil moisture
- Habitat assessments in the Hunter Valley found that 39.4% of Regent Honeyeater records were from lower slopes compared to 1.4% on ridges.

To be suitable for use, remnants need to be of high quality. There are four known key breeding regions for the Regent Honeyeater: north-east Victoria (Chiltern-Albury), Capertee Valley, Bundarra-Barraba region and Hunter Valley (DoE 2016, Roderick et al. 2013). Other breeding sites used intermittently include the Australian Capital Territory, Munghorn Gap Nature Reserve and Mudgee-Wollar (DoE 2016, Roderick *et al.* 2013).

Regent Honeyeaters are a highly mobile species that may visit the Proposal Area from time to time, depending on the availability of food resources both at the site and in other areas. A Regent Honeyeater fatality has not been recorded in available wind farm monitoring data. Two potential risk periods could occur for the species: foraging while in the region, or during migration / nomadic movements through the region.

Figure D I shows that the Proposal would be located in between several Regent Honeyeater breeding areas, including being close to the Mudgee-Wollar IBA. At a glance this suggests that the risk of turbine interactions for the species would be high, as Regent Honeyeaters are likely to travel through (or stop to forage in) the region. However, the location of the proposed turbines is inconsistent with the known habitat requirements and the supposed migration style of the species:

- Turbines are proposed on ridges while the Regent Honeyeater forages in low relief areas
- Turbines are proposed on ridges while the Regent Honeyeater is thought to follow paths through forest in lower elevations and linking riparian corridors during migration
- Turbines are proposed in fragmented and degraded habitat while the Regent Honeyeater depends upon 'rich patches' for foraging, and vegetated corridors for movement paths.

Thus, the number of individuals and flights over the turbine ridges is likely to be low. This suggests that likelihood of potential collisions would be rare. As to the consequence of any fatalities:

- The species is now critically endangered (population may be as low as 350-400 individuals; DoE 2016)
- Low reproductive output (DoE 2016)
- Breeding occurs in the region from time to time (Mudgee-Wollar)

The consequence of any individual's fatality would be significant. Using the risk assessment matrix, this places the Regent Honeyeater at high risk from turbine interactions. But it must be stressed that the high risk is an outcome of consequence due to the low population size NOT likelihood of collision.

Swift Parrot

Swift Parrots were not considered in detail in the WFSA of the BA due to the paucity of records from the region, particularly within the development envelope. As for Regent Honeyeater, Swift Parrots are are "rich patch specialist" species that depend upon high-yielding habitats on fertile soils (Roderick *et al.* 2013). The species preferentially utilises richer and more fertile sites (Saunders & Tzaros 2011) that are:

- Lower in the landscape
- Along gullies
- On lower slopes.

Within the winter non-breeding habitat, Swift Parrots move nomadically through the landscape, using a diversity of foraging habitats (Threatened Species Scientific Committee 2016). The latest population estimates are of around 2000 mature individuals, including 940 breeding pairs, and that the species occurs as a single, migratory population (Roderick *et al*. 2013, Saunders & Tzaros 2011).

Swift Parrots (*Lathamus discolor*) are small, nectivorous parrots that occur in the eucalypt forests of south-eastern Australia. Analysis of BioNet Swift Parrot records in NSW shows the majority of records are located in coastal forests and the Capertee Valley regions. The records from outside of these zones are relatively haphazard and show no clear patterns or regularity of visitation. The closest Important Bird Area (IBA) identified for the Swift Parrot is the Capertee Valley, which is well south of the Project Area. There is a clear absence of records from the region surrounding the proposed LRWF project. It is likely that if Swift Parrots regularly utilised the area within the Wind Farm and around Coolah there would be records present from the region. The absence of records is most likely linked to the lack of larger patches of good quality Box-Ironbark woodland (preferred habitat) in the vicinity of the turbine layout. The degraded woodlands recorded on-site provide limited foraging resources for this species

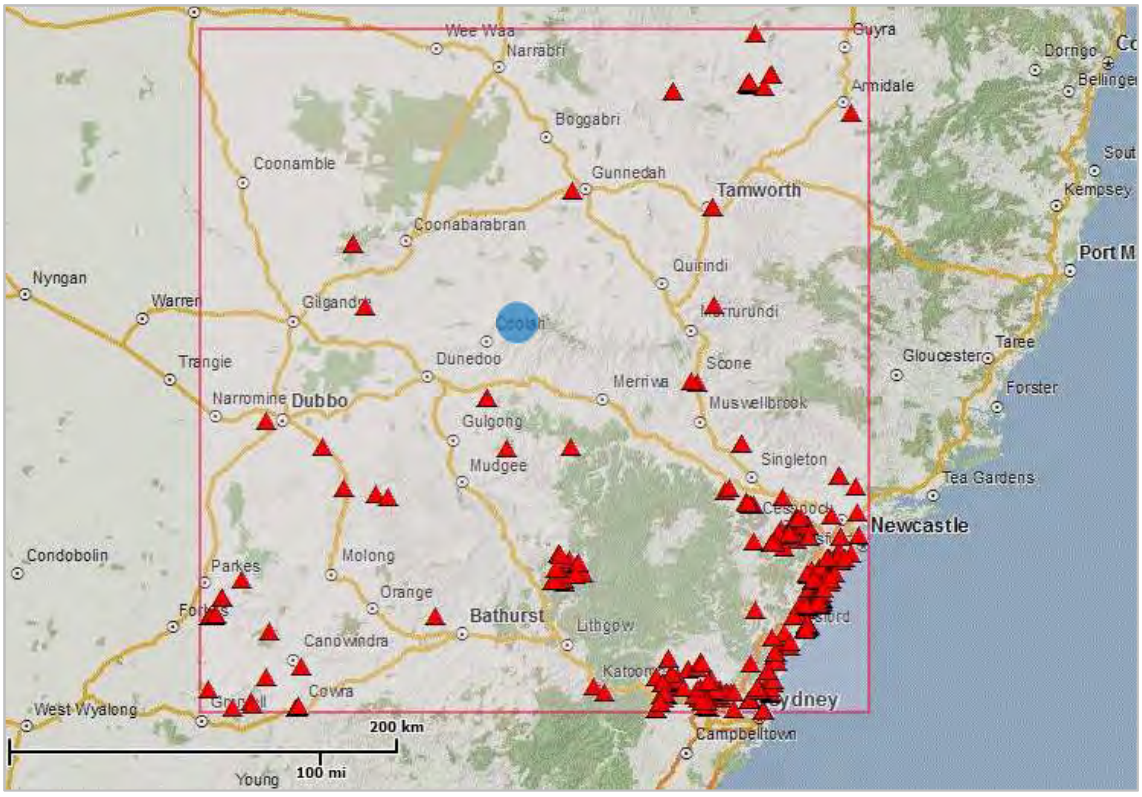


Figure D-II Location of the proposed wind farm (blue dot) within a NSW context, showing all records of Swift Parrots within about 150 km (Bionet Atlas Search Results, Office of Environment and Heritage, accessed 08/2014, http://www.environment.nsw.gov.au/mapviewerapp/)

Swift Parrots are a highly mobile species that may visit the Proposal Area from time to time, depending on the availability of food resources both at the site and in other areas. Two habitat types, the eucalypt forests of the coastal plains and the box-ironbark woodlands of the inland slopes, are considered to be the core non-breeding habitats for Swift Parrots (Kennedy & Overs 2001; Kennedy & Tzaros 2005; Department of the Environment 2014).

Within the winter non-breeding habitat, Swift Parrots move nomadically through the landscape, using a diversity of foraging habitats. The species forage in flocks in areas with high abundances of lerp, nectar and non-aggressive competitors (Threatened Species Scientific Committee 2016; Saunders & Heinsohn 2008). They typically forage in foliage at the top of the canopy (Schodde & Tidemann 2007). Wintering flocks may remain in a district for weeks, returning as a flock to the same tree each night for roosting. The latest population estimates are of around 2000 mature individuals, including 940 breeding pairs, and that the species occurs as a single, migratory population (Roderick *et al*. 2013, Saunders & Tzaros 2011).

A Swift Parrot fatality has not been recorded in available wind farm monitoring data. However, collision mortality for the species is listed as a threat to the species in the Recovery Plan (Saunders & Tzaros 2011) as the species is prone to colliding with fences, windows and cars. Presumably this is due to their very fast and direct flight behaviour (Schodde & Tidemann 2007). The likelihood of collision is thought to be influenced by the proximity of a structure to a concentrated foraging area (Smales 2005). The Recovery Plan goes on to comment that poorly sited wind turbines may have implications for the migratory Swift Parrot (Saunders & Tzaros 2011). A poorly sited wind farm on the mainland, in respect of the Swift Parrot,

would be one placed within, near or between (close) important winter foraging sites, particularly if turbines were placed at lower elevations in the landscape.

An assessment that modelled the potential collision rate of Swift Parrot at 39 (operating and proposed) wind farms within the species' distribution found that total predicted deaths equated to slightly more or less than one parrot killed due to wind turbine collision every ten years (Smales 2005). Thus the potential for an individual to be killed on the LRWF project is even lower, as it would represent just one of the total number of wind farms in operation.

The likelihood of collision for Swift Parrot at LRWF project is judged as rare based on the following points:

- No known important foraging sites nearby
- Generally degraded condition of vegetation communities in the Project Area
- Turbines would be located along ridges while Swift Parrots would forage mostly at lower elevations; dispersal between foraging sites is also likely to be in vegetated corridors at low relief including riparian corridors.

The consequence of collision for Swift Parrot is judged as moderate, based on the following points:

- The Project Area is not near a breeding area for the species
- The species is now critically endangered.

Thus, potential collisions at LRWF project present a moderate risk to the Swift Parrot population. The attribution of moderate risk is based mostly on the consequence of a collision rather than the likelihood.

Large-Eared Pied Bat

In NSW, the patchy occurrence of Large-eared Pied Bat includes concentrations around the sandstone escarpments of the Sydney Basin and the north-west slopes including Coolah Tops, Mount Kaputar National Park to the north and Pilliga Nature Reserve (north-west from Project Area) (SPRAT 2016). There is little potential for turbine interaction in this species, as it probably forages below canopy level. The species may be present in vegetated areas near to the turbine array, but the likelihood of collision is rare (occur in unusual circumstances). The consequence of any collisions of Large-eared Pied Bat may be moderate (may cause significant changes to local abundance) on the basis of:

- Potential nursery site at the southern end of the Project Area.
- There is a concentration of Large-eared Pied Bat records in the region.

This makes the Large-eared Pied Bat a moderate risk species for turbine interactions.

Dusky Woodswallow

Dusky Woodswallow is a flocking seasonal migrant to the area (Schodde & Tidemann 2007, BirdLife 2017). They are aerial insectivores and pursue prey on the wing high in the air or sally just above the tree canopy (Schodde & Tidemann 2007, Lloyd undated). Anecdotal records indicate that flocks, which may be large, also circle high above the ground when preparing to migrate northward in autumn (Lloyd undated, COG undated). One Dusky Woodswallow has been recorded during mortality surveys at an operating wind farm in Australia, based on publicly available information (Smales 2015).

The likelihood of a Dusky Woodswallow collision is possible, given that they occur in the LRWF project area and that they have been previously recorded amongst mortality data. The consequence of a collision is moderate given that:

- The species occurs in flocks therefore multiple fatalities may occur in a single event.

- The western slopes, near the LRWF project area, are the core breeding habitat in NSW (NSW Scientific Committee 2016)

This gives the Dusky Woodswallow a high risk rating for collision.

Square-tailed Kite

The Square-tailed Kite was recorded nesting in riparian vegetation along the Goulburn river in the southern part of the TLSA. Construction activity restrictions within 500 m of the Square-tailed Kite nest are a recommendation of this assessment.

The NSW Scientific Committee (2009) considers that "windfarms may cause occasional collision mortalities of Square-tailed Kites, although this species is a very manoeuvrable, slow flyer and is probably capable of generally avoiding collisions with turbines blades." They also note that collisions may occur with transmission lines. When hunting, the kite quarters and circles over tree canopies and occasionally soars (Schodde & Tidemann 2007). As already discussed, the pair of Square-tailed Kites in the LRWF project area are likely to be sedentary in a large established territory rather than being nomadic. In established territories, the same nest sites are used in subsequent years. During breeding, the male kite is often mobbed by birds as he leaves the nest, although there is a zone of mutual tolerance for about a 200 m radius around the nest (Schodde & Tidemann 2007). As discussed in NGH Environmental (2013a), where raptor nests are near wind farms, the fledgling birds are considered at greatest risk when learning to fly.

Although they have large hunting territories of more than 100 km^2, the wind farm area is around 30 km north of the nest site. This may be beyond the territory of the pair, assuming the territory radiates regularly around the nest. (This is in fact often not the case, but is highly site dependent - Olsen & Fuentes 2005). The wind turbine section of LRWF may be within the home range of the Square-tailed Kite though, which is generally a larger area than a raptor's defended territory. The species is rare, has a low fecundity (0.7 young per pair per year – NSW Scientific Committee 2009), low breeding density and low recruitment rate (Debus 1998).

The likelihood of a Square-tailed Kite collision with a turbine is considered unlikely (an impact might occur at some time) based on:

- WFSA assumed to be outside of the territory of the resident pair (at the southern end of the transmission line), therefore regular encounters with turbines is unlikely
- Dispersing newly fledged individuals may encounter the wind farm
- The species is highly manoeuvrable

The consequence of a Square-tailed Kite collision with a turbine is considered potentially significant on the following basis:

- Established nesting territory nearby; potential for a population sink
- Low fecundity, low breeding density and low recruitment
- Sparsely distributed species across its range.

Therefore, the Square-tailed Kite is potentially at high risk of collisions with turbines.

Eastern Bentwing Bat

Eastern Bentwing Bat was recorded in the LRWF project area in moderate numbers. This is a species for which there is a great deal of information about population and ecology. Populations are centred on a maternity cave, and then the population disperses to other caves for winter within a territorial range

(Churchill 2008). Movement between territories is uncommon (Churchill 2008). Territorial range sizes are unknown but could be extrapolated to be around 31,400 km^2 (1.3 million ha) or a circle with a diameter of 200 km, based on a study that found over-winter caves occur within 100 km of a maternity site (Wilson 2008)[1]. However, with little documented about migration, this assessment assumes that over-winter caves may be greater than 100 km from a maternity cave.

The closest known roost sites are listed below and shown approximately on Figure D-III:

- Wellington Caves: used as intermittent roost, south of Dubbo and about 150km south-west of wind farm (approximate lat/long location -32.6209885,148.9364489)
- Main Cave at Timor Caves Reserve: an important winter roost site, approximately 120 km south of Tamworth and approximately 200 km east of wind farm (approximate lat/long location -31.6848819, 151.1099652)
- Tunnel Cave in Borenore Karst Conservation Reserve: winter roost site, approximately 17 km west of Orange and 220 km south-south-west of wind farm (approximate lat/long location -33.2409309, 148.9252942)
- Kanangra-Boyd Karst in the Kanangra-Boyd National Park: maternity cave approximately 180 km south-west of Sydney and 300 km south of the wind farm (approximate lat/long location -34.0333288, 150.0478059)
- Willi Willi Caves in Macleay Karst Arc: maternity cave, approximately 450 km north-east of the wind farm (approximate lat/long location -30.9553612, 152.4389947)
- Church Cave at Wee Jasper: maternity cave, approximately 35 km north-west of Canberra and 480 km south of the wind farm (approximate lat/long location -35.1250344, 148.3993452).

In southern parts of its range (in the temperate zone) the species migrates north for winter and south for breeding (Churchill 2008). The Willi Willi maternity cave is approximately 450 km north-east of the proposed wind farm. It is located near the border between temperate climate and subtropical climate zones (BOM 2014, BOM 2001). Willi Willi Cave would get allocated to the subtropical zone based on the official climate zones by postcode (Dowell 2014). The remaining caves identified above are within the temperate zone.

Without further information being available, the assumption is made that the population centred around Willi Willi maternity cave would have a territorial range in the same climatic zone, which is mostly north of the cave. Therefore, it would not be expected that these individuals would migrate to utilise the known wintering caves south of Willi Willi. Another assumption, based on available information, is that the populations centred on Kanagra-Boyd and Wee Jasper caves may winter in caves at Timor and Borenore and may utilise intermittent roosts along the way such as Wellington Caves.

The Great Dividing Range has potential to act both as a barrier and funnel for migration movements. Therefore it is further assumed that the bats utilising Wee Jasper on the southern tablelands are more likely to winter at Borenore, on the western slopes, while bats utilising Kanagra-Boyd are more likely to winter at Timor, both being on the eastern side of GDR (DECCW 2010). However, BioNet Eastern Bentwing-

[1] Assuming a maternity cave in the centre of a territory, then the area of the territory could be worked out using πr^2, with r = 100 km.

bat records suggest a migration route between Timor Caves and Kanagra-Boyd on both sides of the range (Figure D-III).

Either way, the proposed Liverpool wind farm does not sit along a migration pathway between known winter and maternity caves. This is supported by Anabat records obtained at LRWF. Although conditions were cold (refer to Section 3.2.1), these surveys were undertaken during the southern migration period for Eastern Bentwing-bat, and yet the species was detected in relatively low numbers. Further, while surveys in the Ulan Mine site (similar habitat to the TLSA) detected the Eastern Bentwing-bat, it has only been recorded occasionally and would not be considered common in the area (Glenn Hoye, pers. comm. 11/03/2015).

The Eastern Bentwing-bat forages above canopy height in treed areas and they fly close to the ground in open habitats such as grasslands (Churchill 2008). Lower flying height around turbines has been confirmed at an operating wind farm on the Southern Tablelands, where Anabat detectors were placed at nacelle height (80 m) and ground height at four wind turbines over several weeks (Richards, G. & NGH Environmental, unpubl.). Eastern Bentwing-bats were recorded at ground height but not at nacelle height. Other species of bat, including White-striped Freetail Bat, were recorded at nacelle height.

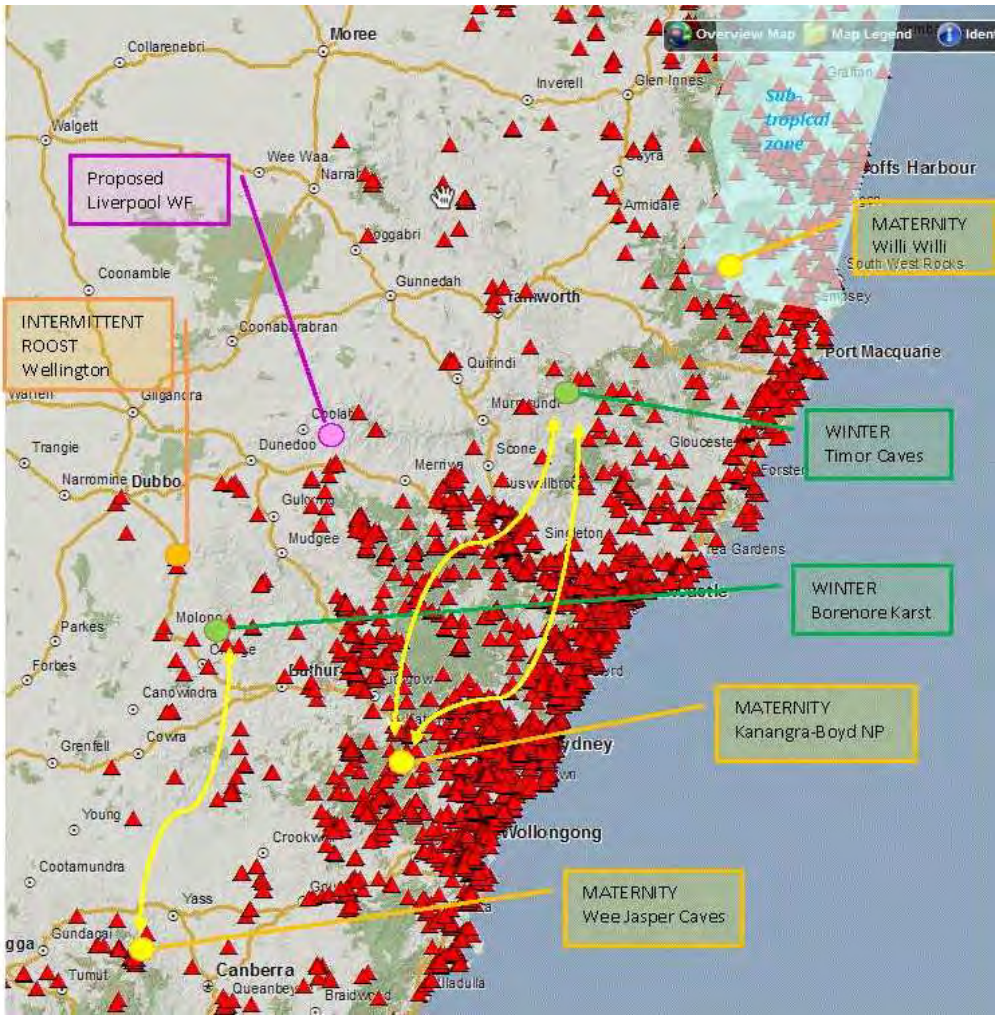


Figure D-III Location of known significant Eastern Bentwing-bat sites relative to proposed Liverpool WF, and assumed migratory pathways.

[Basemap from BioNet 2016), including Eastern Bentwing-bat records indicated by red triangle. Other elements added by NGH Environmental to represent approximate locations of known and assumed features as follows: yellow circles represent known maternity caves, as labelled. Green circles represent known wintering/hibernation caves, as labelled. Orange circle represents nearest known roost cave to the proposed windfarm (pink/purple circle). The approximate location of the subtropical climate zone has also been indicated (blue shading).]

Eastern Bentwing-bats are migratory, and are a fast-flying species that forage above canopy height. These factors suggest that the species would be at high risk of turbine interactions. Given the existing risk factors it is unlikely (an impact might occur at some time) that an Eastern Bentwing-bat would suffer a turbine collision at LRWF, based on the following points:

- Prey pursuit foraging around and/or within the canopy.
- There are no known caves sites or karst areas around the wind farm study area.
- The Proposal Area does not sit along a migration pathway between known winter and maternity caves; high numbers are not expected to pass through the WFSA.
- The proposed turbine sites are mostly located on cleared ridgelines, and here the species would be expected to be flying lower.

- Occurrence on the site is likely to be irregular; short-term (e.g. males on a foraging trip away from a main roost cave over several days) and; of course, seasonal. Therefore frequency of impact would be relatively inconsistent and minor.

Based on the discussion above, the consequence of collision is considered minor. This results in a low risk of collision for the Eastern Bentwing Bat at LRWF.

Yellow-bellied Sheathtail-Bat

The Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*) is a widespread species, with records throughout most of NSW. Despite this, there are very few historical records from within the study area. There are, however, two records of the species from Turill State Conservation Area, in the TLSA. No records of this species were made in the WFSA during the 2012 Anabat surveys. One probable recording was identified from sandstone forest vegetation in the TLSA during the 2012 surveys, but no calls were identified in this area after the more comprehensive 2013 surveys.

One potential record of Yellow-bellied Sheathtail-bat was recorded in the TLSA but is unconfirmed (NGH Environmental 2013b). The species is assumed to be seasonally present between January and July (Churchill 2008, ALA 2016). The collated carcass search data for eight operational wind farms in south-eastern Australia does not list Yellow-bellied Sheathtail-bat as an impacted species (Smales 2015). Yellow-bellied Sheathtail-bat has not been found in mortality searches over 12 months at two wind farms on the southern tablelands (NGH Environmental unpubl. data). However, the Yellow-bellied Sheathtail Bat has been compared to White-striped Freetail Bat in wind morphology and flight behaviour and foraging style (Rhodes & Hall 1997). The White-striped Freetail Bat is susceptible to turbine collision (refer to discussion in NGH Environmental 2013a).

Yellow-bellied Sheathtail-bats occur in a range of habitats including rainforest, woodland and grassland (Churchill 2008). Yellow-bellied Sheathtail-bats are fast, agile predators that intercept insects in flight. They utilise open and semi-open microhabitat just above the canopy of a range of vegetation communities (McKenzie *et al.* 2002, Richards 2005a). They may occur more than five metres from the tree canopy (McKenzie *et al.* 2002). They fly fast and straight most often 15-25 m above the ground even in open habitat, although they may also fly close to the ground (Churchill 2008, Rhodes & Hall 1997, Kitchener 1987). Rhodes & Hall (1997) state that the morphological characteristics of the Yellow-bellied Sheathtail Bat and flight observations in Queensland suggest low manoeuvrability. Other observations suggest high manoeuvrability, with the species able to make tight turns with steep bank angles (McKenzie *et al.* 2002). The differences in observed flight behaviour may be related to geographical variation in morphology (Rhodes & Hall 1997).

The likelihood of turbine interaction for Yellow-bellied Sheathtail-bat at LRWF project is considered to be unlikely (an impact might occur at some time), based on the following points:

- Unknown but assumed occurrence in the area.
- Yellow-bellied Sheathtail Bat flies high and fast over the forest canopy, but lower in more open country.
- Has similar morphological characteristics and habitat use as White-striped Freetail Bat but occurs in lower densities in the landscape.
- Not known to have been recorded in carcass searches at operating Australian wind farms.

The consequence of turbine interaction for Yellow-bellied Sheathtail-bat is considered to be moderate (may cause significant changes to local abundance of species) based on:

- Apparent low density in landscape.
- Paucity of information about the species (err on the side of caution).

This makes Yellow-bellied Sheathtail-bat at moderate risk from the wind farm (turbine interaction).

APPENDIX E AGENCY SUBMISSIONS

E.1 SUBMISSIONS

Office of Environment & Heritage

Your reference:	MP10_0225
Our reference:	DOC14/209720
Contact:	David Geering
	02 6883 5335

Neville Osborne
Manager – Energy Projects
Department of Planning & Infrastructure
GPO Box 39
Sydney NSW 2001

Dear Neville

Liverpool Range Wind Farm MP10_0225

The Office of Environment Heritage (OEH) has reviewed the exhibited Environmental Assessment (EA) for the Liverpool Range Wind Farm, and provides the following submission at Attachment A for consideration by the Department of Planning and Environment (DPE).

OEH notes that this development, initially of up to 417 turbines, has been reduced to a maximum of 288 turbines as a result of avoiding significant biodiversity impacts in the vicinity of Coolah Tops National Park. However, with a Project Area of 40km by 50km, the Liverpool Range Wind Farm is still a very significant development with potential for considerable impacts.

OEH has been involved in discussions with the proponent regarding the Electricity Transmission Line and a potential route through the Durridgere State Conservation Area (SCA) since 2010.

The Minister for the Environment has the statutory power to grant utility services tenures, including electricity transmission lines, in the form of an easement or a right of way over a particular piece or corridor of land reserved under Section 153 (1) the *National Parks and Wildlife Act 1974*. However, easements for these purposes are granted as a matter of discretion when there is no feasible or practical alternative to the proposal being placed on reserved lands or where environmental impact is not significant. Proper assessment of environmental impact is critical to the consideration and exercise of the powers under Section 153.

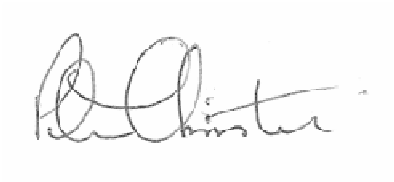
OEH considers that the construction of a transmission lines within Durridgere SCA constitutes a threat to the natural condition and the special features of this area. Therefore OEH **does not support** the proponent's preferred route for the transmission line. OEH is of the view that the proponents should investigate alternate routes with specific attention being made to maximising further avoidance measures.

OEH notes that a number of the issues raised in its adequacy review of February 2013 have not been addressed. A meeting with representatives from Epuron and their consultants on 12 March 2013 canvassed the issues raised by OEH in its adequacy review. At this meeting OEH reiterated concerns arising from the environmental impacts due to the size of the wind farm, its configuration across multiple ridges and the lack of consideration given to impact on migrating birds and bats. Background information and specific recommendations on these issues are provided in Attachment A. OEH considers these important considerations for DPE in relation to the development and operation of this proposal.

PO Box 2111 Dubbo NSW 2830
Level 1 48-52 Wingewarra Street Dubbo NSW
Tel: (02) 6883 5330 Fax: (02) 6884 8675
ABN 30 841 387 271
www.environment.nsw.gov.au

If you have any questions regarding this matter further please contact David Geering on 02 6883 5335.

Yours sincerely,



PETER CHRISTIE
Regional Manager North West
Regional Operations

Attachment A: OEH response to the Liverpool Range Wind Farm Environmental Assessment

ATTACHMENT A

Liverpool Range Wind Farm Project

Response to Environmental Assessment

Acronyms

BA – Biodiversity Assessment

BBAM – BioBanking Assessment Methodology

DBH – Diameter breast height

DGRs – Director General's Requirements

DPE - Department of Planning and Environment

EA - Ecological Assessment

EEC - endangered ecological community

ETL – Transmission line

HBT – Hollow-bearing trees

SCA – State Conservation Area

SoC – Statement of Commitment

BIODIVERSITY IMPACTS – WIND FARM

1. Survey Effort

Wind Farm

The survey effort for bats is inadequate to fully determine the potential for impact.

Table 4.3 of the BA indicates that 16 Anabat surveys, of eight hours duration totalling 128 hours, were conducted. This does not reflect the information provided in Section 4.3.3 which states that "*Three Anabat units were used during the survey at different locations across the site. In all, 15 locations were surveyed for a total of 21 nights of Anabat recording*"Given the size of the study area (40 x 50 km comprising 7000 ha of survey area) this is not likely to provide sufficient data to develop a reasonable understanding of the bat fauna of the area. Indeed, twice as many Anabat surveys were conducted along the electricity transmission route as in the wind farm area. Given the number of turbines (up to 288) proposed in this development, and the considerable impacts that wind farms can have on bat populations, adequately assessing these impacts on bats should be a major component of the Biodiversity Assessment Report.

The OEH Threatened Species Survey and Assessment Guidelines recommend the use of a combination of ultrasonic detection and trapping for bats, as neither method can detect all species. It is, however, acknowledged that for the purpose of this development emphasis is placed on bat species that may be impacted by the direct impact of blade strike or barotrauma. These species may be best detected using ultrasonic detection although the limitations of this technique, such as the detectable distance of bats emitting low frequency calls, should be discussed. It is also noted that there is no discussion in the Methodology as to how the Anabats were set up in order to maximise the detection of bats flying within the potential turbine blade-sweep area.

The map of survey effort within the BA indicates that 6 of the 15 Anabat survey locations were in a relatively small area in the north-east of the study site (the F3 and F4 cluster of

turbines). There are a number of areas where no bat surveys were conducted despite considerable effort to collect other biodiversity data. Several of these areas are relatively well timbered and in close proximity to Coolah Tops National Park, for example clusters F4, G4, F5 and G5. The north-west section of the wind farm was not surveyed for bats at all. Although not as well vegetated as the eastern sections it is still very likely that these areas are utilised by bats, particularly the larger species such as the Yellow-bellied Sheathtail Bat, which forage in more open habitats. Section 6.1.1 of the Transmission Line assessment states that "*Microchiropteran bats may roost in hollow-bearing paddock trees*" while the corresponding section in the Wind Farm assessment is silent on this point. Bat species utilising these more open habitats, notably the Yellow-bellied Sheathtail Bat, are at high risk of blade strike and may be under-represented in the results due to the lack of survey effort.

It is also noted that fauna surveys were conducted early in the season, 8-19 October 2012 and 1-9 October 2013. The OEH Threatened Species Survey and Assessment Guidelines recommend that sampling for bats should ideally be carried out from October to March, the period during which bats are most active. The Guidelines also recommend that the prevailing conditions should be taken into account when planning microchiropteran bat surveys avoiding periods of cold temperatures, strong wind, heavy rain and full moons. The BA provides weather data for the field survey periods as recorded at Merriwa, the nearest weather station. It should be noted that Merriwa is located at an altitude of 250 metres above sea level while areas of the proposed Liverpool Range Wind Farm are in excess of 1000m asl. It could be reasonably expected that minimum temperatures in the study area may be considerably lower than that recorded at Merriwa. In 2012 ten of the thirteen survey nights had minimums of less than ten degrees at Merriawa while in 2013 seven of nine nights recorded minimums less than ten degrees. At these temperatures, and this early in the season, it could be expected that bat activity may be reduced.

Section 7.1.2 of the BA states "*Although records of threatened microbat species are quite widespread in the Wind Farm Study Area, relative activity levels were quite low*". There is no discussion as to why this might be although it is likely that this may be related to the survey limitations discussed above.

The BA provides no explanation for either the lack of Anabat surveys in parts of the study area or why bat surveys were not conducted at more optimal times.

<u>Transmission Line</u>

A number of deficiencies have been detected in survey effort for fauna. For example, the fauna survey utilised a combination of non-invasive survey techniques and fauna habitat assessment to identify areas that may support threatened species, rather than undertaking a comprehensive trapping program. This may result in non-detection or under-detection of some species e.g. Squirrel Gliders and Eastern Pygmy-possum. While an effort has been made to identify habitat characteristics for threatened fauna the lack of certain information undermines this process. For example, no information is provided on size classes of hollows, these being attributed as being small to medium and large. The BA suggests that large hollows "*have the potential to support larger birds such as the Glossy Black-cockatoo, or arboreal mammals such as the Squirrel Glider*". It should be noted that Squirrel Gliders will utilise hollows as small as 5cm diameter further suggesting that the potential occurrence of this species may be under-estimated.

The OEH Threatened Species Survey and Assessment Guidelines recommend the use of a combination of ultrasonic detection and trapping for bats as neither method can detect all species. While the use of Anabat alone was considered satisfactory on the wind farm due to an emphasis placed on bat species that may be impacted by the direct impact of blade strike or barotrauma, this is not the case for the transmission line where ample opportunities exist for the use of other trapping techniques. The reliance on Anabat results alone in forested habitats can result in the non-detection, or under-detection of some species, as acknowledged by Section 4.4.1 of the BA.

Given that the proposed transmission line routes will dissect large remnants of forest and woodland, notably Durridgere SCA along the preferred route, resulting in the potential to isolate some fauna populations OEH is of the view that a greater effort should have been made to better understand the fauna of these areas.

Recommendation:

1.1 That the proponent be required to either

a) undertake additional surveys of the fauna of the study area, notably bats on the wind farm and arboreal mammals along the transmission line, to develop local distribution maps of species encountered. Ideally, survey effort should include, but not be restricted to, periods when it may be expected that the Eastern Bentwing-bat may migrate through the area. Map produced should give an indication of species densities, as best as is reasonably possible given the constraints of the methodologies employed, that can then be used to assess the potential impacts of the currently proposed infrastructure; or

b) assume that the species listed under the TSC Act EPBC Act that are predicted to occur within the locality of the project are present. These assumptions should be further informed by the OEH Threatened Species Profile Database, and other appropriate references, in regard the suitability of habitat for individual species.

2. Assessment of Direct Impacts

The proponent has not provided sufficient detail to support the assessment of impacts on native fauna. While direct loss of habitat is assessed, the BA has not adequately justified conclusions related to the risk of bird and bat collision and the significance of this impact.

Section 9.3.4 (Impact Assessment – Habitat Loss and Blade Strike (Microchiropteran Bats)) devotes a page of discussion to blade strike and bats, of which half is related to two non-threatened species, without providing any specific information as to what impacts may be expected. Section 10.3 (Significance of Impacts – Fauna) makes no mention of the potential of blade strike of bats. Blade strike is mentioned once in relation to several raptor species: "*Operational impacts (blade strike) have some potential to affect these species*" (Section 10.3.1). The potential for some individual species to be impacted by blade strike is addressed in the Assessments of Significance but the conclusions reached are generally unsubstantiated.

Several threatened bird species seen or expected to occur on the site are assessed as having a moderate collision risk (Table 9-7). However, little evidence is provided to support the conclusion that the overall collision potential is relatively low. A total of 12 hours (twenty four 30 minute surveys) was spent conducting bird utilisation surveys, i.e. an assessment of flight behaviours that bring birds into the turbine blade-sweep area. The period of the field surveys (early October 21012 and 2013) is outside the autumn migration period for honeyeater species and key periods when migratory, high-flying species such as swifts are likely to be present. There is also a high likelihood that the short survey periods missed the spring migration of other high-flying migrants such as the Rainbow Bee-eater. These limitations may well result in an under-estimation of the potential impact for blade-strike on migratory birds. With the exception of several raptor species, and minor reference to others species (e.g. Table 9-1), the BA tends to ignore the potential threat to species not listed as threatened.

The Liverpool Range is located in an area of potentially high bird activity. Migrating honeyeaters, including the Critically Endangered Regent Honeyeater (for which no Assessment of Significance was undertaken), routinely move through the Central Tablelands during periods of eucalypt flowering, particularly of White Box grassy woodland. This pattern of migratory behaviour may result in a potentially high likelihood of bird strike at such times

as the birds congregate on ridge tops and fly across cleared areas at rotor height. The potential for such events, highlighted by OEH in its adequacy review, has been ignored. The BA consistently states that the development envelope is largely "*within a highly disturbed and fragmented landscape*". While this may limit the potential for impact on less mobile, sedentary fauna species, this is not necessarily a limitation for more mobile migratory species.

Although limited data exists in Australia, evidence suggests that wind farms can result in considerable bat mortality. Studies indicate that bat mortality is linked to turbine height and wind speed, with more bats killed on low wind evenings. Because bats are relatively long-lived and have low reproductive rates, high levels of adult mortality can have significant impacts on the long-term sustainability of local populations.

Fourteen bat species, of which four are listed under the TSC Act, were identified during surveys of the wind farm area. An additional TSC listed species, the Yellow-bellied Sheathtail Bat, was recorded on the transmission line route. The Eastern Bentwing-bat was the most commonly recorded threatened bat species at the site.

Other than general background information, the BA provides little discussion on the potential impact of blade strike or barotrauma on microbats. This concern was raised by OEH during its adequacy review and again in the 12 March 2013 meeting with the proponent and their consultants. OEH remains concerned that very little supporting information is included within the BA to justify the conclusions as to the likely low impact of the facility on bat species. Some conclusions appear to be based on assumptions that are not substantiated. For example, the Assessment of Significance states that "*The Eastern Bentwing Bat is a sub- and over-canopy feeder, so the majority of feeding is expected to be below the rotor-swept area*". However, in Appendix 3 (Threatened Species Evaluations) the Eastern Bentwing-bat is noted to "*forage above the forest canopy in a diverse range of forest types*". The closely related and ecologically similar Southern Bentwing Bat is known to forage from just above the canopy to many times the height of the canopy (Churchill 2008 cited in Kerr & Bonifacio 2009). This behaviour will bring them into direct conflict with turbine rotors.

The Yellow-bellied Sheathtail Bat is regarded as not being at high risk of turbine strike on the basis of results of the site survey however OEH maintains that this species is likely to be under reported due to a lack of surveys in much of the study area (see Issue 1).

The BA suggests that there are only two "high risk" bat species occurring on the study area despite information provided for some species that might indicate a higher risk category.

The primary mitigation method proposed to minimise the potential for collision or avoidance behaviour (Section 9.3.5) is to "*space turbines at a distance to allow birds to fly between them*". Flight behaviour of birds in response to operational wind farms is complex being affected by a range of factors including weather conditions (including wind speed), configuration of turbines and whether the birds are resident or migratory. There is evidence to suggest that migratory species change their behaviour, most notably flying at a greater height and changing flight direction as a response to turbines. As migratory birds, and bats, seek to maximise flight efficiency and minimise energy expenditure, these impacts may be significant for large wind farms.

The principle tool proposed by the proponent to address potential blade strike impacts appears to be the development of a Flora and Fauna Management Plan and an Adaptive Bird and Bat Management Plan which "*should be prepared prior to construction*". These management plans "*would focus on migratory and at risk bird and bat species to address the inherent uncertainty related to bird and bat collisions at this site*".

A number of species, notably Wedge-tailed and Little Eagle, Powerful, Barking and Masked Owl, Eastern Bentwing Bat, Eastern Cave Bat and Yellow-bellied Sheathtail Bat have been identified as focal species of an operational Bird and Bat Management Plan to confirm various assumptions made in this assessment. OEH would prefer to see clarification of these

issues in the impact assessment process in order to fully assess potential impacts and determine whether sufficient avoidance or mitigation measures have been employed.

Section 9.3.6 (Buffers for Birds and Bats) makes reference to a German study indicating that turbine placement was a key factor in bat mortality with 89% of all bat fatalities near turbines that were within 100 m of a wooded area. A key recommendation of Section 9.3.6 is that "*A minimum buffer of 100 m from the turbine blades is recommended for areas of high value for birds and bats*". The BA suggests that this will be in moderate or moderate-good quality wooded areas. OEH is of the opinion that the bat surveys conducted are inadequate to fully determine bat activity patterns across the wind farm and that assumptions should not be made on this basis. It is also unclear how this relates to the constraints mapping. Many turbines located in areas mapped as Moderate or Low appear to be relatively close to, or within, reasonably well timbered sites.

The limitations surrounding the inadequate survey effort for bats within the wind farm study area raised above are insufficient to support any rigorous efforts to better determine the potential for impact on bats. Furthermore, the BA relies on habitat quality, essentially regarded as vegetation in moderate or moderate-good condition, as a surrogate for threatened species presence. This potentially misrepresents their likely presence as hollow-roosting bats may utilise trees in fragmented landscapes and, as such, may not receive due consideration in the impact assessment.

The recommendation that a Flora and Fauna Management Plan, as well as an adaptive Bird and Bat Management Plan, should be prepared prior to construction does not address OEH's current concerns.

Recommendation:

2.1 That the proponent consider Recommendation 1.1 and conduct further assessment of the potential for bird and bat strike and baratrauma within the wind farm. This assessment should consider the comments above and be undertaken prior to approval and be incorporated into the Bird and Bat Management Plan with recommendations as to what mitigating measures, such as buffer areas or reconfiguration of the turbine layout, will be implemented to minimise bird and bat strike and barotrauma

3. Indirect Impacts

The proponent has not provided sufficient detail to support the assessment of indirect impacts on native fauna relating to the disturbance to birds and bats resulting in avoidance of habitats in or near wind farms.

Behavioural displacement of fauna can result in changed patterns of habitat use in the vicinity of operational wind farms. This can manifest itself in lower densities of particular species to complete avoidance; the habitat is no longer available to the bird, or bat. There is considerable evidence that this avoidance can vary significantly due to a range of factors. It has been suggested that migratory species with seasonal patterns of habitat use are more likely to be impacted than sedentary species.

Likewise, the distance for which the distance impacts habitat can vary according to species. A distance of 600m is often reported as the zone of disturbance from turbines for birds but distances ranging from 80m for some species of grassland birds to 800m for waterfowl have been reported.

The BA indicates that turbines are to be located on ridges spaced approximately two to five kilometres apart with spacing along these ridges of 300m to 600m. The expectation is that this will allow safe passage between turbines for birds and bats, without creating a barrier affect. Section 9.3.5 states that "*As the development envelope lies largely with a highly disturbed and fragmented agricultural landscape, there is limited opportunity for the turbine*

layout to sever movement corridors for fauna species". The BA does not take into account the ability for many migratory species to traverse habitats, including those in disturbed and fragmented landscapes, that might otherwise not be utilised. Maps of the wind farm provide no indication that vegetation in any section of the wind farm is not suitable for the migratory species that are likely to occur.

Section 9.2.3 does raise the potential for rows of turbines to act as multiple barriers to the movement of birds and bats however there is no further discussion relating to this issue. The size of the Liverpool Range Wind Farm is of concern should turbines constitute a barrier for migrating honeyeaters, including the critically endangered Regent Honeyeater, and potentially migratory bats such as the Eastern Bentwing-bat. The wind farm not only has the potential to disrupt migration but also to limit or exclude access to essential resources over a considerable area.

Locating wind farms in areas which constitute movement corridors through the landscape (whether the species using them are migratory or not) will increase the risk of impact on bird and bat species generally. Movement corridors will become increasingly important should species be forced to relocate in response to climate change.

Recommendation:

3.1 That the proponent investigates the potential for the current wind farm configuration to

a) disrupt the migratory route of birds and bats, including species not listed in either the TSC Act and EPBC Act; and

b) reduce the area of habitat available to fauna, in particular seasonal migratory species

in order to determine whether reconfiguration of turbines or additional offsets may be required.

4. Cumulative impacts

The BA does not address cumulative impacts although Section 8.3.1 specifically states "*Cumulative impacts of the Transmission Line and Wind Farm have been considered*". It is possible that this refers to the cumulative impacts of the two components of the development.

It is possible that the authors of the BA may have considered that there are no cumulative impacts of the wind farm, as it relates to other wind farms as, at this current time, the nearest known wind farm developments are approximately 100 kilometres from the Liverpool Range wind farm. These are Kyoto (42 Turbines, ~90 km to the ESE near Scone), Bodandra (40 turbines, ~100 km SW near Wellington), Uungula (330 turbines, ~100 SSW between Wellington and Mudgee) and Crudine Ridge (80 turbines, ~135km S between Bathurst and Mudgee).

Although some distance from the Liverpool Range Wind Farm, it should be conceded that the development of these wind farms on the Central Tablelands, and to the east of the Liverpool Range in the case of Kyoto, each have similar issues in relation to potential impacts on migratory birds and bats. This is particularly so for the Uungula Wind Farm which has a similar number of turbines to Liverpool Range over a considerable area.

The EA concludes that the potential bird bird-strike is generally low although it does not address the likelihood of any impact on migrating honeyeaters, at least several species of which are likely to occur in the Liverpool Range area in large numbers during years of significant winter flowering of the Box – Gum woodlands (see Issue 2). Nor does it address

the likelihood of migratory bats such as the Eastern Bentwing-bat passing through the wind farm site despite it being frequently recorded across the study area.

These migratory species, in addition to species such as the Rainbow Bee-eater and White-throated Needletail, are known to travel considerable distances north–south. This migration route has the potential to bring them into contact with a number of wind farm developments on the Central Tablelands as well as other wind farms on the Northern and Southern Tablelands. This has the potential to compound mortality rates as well as potentially disrupt migration routes. Any such disruption on the southern migration, when migrating birds are generally in poorer condition due to the energy requirements of long distance migration, can indirectly increase mortality within the population.

Recommendation:

4.1 That the proponent gives genuine consideration of cumulative impacts to migratory fauna in both a regional and state wide context and give all due consideration to reconfiguring the wind farm layout should impacts be unacceptable.

5. Impact Avoidance

Wind Farm

OEH considers that there is insufficient information to determine whether further avoidance measures of native vegetation is possible or required.

OEH acknowledges the removal of 130 turbines from the far-north-east section of the wind farm adjacent to Coolah Tops National Park. This avoids impact in the most heavily timbered section of the wind farm and reduces potential impact to Powerful Owls. The BA further suggests (Section 11.1.1) that this area had been previously identified as "*highly constrained in that it posed a potential barrier to the movement of threatened owls and microchiropteran bats*". Serious consideration has apparently not been given to the impact of turbine placement elsewhere in the wind farm.

The "indicative" locations of many turbines in areas mapped as a Moderate or Low Constraint appear to be relatively adjacent to, or within, reasonably well timbered sites (further discussed in Issue 3). Section 8 of the BA outlines the ecological issues and allocates constraint classes that are applied to the development. The major driving factors are Box-Gum Woodland EEC, mature habitat in moderate-good or good condition supporting hollow-bearing trees (HBTs) and landscape connectivity. The BA regards mature habitat with HBTs as being restricted to Norton's Box Woodland and Mountain Gum Silvertop Stringybark Forest in the northern section of the wind farm and areas with landscape connectivity as occurring only in the north-east corner and eastern boundary of the wind farm close to Coolah Tops National Park. OEH is concerned that this seriously under-estimates the value of other areas of the wind farm as habitat for fauna.

The BA (Section 11.1.2) commits to the development of "*SoCs for moderate to high constraint areas or other areas where development has the potential to result in a significant impact*". However, there is no indication of what constitutes a "significant" impact nor does this treatment allow OEH to currently assess impacts and whether avoidance or mitigation measures are adequate. There is also a risk that some areas currently mapped as Low Constraint may be of greater importance as habitat than currently assessed due to inadequacies in survey effort leading to a poor understanding of the bat fauna of the area (see Issue 2).

A key recommendation of the BA (Section 9.3.6) is that "*A minimum buffer of 100 m from the turbine blades is recommended for areas of high value for birds and bats*". OEH is of the opinion that there is insufficient information in the BA to determine where these areas are located. This is discussed in further detail in Issue 2.

In order for OEH to adequate assess the impact of this development consideration should be given to efforts by the proponent to modify, wherever possible, infrastructure to avoid or minimise impacts. The BA does not demonstrate such actions in much of the wind farm area.

Transmission Line

It appears that biodiversity impacts on the preferred and alternate route are comparable: "*The alternate and second alternate transmission line route options have no apparent advantages towards biodiversity other than that they avoid Durridgere SCA*" (Section 7.3.1).

The BA has determined (Tables 7-1, 7-2 and Section 9.1) that the preferred route has less vegetation and habitat loss than the alternate routes (233.1ha – preferred ETL, 261.3 – alternate ETL and 303.9ha – 2nd alternate ETL). However, it is uncertain to what extent modifications to the routes presented might influence total areas cleared. The BA acknowledges that the figures provided present a "*worst case scenario*".

Table 7-1 indicates that the alternate ETL corridor has significantly higher predicted clearing rates of riparian forest than the preferred ETL corridor. The BA has failed to demonstrate that avoidance of riparian areas along the alternate Route is not possible. The maps provided suggest that some riparian areas have been traversed by the ETL route rather than efforts made to intersect them to minimise impact. Greater effort to minimise impacts to riparian areas, where high value habitat features such as mature, hollow-bearing trees and more fertile soils occur, is to be encouraged.

While it is stated (Section 9.2) that "*the proponent commits to upfront offset ratios before clearing proceeds which is an incentive to achieve 'minimal clearance' during the detailed design and construction phases*" this does not appear to be reflected in the design of the alternate ETL route.

The BA notes that the development of Statement of Commitments will be developed for areas of moderate-high constraint areas. The aim of these commitments is to "*minimise disturbance and avoid significant impacts*". Table 9-1 contains a number of measures to minimise impacts for the proposal. These "commitments" are very general, relating primarily to the construction phase of the development, and do not address the concerns of OEH in regards avoidance of riparian areas.

Two major routes have been proposed however there is no discussion as to why further potential routes with less impact to remnant woodland and forest are not presented in the BA. At a meeting attended by representatives of the proponent, their consultant and OEH on 5 February 2014 it was alluded to that there were issues with landholders on other routes although no further justification was provided.

Recommendations:

That the proponent be required to:

5.1 Ensure that all avoidance measures implemented in finalising the location and design of the facility are fully described;

5.2 Be required to undertake a more thorough investigation of the transmission line routes, particularly the alternate routes, to identify where modifications can be made to maximise avoidance of high conservation vegetation such as in riparian areas and

5.3 Sufficiently justify the level of avoidance implemented.

6. Monitoring & Mitigation

Wind Farm

The BA does not provide detail of any monitoring to assess the impacts of rotor strike nor does it adequately consider mitigation measures in response to bird and bat strike. Table 11-2 indicates that an Adaptive Bird and Bat Management Plan will be developed with a focus on "high risk" species and "higher risk" locations "*in order that actions can be undertaken to address unforeseen impacts*". OEH suggests that, given the general inadequacies of the impact assessment undertaken, that this approach is unlikely to identify the unforeseen impacts that OEH is concerned about.

OEH would encourage a monitoring program to monitor impacts of bird and bat strike across the wind farm in consultation with OEH. This monitoring program should be capable of detecting any changes to the population of birds and/or bats that can reasonably be attributed to the operation of the Project. This may be through direct impact such as habitat removal or through blade-strike or barotrauma or through indirect impacts such as habitat alienation (see Issue 3). This monitoring program may require data to be collected prior to the commencement of construction.

Should impacts be identified, mitigation measures must be proposed that will eliminate or significantly reduce these impacts. Foreseeable potential impacts such as unacceptably high mortalities due to blade-strike or barotrauma can be addressed by proposing mitigation actions, such as the modification of turbine operation, during periods when thresholds for mortality are exceeded or have the potential to be exceeded. Emphasis should not be entirely placed on EPBC Act or TSC Act listed species but should take into account the potential impact on species whose behaviour places them at high risk.

The BA also suggests that a minimum buffer of 100 metres from the turbine blades is recommended for areas of high habitat value for birds and bats and that a Flora and Fauna Management Plan, as well as an adaptive Bird and Bat Management Plan, should be prepared prior to construction. However no clear statement is made concerning setback distances for turbines from moderate to moderate-good condition wooded areas.

Transmission Line

The BA states that "*Detailed mitigation prescriptions have been developed to address the remaining risks, aimed at avoiding a significant impact on any listed threatened entity*" (Section 10). These mitigation measures are presented in Table 9-1 although, as indicated above, these measures are general in nature, are not justified and are not supported by any discussion regarding the level of success of these measures at other sites. For example, the installation of gliding poles is suggested should clearing for the transmission line easement exceed 40m in areas of Squirrel Glider habitat without any consideration of the potential for collisions with power lines. There is evidence (Sloans et al. 2013) that suggests that Squirrel Gliders may show a preference for rope bridges rather than glide poles.

Section 8.3.1 notes that the preferred transmission line route passes within 50m of a Square-tailed Kite nest and that the final design will need to observe a buffer of at least 200m from the nest tree. As birds of prey are generally very susceptible to disturbance in the vicinity of nests during the breeding season construction should avoid the period July to February.

Table 9.1 makes no specific mention of the Square-tailed Kite although it does indicate that a Flora and Fauna Management Plan will be developed to report on and manage impacts. OEH would prefer to see clarification of these issues in the impact assessment process in order to fully assess potential impacts and determine whether sufficient avoidance or mitigation measures have been employed.

Recommendations:

6.1 That the proponent develop a Flora and Fauna Management Plan in consultation with OEH prior to approval that provides detail of how impacts on bird and bat populations will be mitigated, including details on where these actions will be implemented, performance indicators, monitoring objectives and schedule and adaptive management measures.

6.2 That the proponent develop a Bird and Bat Monitoring Plan in consultation with OEH prior to approval that provides detail of how impacts on bird and bat populations will be monitored, including details on survey locations, parameters to be measured, frequency of surveys and analyses and reporting.

6.3 That the proponent adequately consider the range of mitigation measures for implementation at the site to mitigate any predicted or observed bird and bat impacts, including information on the level of success of these measures at other sites (where known).

6.4 That should the project be approved, the DPE include a condition of consent requiring a monitoring program capable of detecting any changes to the population of birds and/or bats that can reasonably be attributed to the operation of the project. This may require data to be collected prior to the commencement of construction. Data relating to mortality rates should be submitted to OEH on an annual basis for the first five years of operation and every two years thereafter.

7 Durridgere State Conservation Area

The DGRs specifically state that "*in particular justification should be provided regarding the suitability of the transmission line route through Durridgere State Conservation Area*".

State Conservation Areas are reserved to protect and conserve significant or representative ecosystems, landforms, natural phenomena or places of cultural significance, while providing opportunities for sustainable visitation, enjoyment and research.

The Durridgere SCA Draft Plan of Management states that the SCA is considered to be of significance for a number of key values:

- The reserve conserves a relatively large area remnant bushland in a predominately cleared landscape utilised for agricultural production and with increasing development for coal mining
- The reserve provides linkages from Wollemi, Goulburn River NPs and Munghorn Gap NR in the Sydney Basin and South Western Slopes bioregions west to the Goonoo forests and north via Weetalibah and Binnaway NPs to the Pilliga forests
- The reserve conserves over 200 native species
- The area supports a number of threatened species (both flora and fauna), and mature, old growth trees, which provide valuable habitat for a wide range of animal species
- Despite some hardwood extraction and a history of sporadic grazing use, the reserve remains in a relatively undisturbed condition

The last two points contradict Section 7.3.1 of the BA that suggests that vegetation in the SCA is mostly regrowth; "*In Durridgere SCA, more recent logging, when the area was a State Forest, has meant that in general the trees are younger than in many of the forest remnants on private property*".

A transmission line corridor through Durridgere SCA has the potential to seriously impact the ecological integrity of this significant forest remnant as well as have significant aesthetic impacts on the SCA. The DGRs specifically require the EA to "*include an assessment of any cumulative visual impacts from transmission line infrastructure*". This has not been provided, nor has any justification of the suitability of the transmission line through the SCA.

The BA recommends that the preferred route should be prioritised for further refinement as vegetation and habitat loss is least on this route. As has already been suggested (Issue 5), there may potentially be opportunities to reduce vegetation clearing with modifications of the alternate route. Regardless, OEH is of the view that this should not be the only factor considered.

Section 7.3.1 of the BA acknowledges that "*The alternate and second alternate transmission line route options have no apparent advantages towards biodiversity other than that they avoid Durridgere SCA*". This being the case, the BA fails to provide a convincing argument in favour of the preferred route. Indeed, the public good is best served by avoiding serious impact to an area of public land. In additional to the direct impact of clearing the easement, indirect impacts will need to be managed in the long term post construction.

The BA acknowledges that "*the works have the potential to introduce and spread weed species*" (Section 7.2.4). Notwithstanding the assertion that "*with the implementation of specific weed control measures, the risk of spreading and introducing additional weed species is considered to be manageable*" the risk of weeds being spread into the SCA along access tracks servicing the transmission line post construction cannot be under-estimated. Similarly, there is a high likelihood that feral animals, notably foxes, will increase in the SCA, initially as a result of clearing of the transmission line route and, long-term, by gaining access along maintenance tracks post construction.

In addition to habitat loss and potential isolation of fauna populations there is potential for mortality of fauna striking power lines. While the BA acknowledges that there is some potential for direct mortality of large forest owls as a result of turbine strike there is no consideration of mortalities as a result of owls striking power lines through forested areas. Some species, notably Masked and Barking Owls, favour hunting in more open areas and are likely to do so within the easement. Section 10 states that "*The conclusion of the Assessment of Significance revealed there is potential for the proposal to result in a significant impact for the Powerful Owl, Squirrel Glider and some microchiropteran bats in particular areas if they are developed. To avoid significant impact to these species recommendations for follow up survey work has been prescribed before any development occurs within these areas*". While additional surveys may clarify the potential for impact it will not necessarily avoid impact.

In the absence of additional information, OEH do not support the proposed preferred route through Durridgere SCA.

Recommendation:
7.1 OEH recommends that further investigations be undertaken regarding the alternate routes with specific attention being made to avoidance measures as detailed in Section 9.1 of the Biodiversity Assessment of the Transmission Line, particularly riparian areas.

OFFSETS

8 Offset Proposal

The DGRs specifically states that "*Sufficient details must be provided to demonstrate the availability of viable and achievable options to offset the impacts of the project and to secure these measures in perpetuity*". The BA does not include a detailed offset proposal although it does commit to an offset plan being developed prior to construction. The DGRs have therefore not been satisfied.

Section F2, the Offset Strategy Implementation Overview, suggests the proponent is only prepared to provide a Draft Strategy (i.e. Section F2 of the BA) prior to approval, the Offset Plan to be developed prior to impact and the verification of impacts, and presumably

verification of the offset area required, after construction. Formalisation of the offset properties including a management plan is scheduled to occur "*prior to operation*".

In order to ensure that all impacts are demonstrated to be adequately accounted for, offset commitments should be available for scrutiny prior to the approval of the impact. One of the basic requirements of an Environmental Assessment is to quantify the 'losses' of vegetation and habitats within developable areas and determine the offset target required to compensate for those losses. The BA fails, in the first instance, to fully quantify the impact. This is then compounded by the failure of the BA to provide any more than general comments regarding potentially suitable offset areas in the Project Area. The BA states that no sites have been "highlighted" as offset areas but several potential areas had been identified.

OEH commented, during its adequacy review of the draft EA, that rather than being deferred to the post-consent stage, a detailed offset strategy should be included as part of the assessment so that its adequacy in maintaining or improving biodiversity can be analysed in relation to overall impacts on flora and fauna. This has not occurred.

Recommendation:

8.1 That the DPE request that a detailed offset strategy should be provided prior to approval so that it's likely effectiveness in maintaining or improving biodiversity can be analysed. The offset strategy should:

- Propose an offset which is supported by a suitable metric and addresses the Department's *'Principles for Biodiversity Offsets in the NSW'*; and
- Locate the offset sufficiently remote from the influence of the turbines.

9. Offset ratios

The Biodiversity Assessment proposes a tiered system for offsetting vegetation. For EECs this ranges from 1:20 for vegetation in good condition, 1:10 for moderate – good, 1:5 for moderate and 1:2 for vegetation in poor or poor-moderate condition. Other native vegetation is proposed to be offset at a ratio of 1:1.

The condition class system used has resulted in 136.6 ha of impacted EEC being scored as poor condition (despite acknowledgement that under the OEH Biometric condition definition all EEC would be classified as being in moderate to good condition), and thus offset at a ratio of 1:2. Under the above condition class only 2.9 ha of EEC is regarded as being in either moderate or moderate-good condition and thus offset at higher ratios.

The Appendix F proposes that vegetation that is known to be threatened species habitat will be offset at a higher ratio (1:2 to 1:20 depending upon condition class) however the BA fails to demonstrate how threatened species habitat will be identified. OEH considers the proposed system of offset ratios lacking in a scientific rationale and that a maintain or improve outcome has not been achieved.

It is clearly stated that the BioBanking Assessment Methodology (cited in the BA as the Biometric Assessment Methodology) would not be used to calculate offsetting ratios. The rationale for this decision was to avoid duplicating survey effort although with forward planning vegetation surveys during the assessment phase would have resulted in data that could have been used in the BBAM. This decision is unfortunate as the use of the BBAM provides an invaluable tool that can be used to inform the quantum and compatible vegetation communities. As a consequence it provides a transparent, consistent and robust framework for the assessment and management of biodiversity offsets.

The BA suggests that the ratios have been generated based on the author's experience with the BioBanking calculator in similar habitats. An effort to justify these ratios has been made in Section F3.2 by citing ratios approved for other projects without providing the necessary context to substantiate those claims.

Recommendation:

9.1 That the proponent demonstrate the adequacy of the proposed ratios by either running a BioBanking scenario, using representative data if actual data not be available, or providing OEH with sufficient data to run such a scenario itself.

References

Kerr, G.D. & R.S. Bonifacio (2009). *Regional Action Plan for the Southern Bent-wing Bat* Miniopterus schreibersii bassanii *in the South East of South Australia*. Mount Gambier, South Australia: Department for Environment and Heritage.

Soanes, K., Camody Lobo, M., Vesk, P.A., McCarthy, M.A., Moore, J.L. & van der Ree, R. (2013). *Movement re-established but not restored: Inferring the effectiveness of road-crossing mitigation for a gliding mammal by monitoring use.* Biological Conservation 159: 434–441.

Australian Government
Department of the Environment

Ref: EPBC 2014/7136

Mr Neville Osborne
Team Leader
Energy Infrastructure Projects
Department of Planning & Environment
GPO Box 39
SYDNEY NSW 2000

Dear Mr Osborne

Liverpool Range Wind Farm, NSW

Thank you for your invitation to comment on the Environmental Impact Statement (EIS) for the Liverpool Range Wind Farm.

Please find below the Department's comments in relation to the EIS. This advice is provided on a without prejudice basis to assist the proponent in meeting the requirements of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The Department is satisfied that potential impacts of the proposal on matters of national environmental significance and, in particular, the *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland* ecological community, the Swift Parrot (*Lathamus discolor*) and Regent Honeyeater (*Anthochaera phrygia*) have been adequately assessed, based on the additional information that was provided in the Biodiversity Assessment Addendum Report (dated July 2014).

However, the proponent is required to meet the requirements of the *EPBC Act 1999 Environmental Offsets Policy (October 2012)* and the *Offsets Assessment Guide* prior to the finalisation of the EPBC approval.

The Department notes that although the Offset Strategy (Appendix F in the Biodiversity Assessment) details the principles that will be used to identify potential offset areas (including long term protection under Conservation Property Vegetation Plans), specific offset sites are yet to be identified, other than that they will be within properties within the project site.

The offset information that is required includes, the locations of the proposed offset areas (including plans showing the boundaries of the offsets), the current condition of the proposed offsets, the management actions that are proposed to improve the ecological condition of the proposed offsets and in perpetuity funding arrangements.

The Department also requests the Department of Planning & Environment to consider incorporating the proposed offsets into any approval conditions, including provision for in perpetuity protection and management of the proposed offsets.

The scale of the offsets required for the loss of White Box Grassy Woodland is dependent on which of three potential routes the electricity transmission line easement will follow. The Department would appreciate any advice you are able to provide as to when this decision is likely to be made.

If you have any questions on the above advice, please contact Mark Jenkins on (02) 6274 1558 or email mark.jenkins@environment.gov.au.

Yours sincerely

Nathan Harris
Acting Director
NSW Section
South-Eastern Australia Environment Assessments
3 October 2014

E.2 APPROACH TO ADDRESSING SUBMISSIONS

TOPIC	AGENCY ADEQUACY COMMENT	AGENCY RECOMMENDATION	NGH SOLUTION TO ADDRESS INADEQUACY	LOCATION IN THIS ADDENDUM
OEH				
Survey Effort (Wind Farm)	The survey effort for bats is inadequate to fully determine the potential for impact on the wind farm study area. • Number and duration of Anabat surveys is different in Section 4.3.3 and Section 4.3. • No discussion in BA of how Anabat devices were set up to maximise bat call detection. • Clusters F4, G4, F5, G5, and the north-western section of the wind farm were not surveyed for bats. • Surveys were probably undertaken at a time of year when weather conditions reduced bat activity. • No discussion as to why activity levels of threatened bat species were "quite low".	That the proponent either: 1. Undertake additional bat surveys of the WF study area, or 2. Assume that threatened bats listed under the TSC Act and EPBC Act that are predicted to occur within the locality are present.	• Clarify number of Anabat survey nights and overall duration of Anabat recording. • Clarify methodology of Anabat surveys. • Assume that relevant listed threatened species are present within the identified areas and produce/update AoSs as required. • Update and clarify bat results from the BA regarding activity levels and temperatures during surveys (summarised in OEH review). • Assume that the lack of harp trapping on the transmission line route resulted in non-detection or under-detection of any potentially-occurring threatened low-flying bat species.	• See Section 3.3 for total survey effort including Anabat survey nights, and Section 7.1.3 for a further break-down of Anabat effort. • See Section 3.1.1 for Anabat methodology for new surveys (2015) and 7.1 for clarifications on previous surveys and limitations including survey timing and activity levels of bats. • Presence assumed and CRA prepared for (Appendix D): Eastern Cave Bat, Corben's Long-eared Bat, Large-eared Pied Bat, Eastern Bentwing Bat, Yellow-bellied Sheathtail Bat • Presence assumed for: Little Pied Bat, Yellow-bellied Sheathtail Bat

TOPIC	AGENCY ADEQUACY COMMENT	AGENCY RECOMMENDATION	NGH SOLUTION TO ADDRESS INADEQUACY	LOCATION IN THIS ADDENDUM
Survey Effort (Transmission Line)	• No information provided on size class of hollows. • No detailed information provided on hollow use by threatened species. • Use of Anabat detection alone along TL probably resulted in non-detection or under-detection of some bat species.	That the proponent either: 1. Undertake additional bat and arboreal mammal surveys of the TL study area, or 2. Assume that threatened bats and mammals (e.g. squirrel glider and eastern pygmy possum) listed under the TSC Act and EPBC Act that are predicted to occur within the locality of the project are present.	• Clarify size categories of hollows • Provide information on size of hollows used by relevant threatened species, and quantify as best as possible the extent of habitat for each species in all areas of potential habitat. • Assume threatened arboreal mammals occur on site and use existing data to assess impact.	• See Section 3.1.1 and 7.1.4 for clarification of hollow size categories in new (2015) and previous surveys, respectively. • Refer to Section 4.2.2 for microhabitat suites and 5.3.2 for quantification of impact. • Refer to Section 7.1.4 for hollow use by threatened species. • Presence assumed and additional AoS has prepared for Eastern Pygmy-possum (Appendix C). • Squirrel Glider was assessed in the original BAs (NGH Environmental 2013 a and b).
Assessment of direct impacts	The proponent has not provided sufficient detail to support the assessment of impacts on native fauna. The BA has not adequately justified conclusions related to the risk of bird and bat collision and the significance of this impact. • No specific information as to what impacts may be expected. • Conclusions reached regarding blade strike in Assessments of Significance are generally unsubstantiated.	That the proponent conduct further assessment of the potential for bird and bat strike and barotrauma within the wind farm study area. This should be undertaken prior to approval and be incorporated into the Bird and Bat Management Plan with recommendations as to what mitigating measures, such as buffer areas or reconfiguration of the turbine layout, will be implemented to minimise bird and bat strike and barotrauma.	• Re unsubstantiated: Information on non-threatened species is used to inform impacts on less-studied threatened species. This is considered relevant - some species may be good indicators of habitat health and presence of threatened species. • Provide supporting data for conclusions in the Assessments of Significance. Update AoS's • Provide information regarding blade strike and barotrauma including Australian migratory birds, non-threatened species and bats.	• General assumptions stated in Section 5.1. • Specific information as to the impacts that can be expected, including migratory and non-threatened species, is in Section 7.2. • A species-by-species collision risk assessment has been provided in Section 5.5 for Regent Honeyeater, Swift Parrot, Eastern Bentwing-bat, Yellow-bellied Sheathtail-bat, Eastern Cave Bat, Corben's Long-eared Bat and Large-eared Pied Bat. Migration events for relevant species is also discussed in Section 7.3. • Refer to Section 8 for updated impact avoidance actions and recommendations.

TOPIC	AGENCY ADEQUACY COMMENT	AGENCY RECOMMENDATION	NGH SOLUTION TO ADDRESS INADEQUACY	LOCATION IN THIS ADDENDUM
	• Surveys were outside the autumn migration period for honeyeater species and key periods when migratory, high-flying species such as swifts are present. • The BA tends to ignore potential threat to species not listed as threatened. • No AoS undertaken for Regent Honeyeater. • Little discussion on the potential impact of blade strike or barotrauma on microbats. • Need clarification of assumptions relating to impacts. • It is unclear how the constraints mapping reflects the placement of turbines		• Include AoS for Regent Honeyeater. • Very little data is available in Australia on the impact of wind farms on microbats. • Assumptions are given in Section 10.1 of the WF report. However, they can be clarified further. • There are inherent uncertainties in the impact assessment that cannot be clarified prior to construction. It is impossible to provide an accurate quantitative assessment of impacts such as blade strike due to the lack of published Australian data. A collision risk assessment approach has been used to review assessment of collision. • Constraints maps: confirm that areas considered high value for birds and bats are located at least 100 m (preferably 200 m (pers. comm. Glenn Hoye)) from turbines.	
Assessment of indirect impacts	The proponent has not provided sufficient detail to support the assessment of indirect impacts on native fauna relating to the disturbance to birds and bats	That the proponent investigates the potential for the current wind farm configuration to:	• Barrier effect was discussed in NGH Environmental (2013a, section 9.2.3). Long term or permanent behaviour displacement leading to barrier	• Literature review on barrier effect and behavioural displacement in Section 7.2.3. Cumulative impacts in Section 7.4.

TOPIC	AGENCY ADEQUACY COMMENT	AGENCY RECOMMENDATION	NGH SOLUTION TO ADDRESS INADEQUACY	LOCATION IN THIS ADDENDUM
	resulting in avoidance of habitats in or near wind farms. • Limited discussion of behavioural displacement of fauna. • Lack of discussion around barrier effect of multiple barriers created by turbine arrays on adjacent ridges.	(a) Disrupt the migratory route of birds and bats, including species not listed in either the TSC Act and EPBC Act; and (b) Reduce the area of habitat available to fauna, in particular seasonal migratory species In order to determine whether reconfiguration of turbines or additional offsets may be required.	effect has been clearly demonstrated at overseas and offshore wind farms, but has yet to be demonstrated at Australian terrestrial wind farms.	
Cumulative impacts	The BA does not address cumulative impacts. • Migrating species may pass through multiple wind farms when moving north-south or east-west and this is likely to compound impacts.	That the proponent gives genuine consideration of cumulative impacts to migratory fauna in both a state-wide and regional context and give due consideration to reconfiguring the wind farm should impacts be unacceptable.	• Discuss potential cumulative impacts as a result of other wind farms in the region, including the Kyoto, Bodandra, Uungula, and Crudine Ridge WFs.	• Cumulative impacts Section 7.4 • Migratory species Section 7.3.
Impact avoidance (wind farm study area)	OEH considers that there is insufficient information to determine whether further avoidance measures of native vegetation is possible or required. • Serious consideration has not been given to the impact of turbine placement in the wind farm. • OEH is concerned that the value of communities not dominated by Norton's Box or Mountain		• Fauna habitat areas analysed and mapped separate from vegetation communities. • Clarify significant impact guidelines.	• Fauna habitat methods Section 3.1.1 and discussion Section 4.2. • Quantification of fauna habitat types in Section 5.3.2. • The definition of a significant impact is given in DECC (2007).

TOPIC	AGENCY ADEQUACY COMMENT	AGENCY RECOMMENDATION	NGH SOLUTION TO ADDRESS INADEQUACY	LOCATION IN THIS ADDENDUM
	Gum/Stringybark are under-valued as habitat for fauna. • There is no indication of what constitutes a significant impact.			
Impact avoidance (transmission line study area)	• The BA has failed to demonstrate that avoidance of riparian areas along the alternate route is not possible. • It is uncertain to what extent modifications to the route presented might influence the total area being cleared. • No discussion of why further potential routes with less impact to woodland and forest are not presented.	That the proponent be required to: • Ensure that all avoidance measures implemented in finalising the location and design of the facility are fully described • Undertake a more thorough investigation of the transmission line routes, to identify where modifications can be made to maximise avoidance of high conservation value vegetation such as riparian areas. • Sufficiently justify the level of avoidance implemented.	• Provide more detail of avoidance and mitigation measures where possible. • Route selection will reduce impact figures and clarify assessment. • As the TX line in linear in nature and covers a large area, it is not possible to completely avoid crossing riparian areas. Impacts have been minimised where possible. • Proponent to justify chosen route.	• Additional mitigation measures included in Section 8. • One TX line route has been chosen and assessed. • Clearing areas for riparian communities in Section 5.3.1 • Route justification in Section 2.
Monitoring and mitigation	The BA does not provide detail of any monitoring to assess the impacts of rotor strike nor does it adequately consider mitigation measures in response to bird and bat strike. • Mitigation measures are general in nature.	• That the proponent develop a FFMP in consultation with OEH before approval. • That the proponent develop a BBMP in consultation with OEH prior to approval. • That the proponent adequately consider the range of mitigation measures for implementation at the site to mitigate any predicted or observed bird and bat impacts.	• Flora and Fauna Management Plan and Bird and Bat Adaptive Management Plan will be developed in consultation with OEH if the project is approved. • Provide more detail of avoidance and mitigation measures where possible.	• It is understood that OEH will be releasing guidelines shortly. • Additional mitigation measures in Section 8.

TOPIC	AGENCY ADEQUACY COMMENT	AGENCY RECOMMENDATION	NGH SOLUTION TO ADDRESS INADEQUACY	LOCATION IN THIS ADDENDUM
		• That should the project be approved, the DPE include a condition of consent requiring a monitoring program capable of detecting any changes in the population of birds and/or bats that can reasonably be attributed to the operation of the project.		
Durridgere SCA	OEH do not support the proposed preferred route through Durridgere SCA	OEH recommends that further investigations be undertaken regarding the alternate routes with specific attention being made to avoidance measures.	• Determine new preferred route that does not pass through Durridgere SCA.	• New route has been developed in consultation with OEH.
Offsets	The BA does not include a detailed offset proposal. • Offset commitments should be available for scrutiny prior to the approval of the impact.	That the proponent provide a detailed offset strategy prior to approval.	• Produce a detailed offset strategy, prior to approval, which contains proposed viable offset areas and options to secure these areas in perpetuity.	• Offset Strategy summarised in Section 6 and provided in Appendix F.
Offset ratios	OEH considers the proposed system of offset ratios *lacking in a scientific rationale* and that a 'maintain or improve' outcome has not been achieved.	That the proponent demonstrate the adequacy of the proposed ratios by either running a BioBanking scenario, using representative data if actual data not be available, or providing OEH with sufficient data to run such a scenario itself.	• Develop offset ratios by running a BioBanking scenario, using representative values	• BioBanking scenario and Offset Strategy summarised in Section 6 and provided in Appendix F.
DPE				
Discrepancies in estimated disturbance areas for assessing	Table 9-2 BA totals are incorrect.	Provide updated tables with correct figures. Ensure consistent impact area assumptions.	• State all impact area assumptions, in consultation with Epuron. • Impact area calculations updated	• Assumptions given in Section 2 • Clearing area figures in Section 5.3

TOPIC	AGENCY ADEQUACY COMMENT	AGENCY RECOMMENDATION	NGH SOLUTION TO ADDRESS INADEQUACY	LOCATION IN THIS ADDENDUM
impacts on biodiversity				
Access Tracks	• As indicated above, it is unclear whether existing farm tracks are included in the defined survey area and to be included in the proposed 200m "project corridor". • Inconsistency between width for access tracks leading to 10m TLSA vs. 20m for WFSA.	Should be consistent in assumptions.	• State all impact area assumptions, in consultation with Epuron. • Single assessment for both projects	• Assumptions in Section 2 • Combined impact areas by vegetation type provided in Section 5
Public Road Access – Biodiversity Impacts	No biodiversity assessment has been completed on potential impacts on biodiversity as a result of upgrades to public roads.	These areas are either outside the project boundary or development envelope and would not form part of the project determination if these impacts are not assessed. Eg. would need to be assessed by appropriate roads authority under REF separate to this development consent.	• Epuron to provide all impact areas in mapping and impact area estimations	• Section 2 and Section 5.1-5.3
Vegetation Type areas not assessed	• States that 131.2 ha was not assessed – it is not clear where these areas are. • Also as per comment above the maps do not include vegetation mapping around clearing (20 or 10m disturbance) associated with access tracks.	Clarify where this missing mapping is within the development envelope.	• All areas of development enveloped have now been mapped, including tracks.	• Refer to Section 5 for calculations and Appendix A for maps.

TOPIC	AGENCY ADEQUACY COMMENT	AGENCY RECOMMENDATION	NGH SOLUTION TO ADDRESS INADEQUACY	LOCATION IN THIS ADDENDUM
Flora Surveys and low condition derived native grassland/ exotic pasture	Based on survey effort maps in BA Appendix C – a number of the ridge lines have had no flora plots or inspections undertaken to allow assessment for vegetation community or condition class. How has the mapping been undertaken?		• More than 160 hours were spent in actual flora survey time and over 300 ha were physically inspected and searched. The study are is so vast, that it is necessary to extrapolate the remaining area from these survey sites. Due to the requirements of assessment both vegetation/habitat type and condition need to be extrapolated. • Clarify how extrapolation is undertaken.	• Extrapolation methods in Section 7.1.2.
Fauna Surveys and potential high quality bat/bird habitat within the project boundary/ proximity to turbines.	• in some cases there appears to be potential good quality fauna habitat (woodland) immediately adjoining areas classified as low condition. • BA Section 9.3.5 also notes that a greater distance of 600m between turbines within areas of intact woodland is better to minimise barrier effects and to avoid placing turbines between core areas of habitat. • While a habitat assessment was undertaken (s4.3.3	• Maps showing habitat/ habitat condition / connectivity between core habitat patches results would be useful, particularly focusing on fauna species at risk through blade strike, barotrauma and barrier effects. • Additional mapping across the windfarm project area will also assist in confirming potential offset areas as discussed below. • Mapping of specific fauna type habitats would also be useful here ie. Squirrel Glider habitat, Powerful Owl habitat.	• Provide maps showing habitat/ habitat condition • Provide maps showing specific fauna type habitats. • Provide more detail of avoidance and mitigation measures where possible.	• Habitat type and condition maps in Appendix A.5-A.9. • Habitat discussion in Section 4.2 • Discussion of collision and barrier effect in Section 5.5 and 7.2. • Discussion of mitigation measures including nest sites in Section 8.

TOPIC	AGENCY ADEQUACY COMMENT	AGENCY RECOMMENDATION	NGH SOLUTION TO ADDRESS INADEQUACY	LOCATION IN THIS ADDENDUM
	methodology) and incorporated into constraints mapping, no separate habitat quality mapping is provided of good quality habitat in close proximity to the development • envelope or connectivity etween good quality woodland patches across turbines. • A high number of Wedge–tailed Eagle sightings were recorded during the surveys. The BA recommends a buffer to Wedge-tailed eagle nests, noting distances of between 500-1,000 m have been used elsewhere.	• Mapping of the 100m bird and bat buffer as described at p.69 of the BA should be included. • Spring fauna surveys did not comprehensively search for Wedge-tailed Eagle nests. The RTS should outline proposed management measures for protecting and buffering nest sites detected in pre-construction surveys.		
Biodiversity Offsets	It is noted that the Proponent commits to undertaking Biometric (BBAM) plots in the proposed offset areas.	• Utilisation of the Framework for Biodiversity Assessment (FBA) to calculate the offset requirements for the project • Demonstrate the adequacy of the proposed offsets in consultation with OEH. • Identify whether a staged offsetting • approach is proposed (refer to general comments below about staging of the project).	Prepare biodiversity offset strategy, in accordance with previous advice and similar to prepared for Yass wind farm, showing feasibility of offset candidates.	• Offset strategy summarised in Section 6 and provided in Appendix F. Note, not all offset locations have not yet been confirmed.

TOPIC	AGENCY ADEQUACY COMMENT	AGENCY RECOMMENDATION	NGH SOLUTION TO ADDRESS INADEQUACY	LOCATION IN THIS ADDENDUM
		• Offset locations within the project boundary be defined – including current condition and • proposed management actions/ security and incorporated into the project approval conditions. • Any offsets within the project boundary would need to be a reasonable distance from turbine areas to avoid any indirect impacts from the turbines – OEH submission indicated potential indirect impacts "zone of disturbance" of 600m for fauna.		

APPENDIX F REVISED OFFSET STRATEGY

EPURON

Biodiversity Offset Strategy

LIVERPOOL WIND FARM PROJECT

FEBRUARY 2017

ngh environmental

www.nghenvironmental.com.au

Document Verification

ngh environmental	Project Title:	Biodiversity Offset Strategy Liverpool Wind Farm Project

Project Number:

Project File Name: liverpool offset strategy v1.docx

Revision	Date	Prepared by (name)	Reviewed by (name)	Approved by (name)
Final v1	01/02/2017	Brooke Marshall	Dave Maynard	Brooke Marshall

NGH Environmental Pty Ltd (ACN: 124 444 622. ABN: 31 124 444 622) and NGH Environmental (Heritage) Pty Ltd (ACN: 603 938 549. ABN: 62 603 938 549) are part of the NGH Environmental Group of Companies.

www.nghenvironmental.com.au e ngh@nghenvironmental.com.au

Sydney Region
18/21 mary st
surry hills nsw 2010 (t 02 8202 8333)

Canberra - NSW SE & ACT
unit 17/27 yallourn st (po box 62)
fyshwick act 2609 (t 02 6280 5053)

Wagga Wagga - Riverina and Western NSW
suite 1, 39 fitzmaurice st (po box 5464)
wagga wagga nsw 2650 (t 02 6971 9696)

Newcastle - Hunter and North Coast
153 tudor st
hamilton nsw 2303 (t 02 4969 4910)

Bega - ACT and South East NSW
suite 1, 216 carp st (po box 470)
bega nsw 2550 (t 02 6492 8333)

Bathurst - Central West and Orana
35 morrisset st (po box 434)
bathurst nsw 2795 (m 0448 820 748)

CONTENTS

TABLES

1 INTRODUCTION

1.1 PURPOSE OF THIS STRATEGY

The objective of this Offset Strategy is to demonstrate that suitable and adequate offsets will be achievable for the Liverpool Range Wind Farm Project, with reference to the Framework for Biodiversity Assessment (FBA, 2016) for Major Projects. This strategy includes:

Section 2 **Preliminary development site credit calculations**

- A preliminary assessment of the offset requirement for the proposal, sourcing VIS benchmark plot data, in advance of obtaining project specific plot data and using the Major Projects option of the NSW Office of Environment and Heritage (OEH) BioBanking Credit Calculator (BCC) and the rules under the FBA.
- An estimate of the areas that would be required to meet the offset requirement.

Section 3 **Preliminary offset candidate evaluation**

- Identification of candidate offset sites within the vicinity of the project, their availability and general adequacy to meet the offset requirements.

Section 4 **Implementation**

- Options being considered to secure and manage the offset sites.
- Time lines for implementation of a detailed offset plan.

1.2 DATA SOURCES

Data for this assessment was sourced as follows:

- Vegetation type and condition of the development site: Biodiversity Assessment Addendum of the Liverpool Wind Farm (NGH Environmental 2017). The addendum provides the most complete dataset, including areas surveyed in the 2013 Biodiversity Assessments for the project as well as additional areas surveyed in 2015 and 2016.
- Impact area calculations: Biodiversity Assessment Addendum of the Liverpool Wind Farm (NGH Environmental 2017), using 'worst case' or 'upper limit values' where multiple route options / layouts are proposed. Areas were calculated using a GIS by Epuron, using the project infrastructure layout, buffered by required widths for road, transmission lines, turbine footings and hardstands etc.

• Plot data (vegetation survey data required to be entered into the online BCC):	OEH vegetation database benchmark data is used to derive plot data. Using benchmark data assumes all vegetation to be impacted is of high quality; scores for native species diversity, native overstorey regeneration, fallen timber, hollow-bearing trees, weediness and other parameters reflect a vegetation community in good condition. Median parameter values are entered in this preliminary assessment, within the benchmark range. No Biometric surveys have been undertaken for the project at this stage.
• Threatened species: ○ Threatened species likely or unlikely to be impacted ○ Threatened species habitat impact areas	Biodiversity Addendum of the Liverpool Wind Farm (NGH Environmental 2017). As above, the addendum provides the most complete dataset including an assessment of threatened species impacts for the project.
• BioBanking calculations:	OEH BioBanking online calculator, commencing December 2016; selecting Major Project and Linear Assessment. ID 0035/2016/4151MP and 0035/2017/4183MP; two assessments are required as the project spans two Catchment Management Area boundaries.
• Offset area estimate:	OEH credit converter tool, accessed January 2017.

2 PRELIMINARY CREDIT CALCULATIONS: DEVELOPMENT SITE

2.1 OVERVIEW

Key aspects of this credit assessment methodology are detailed below. The assessment is considered preliminary, to ensure suitable and adequate offsets will be achievable for the Liverpool Wind Farm Project, in advance of plot data collection and some remaining pre-clearance surveys to be undertaken prior to construction.

The final offset requirement is proposed to be calculated using field collected plot data, and would be based on the final impact areas derived from civil construction drawings (not yet available). This will provide a further incentive throughout the detailed design to minimise the clearing impacts of the works and thereby reduce the offset requirement.

Two assessments were run as the development spans two CMAs:

- The northern section: Central West CMA, Section 2.2 (map provided in Appendix A.1)
- The southern section: Hunter / Central Rivers CMA, Section 2.3 (map provided in Appendix A.5)

2.2 BIOBANKING ASSESSMENT CENTRAL WEST CMA

2.2.1 Landscape assessment

Native vegetation extent, before and after the project

In accordance with Appendix 5 of the FBA, using a GIS generated 550 m buffer from the centreline of infrastructure components:

- The total area of the project buffer is 23,522.48 ha.
- The total area of native vegetation mapped within the buffer (using canopy connected by less than 100m as a surrogate for native vegetation, as woody vegetation would have originally covered the site) is 15,193.14 ha.

The current native vegetation cover score is therefore 65%.

- The total area of native vegetation within the buffer that would be impacted by the project is 154.35 ha.

The future native vegetation cover score is therefore 64%. The extent of native vegetation within the buffer is mapped in Appendix A.1

Rivers and streams

The proposal traverses several waterways. The largest include:

- In the north, the proposed infrastructure crosses several waterways with their headwaters in Coolah Tops National Park. The largest is **Trabragar River**, a second order river where the project transmission line crosses it. It would not be impacted directly.

- Near Cassilis, the transmission line crosses **Four Mile Creek**, a second order river in this location. It would not be impacted directly.

Native vegetation in the area is generally 1,000-5,000ha with connecting widths 100-500m; as such a 'large biodiversity link' has been entered in the BCC.

Patch size

For a development that is linear shaped or a multiple fragmentation development, the assessor must assess the patch size for each **Mitchell landscape** in which the development occurs, averaging the scores. For this project, several landscapes are impacted:

- Liverpool Range Valleys and Footslopes 80% cleared – most of the wind farm site
- Coolah Tops 61% cleared – small area at the very northern extent of wind farm site
- Liverpool Tops 20% cleared – small area at the north east extent of wind farm site

Refer to map of Mitchell Landscapes, Appendix A.2. The average patch size score is 12.5.

Area to perimeter ratio

One representative patch within the GIS produced buffer would be affected by the project (ID: A). The patch is made up of one polygon. The area and perimeter ratio before development is shown below.

Table 2-1 Area to perimeter ratio

Patch	Area (m^2)	Perimeter (m)
A	5,026,890	26,435.54
Area m^2 / Perimeter m	**190.16**	

Patch A is shown in Appendix A.3.

The effect of the development (the future score) is to increase the number of polygons. Taking into account the development, the future area and perimeter ratio of Patch A after development is shown below.

Table 2-2 Future patch size and perimeter

Patch A	Area (m^2)	Perimeter (m)
a	3,313,070	14,647.75
b	1,650,160	20,287.60
Totals:	**4,963,230**	**34,935.35**
Area m2 / Perimeter m	**142.07**	

As the current ratio is greater than the future ratio, the calculator returns a proportional change % and score of Zero (0).

The landscape assessment score resulting from these inputs is 25.5.

Location of the site

IBRA SUBREGIONS

The proposed infrastructure crosses three IBRA subregions:

- Brigalow Belt South - Liverpool Range – northern area and the majority of site, including most wind turbines
- Brigalow Belt South - Pilliga – central area, south of Cassilis
- Sydney Basin – Kerrabee – southern area

Refer to map of IBRA regions, Appendix A.4. The Liverpool Range - Central West was entered into the BCC.

LOCAL GOVERNMENT AREAS (LGA)

The proposed infrastructure crosses three LGAs:

- Warrumbungle Shire
- Upper Hunter Shire
- Mid-Western Regional

Upper Hunter is the central LGA and has been entered in the calculator.

CATCHMENT MANAGEMENT AREAS

- The majority of the wind farm infrastructure proposed would be located in the Central West CMA.
- The majority of the transmission line is in the Hunter Rivers CMA.

This assessment considers infrastructure proposed in the Central West CMA only.

The resulting landscape score is 20.5.

2.2.2 Vegetation zones

The native vegetation zones that would be impacted by the northern section of the project (within the Central West CMA) as entered into the BCC (including their condition class, number of biometric plots required for them, as determined by the BCC), are provided below.

For one community, not plot data were available on the VIS database (Derived Speargrass – wallaby grass – wire grass mixed forb grassland mainly in the Coonabarabran – Pilliga – Coolah region ID 395). In the northern section of the project, this community often occurs adjacent to Silvertop Stringybark - Yellow Box – Norton's Box grassy woodland on basalt hills mainly on northern aspects of the Liverpool Range ID 488. This community and benchmark data were utilised in the BCC, deleting the overstorey cover to zero and reducing the species richness by two (to account for overstorey species). This vegetation type is of the same formation (Grassy Woodlands) in accordance with OEH advice (S. Cox, 19 Jan 2017).[1]

2.2.3 Plot data used in the assessment

Use of benchmark data

As plot field data has not been collected for the project, the proposed approach of this preliminary assessment, as discussed in the OEH submission, is to use OEH benchmark plot data. This approach has

[1] Vegetation communities of the same class were also considered but had poor species assemblage overlap.

also been used recently for the Rye Park Wind Farm; OEH held benchmark data specific to the vegetation communities to be impacted are used and are considered representative of the values that would be obtained in vegetation onsite in good condition. It may therefore be considered a conservative approach, over estimating areas that are actually of lesser quality. It is considered reasonable as this is a preliminary assessment used to determine whether offsets are feasible for the project. Having determined the likely scope of offsets, a commitment is made by the project to secure offsets in accordance with the FBA BCC methodology, using field collected plot data and based on the final construction footprint.

Modifications to benchmark data

The following plot data have been derived from benchmark data on the OEH vegetation data base. The number of plots required, as shown in Table 2-3, have been duplicated for each zone. In the cases where no benchmark is provided for a parameter, a precautionary treatment has been applied as follows:

- Exotic cover is scored as zero, assuming the vegetation is weed free.
- Regeneration is scored as 1, assuming all occurring trees are regenerating.
- Where hollow-bearing tree bench marks are listed as a decimal (ie 0.8), 1 is entered in the plot data.

Note, as the data were not collected in the field, no Easting and Northing locations apply; '111111, 1111111' has been entered for each plot.

The management scores *with development* have been entered as zero for each parameter – that is, total removal of habitat would result from the development. Future site value scores would all be zero.

Table 2-3 Impacts in vegetation zones within the project's Central West CMA, northern section (Endangered Ecological Communities (EECs) shown in bold)

Reported as:	Formation	Biometric name	Impact area	Plot number
River Oak – Rough-barked Apple – red gum – box riparian tall woodland (ID084)	Forested wetlands	River Oak - Rough-barked Apple - red gum - box riparian tall woodland (wetland) of the Brigalow Belt South Bioregion and Nandewar Bioregion	6.47	3
Rough-barked Apple - Blakely's Red Gum – Yellow Box woodland on alluvial clay to loam soils on valley floors in the northern south-west slopes and BBS Bioregions (ID281)	**Grassy woodlands**	**Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South bioregion**	**7.79**	**3**
Derived Speargrass – wallaby grass – wire grass mixed forb grassland mainly in the Coonabarabran – Pilliga – Coolah region (395)[2]	**Grassy woodland**	**Changed in the BCC to:** **Silvertop Stringybark - Yellow Box – Norton's Box grassy woodland on basalt hills mainly on northern aspects of the Liverpool Range (ID488)** **This could not be entered in the BCC as an EEC.**	**9.34**	**3**
Yellow Box Gum Woodland (ID 437)	**Grassy woodland**	Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion	**1.51**	**1**
Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region (ID483)	**Grassy Woodlands**	**White Box grass shrub hill woodland on clay to loam soils on volcanic and sedimentary hills in the southern Brigalow Belt South Bioregion**	**64.94**	**5**
Silvertop Stringybark - Yellow Box – Norton's Box grassy woodland on basalt hills mainly on northern aspects of the Liverpool Range (ID488)	Grassy Woodlands	Silvertop Stringybark - Yellow Box +/- Nortons Box grassy woodland on basalt hills mainly on northern aspects of the Liverpool Range, Brigalow Belt South Bioregion	59.77	5
Silvertop Stringybark – Forest Ribbon Gum very tall moist open forest on basalt plateau on the Liverpool Range (ID490)	Grassy Woodlands	Silvertop Stringybark - Forest Ribbon Gum very tall moist open forest on basalt plateau on the Liverpool Range, Brigalow Belt South Bioregion	1.05	1

[2] This vegetation type is described and mapped in the biodiversity addendum report. As no benchmark data is available and this community occurs adjacent to Silvertop Stringybark - Yellow Box – Norton's Box grassy woodland on basalt hills mainly on northern aspects of the Liverpool Range ID488 onsite, an additional ID 488 zone was created and ID 488 modified plot data were used in the assessment (overstorey reduced to zero, species richness reduced by two).

Reported as:	Formation	Biometric name	Impact area	Plot number
Brittle Gum - Silvertop Stringybark grassy open forest of the Liverpool Range (ID495)	Dry Sclerophyll Forests (Shrub/grass sub-formation)	White Box - Red Stringybark shrubby woodlands on basalt slopes of the Nandewar Bioregion and Brigalow Belt South Bioregion	3.12	2
White Box - White Cypress Pine shrubby open forest (ID588)	Dry Sclerophyll Forests (Shrub/grass sub-formation)	White Box - White Cypress Pine shrubby hills open forest mainly in the Nandewar Bioregion	0.36	1

Table 2-4 Plot data, derived from OEH database benchmarks

River Oak – Rough-barked Apple – red gum – box riparian tall woodland (ID084)

084	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Overstorey regeneration	Total length of fallen logs	Easting	Northing	Zone
1	21	29	10	16	3	10	0	1	1	50	111111	1111111	1

Rough-barked Apple - Blakely's Red Gum – Yellow Box Woodland on Alluvial Clay to Loam Soils on Valley Floors in the Northern South-West Slopes and BBS Bioregions (ID281)

281	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Overstorey regeneration	Total length of fallen logs	Easting	Northing	Zone
1	19	18	10	30	4	10	0	0.8	1	66	111111	1111111	1

Derived Speargrass – Wallaby Grass – Wire Grass mixed forb grassland mainly in the Coonabarabran – Pilliga – Coolah region (395); plot data entered into BCC was derived from Silvertop Stringybark - Yellow Box – Norton's Box grassy woodland on basalt hills mainly on northern aspects of the Liverpool Range (ID488) and not VIS plot data for 395 is available.

488 modified[3]	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Overstorey regeneration	Total length of fallen logs	Easting	Northing	Zone
1	30	0	8	40	12	10	0	2	1	15	111111	1111111	1

Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion (ID437)

437	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Overstorey regeneration	Total length of fallen logs	Easting	Northing	Zone
1	25	20	12	30	4	12	0	1	1	50[4]	111111	1111111	1

Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region (ID483)

483	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Overstorey regeneration	Total length of fallen logs	Easting	Northing	Zone
1	23	30	30	30	8	20	0	2	1	50	111111	1111111	1

Silvertop Stringybark - Yellow Box – Norton's Box grassy woodland on basalt hills mainly on northern aspects of the Liverpool Range (ID488)

488	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Overstorey regeneration	Total length of fallen logs	Easting	Northing	Zone
1	32	40	8	40	12	10	0	2	1	15	111111	1111111	1

Silvertop Stringybark – Forest Ribbon Gum very tall moist open forest on basalt plateau on the Liverpool Range (ID490)

[3] ID 488 plot modified as follows: overstorey scored as zero, overstorey richness reduced by two to account for said overstorey species.

[4] There is a suspected error in the benchmark data that lists this score as 0.5m. 50m has been used instead, which more closely resembles the score for similar vegetation types.

490	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Overstorey regeneration	Total length of fallen logs	Easting	Northing	Zone
1	32	40	8	40	12	10	0	2	1	15	111111	1111111	1

Brittle Gum - Silvertop Stringybark grassy open forest of the Liverpool Range (ID495)

495	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Overstorey regeneration	Total length of fallen logs	Easting	Northing	Zone
1	33	30	12	19	8	4	0	2	1	20	111111	1111111	1

White Box - White Cypress Pine shrubby open forest (ID588)

588	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Overstorey regeneration	Total length of fallen logs	Easting	Northing	Zone
1	26	18	18	25	6	4	0	1	1	15	111111	1111111	1

2.2.4 Geographic features

The following features returned in the BCC would/would not be impacted:

Table 2-5 Geographic features

• Impacted	Pale-headed Snake	*Hoplocephalus bitorquatus*	land within 40 m of watercourses, containing hollow-bearing trees, loose bark and/or fallen timber
• Impacted	Grey Falcon	*Falco hypoleucos*	land containing within 100 m of riparian woodland on inland rivers containing mature living eucalypts or isolated paddock trees overhanging water or dry watercourses
• Not impacted[5]	Large-eared Pied Bat	*Chalinolobus dwyeri*	land containing escarpments, cliffs, caves, deep crevices, old mine shafts or tunnels

2.2.5 Ecosystem credit species

The following species are all species predicted by the BCC to occur, based on the data entered for the landscape assessment and the geographic and habitat features in the assessment. These constitute all species which will generate ecosystem credits in the credit calculations.

Table 2-6 Species predicted to occur.

• Black-chinned Honeyeater (eastern subspecies)	*Melithreptus gularis subsp. gularis*
• Brown Treecreeper (eastern subspecies)	*Climacteris picumnus subsp. victoriae*
• Bush Stone-curlew	*Burhinus grallarius*
• Corben's Long-eared Bat	*Nyctophilus corbeni*
• Diamond Firetail	*Stagonopleura guttata*
• Eastern False Pipistrelle	*Falsistrellus tasmaniensis*
• Flame Robin	*Petroica phoenicea*
• Glossy Black-Cockatoo	*Calyptorhynchus lathami*
• Grey-crowned Babbler (eastern subspecies)	*Pomatostomus temporalis subsp. temporalis*
• Hooded Robin (south-eastern form)	*Melanodryas cucullata subsp. cucullata*
• Little Eagle	*Hieraaetus morphnoides*
• Little Lorikeet	*Glossopsitta pusilla*

[5] In response to the OEH submission, this species is assumed to occur in the southern assessment (Hunter/ Central Rivers). However, no caves now occur in the project footprint and so no impact on this geographic feature has been entered.

• Masked Owl	*Tyto novaehollandiae*
• Painted Honeyeater	*Grantiella picta*
• Powerful Owl	*Ninox strenua*
• Scarlet Robin	*Petroica boodang*
• Speckled Warbler	*Chthonicola sagittata*
• Spotted Harrier	*Circus assimilis*
• Spotted-tailed Quoll	*Dasyurus maculatus*
• Swift Parrot	*Lathamus discolor*
• Turquoise Parrot	*Neophema pulchella*
• Varied Sittella	*Daphoenositta chrysoptera*
• Yellow-bellied Glider	*Petaurus australis*
• Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*

2.2.6 Threatened species credit species

The following species were returned by the BCC as requiring survey. The table below states whether each species was detected during surveys and furthermore, if impacts are likely.

Table 2-7 Species that generate species credits if impacted.

•	Australasian Bittern	*Botaurus poiciloptilus*	Not identified	No impact
•	Brush-tailed Phascogale	*Phascogale tapoatafa*	Not identified	No impact
•	Eastern Pygmy-possum	*Cercartetus nanus*	Not identified	No impact
•	Grey Falcon	*Falco hypoleucos*	Not identified	No impact
•	Koala	*Phascolarctos cinereus*	Not identified	No impact
•	**Large-eared Pied Bat**	***Chalinolobus dwyeri***	**Identified**	**Impact**
•	Pale-headed Snake	*Hoplocephalus bitorquatus*	Not identified	No impact
•	Regent Honeyeater	*Anthochaera phrygia*	Not identified	No impact
•	**Squirrel Glider**	***Petaurus norfolcensis***	**Identified in WFSA**	**Impact**

The Large-eared Bat and Squirrel Glider were returned by the BCC. Based on habitat modelling an estimated 19 ha of potential moderate or better woodland habitat would be impacted for each species. This has been entered as a loss.

Additionally, the following species are known to occur and have been entered into the BCC as being impacted as follows:

- Eastern Bentwing-bat *Miniopterus schreibersii oceanensis*

If species are identified in consultation with OEH or in subsequent surveys, this information would inform the final offset package to be developed for the project.

2.2.7 Credit statement

The following credit statement was returned from the BCC.

Table 2-8 Credit statement for the Central West northern section of the proposal

PC type code	Plant community type name	Management zone area (ha)	TS with highest credit req	Ecosystem credits required
CW180	River Oak - Rough-barked Apple - red gum - box riparian tall woodland (wetland) of the Brigalow Belt South Bioregion and Nandewar Bioregion	6.47	Masked Owl	518
CW111	Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	7.79	Powerful Owl	562
CW304	Silvertop Stringybark - Yellow Box +/- Nortons Box grassy woodland on basalt hills mainly on northern aspects of the Liverpool Range, Brigalow Belt South Bioregion	9.34	Powerful Owl	581
CW322	White Box grass shrub hill woodland on clay to loam soils on volcanic and sedimentary hills in the southern Brigalow Belt South Bioregion	64.94	Powerful Owl	4078
CW304	Silvertop Stringybark - Yellow Box +/- Nortons Box grassy woodland on basalt hills mainly on northern aspects of the Liverpool Range, Brigalow Belt South Bioregion	59.77	Powerful Owl	4789
CW303	Silvertop Stringybark - Forest Ribbon Gum very tall moist open forest on basalt plateau on the Liverpool Range, Brigalow Belt South Bioregion	1.05	-	32

PC type code	Plant community type name	Management zone area (ha)	TS with highest credit req	Ecosystem credits required
CW210	White Box - Red Stringybark shrubby woodlands on basalt slopes of the Nandewar Bioregion and Brigalow Belt South Bioregion	3.12	Masked Owl	210
CW225	Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion	1.51	Masked Owl	118
CW214	White Box - White Cypress Pine shrubby open forest of the Nandewar Bioregion and Brigalow Belt South Bioregion	0.36	Masked Owl	22

Scientific name	Common name	TS offset multiplier	Species credits required
Petaurus norfolcensis	Squirrel Glider	2.2	418
Chalinolobus dwyeri	Large-eared Pied Bat	1.3	247
Miniopterus schreibersii subsp. oceanensis	Eastern Bentwing-bat	1.3	247

2.3 BIOBANKING ASSESSMENT HUNTER / CENTRAL RIVERS CMA

2.3.1 Landscape assessment

Native vegetation extent, before and after the project

In accordance with Appendix 5 of the FBA, using a GIS generated 550 m buffer from the centreline of infrastructure components:

- The total area of the project buffer is 9,789.16 ha.
- The total area of native vegetation mapped within the buffer (using canopy connected by less than 100m as a surrogate for native vegetation) is 3,076.93 ha.

The current native vegetation cover score is therefore 31%.

- The total area of native vegetation within the buffer that would be impacted by the project is 247.13 ha.

The future native vegetation cover score is therefore 29%. The extent of native vegetation within the buffer is mapped in Appendix A.5.

Rivers and streams

The proposal traverses several waterways. The largest include:

- Near Turil, the transmission line crosses **Curryall Creek**, a third order river in this location. It would not be impacted directly.
- In the south, the transmission line crosses **Goulburn River**, a fourth order river in this location. It would not be impacted directly.

As the easements may require additional clearing within these riparian corridors, impact on a 'riparian buffer of a 4th or 5th order stream has been selected.

Patch size

For a development that is linear shaped or a multiple fragmentation development, the assessor must assess the patch size for each **Mitchell landscape** in which the development occurs, averaging the scores. For this project, several landscapes are impacted:

- Cassillis Slopes 65% cleared - most of the transmission line easement
- Talbragar – Upper Macquarie Terrace Sand 93% cleared – small areas of transmission line and access
- Goulburn River Channels and Floodplains 71% cleared – very small area of transmission line at south of project site

Refer to map of Mitchell Landscapes, Appendix A.2. The average patch size score is 12.5.

Area to perimeter ratio

One representative patch within the GIS produced buffer would be affected by the project (ID: A). The patch is made up of one polygon. The area and perimeter ratio before development is shown below.

Table 2-9 Area to perimeter ratio

Patch	Area (m^2)	Perimeter (m)
A	33,130,700	14,647.75
B	16,501,600	20,287.60
Area m^2 / Perimeter m	**142**	

Patch A is shown below in Appendix A.6.

The effect of the development (the future score) is to increase the number of polygons. Taking into account the development, the future area and perimeter ratio of Patch A after development is shown below.

Table 2-10 Future patch size and perimeter

Patch A	Area (m^2)	Perimeter (m)
a	1,481,580	11,229.79
b	949,369	6,455.49
c	4,943	412.47
d	6,518	328.40
e	1,031	268.25
Totals:	**2,443,441**	**18,694.39**
Area m2 / Perimeter m	**131**	

As the current ratio is greater than the future ratio, the calculator returns a proportional change % and score of Zero (0).

The landscape assessment score resulting from these inputs is 23.45.

Location of the site

IBRA SUBREGIONS

The proposed infrastructure crosses three IBRA subregions:

- Brigalow Belt South - Liverpool Range – northern area
- Brigalow Belt South - Pilliga – central area, south of Cassilis
- Sydney Basin – Kerrabee – southern area

Refer to map of regions, Appendix A.4. The Kerrabee – Hunter central rivers was entered into the BCC.

LOCAL GOVERNMENT AREAS (LGA)

The proposed infrastructure crosses three LGAs:

- Warrumbungle Shire
- Upper Hunter Shire
- Mid-Western Regional

Upper Hunter is the central LGA and has been entered in the calculator.

CATCHMENT MANAGEMENT AREAS

- The majority of the wind farm infrastructure proposed would be located in the Central West CMA.
- The majority of the transmission line is in the Hunter / Central Rivers CMA.

This assessment considers infrastructure proposed in the Hunter / Central Rivers CMA only.

The resulting landscape score is 24.75.

2.3.2 Vegetation zones

The native vegetation zones that would be impacted by the southern section of the project (within the Hunter Rivers / Central CMA) as entered into the BCC (including their condition class, number of biometric plots required for them, as determined by the BCC), are provided below.

For one community, not plot data were available on the VIS database (Derived Speargrass – wallaby grass – wire grass mixed forb grassland mainly in the Coonabarabran – Pilliga – Coolah region ID 395). In the southern section of the project, this community occurs most often adjacent to Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region ID 483, this community and benchmark data were utilised in the BCC, deleting the overstorey cover to zero and reducing the species richness by two (to account for overstorey species). This vegetation type is of the same formation (Grassy Woodlands) in accordance with OEH advice (S. Cox, 19 Jan 2017).[6]

2.3.3 Plot data used in the assessment

As stated in Section 2.2.3, the following plot data have been derived from benchmark data on the OEH vegetation data base. The number of plots required, as shown in Table 2-3, have been duplicated for each zone. In the cases where no benchmark is provided for a parameter, a precautionary treatment has been applied as follows:

- Exotic cover is scored as zero, assuming the vegetation is weed free.
- Regeneration is scored as 1, assuming all occurring trees are regenerating.
- Where hollow-bearing tree bench marks are listed as 0.8, 1 is entered in the plot data.

Note, as the data were not collected in the field, no Easting and Northing locations apply; '111111, 1111111' has been entered for each plot.

The management scores *with development* have been entered as zero for each parameter – that is, total removal of habitat would result from the development. Current site value scores are shown in Table 2-3. Future site value scores would all be zero.

[6] Vegetation communities of the same class were also considered but had poor species assemblage overlap.

Table 2-11 Vegetation zones within the project (EECs shown in bold)

Reported as:	Formation	Biometric name	Impact area	Plot number
Riparian Blakely's Red Gum - box - sedge - grass tall open forest of the central NSW South Western Slopes Bioregion (ID 278). [7]	**Grassy Woodlands**	**Entered in BCC as:** **Blakely's Red Gum - Yellow Box grassy woodland of the New England Tableland Bioregion HU681, 278 plot data used.**	**3.55**	**2**
Rough-barked Apple - Blakely's Red Gum – Yellow Box Woodland on Alluvial Clay to Loam Soils on Valley Floors in the Northern South-West Slopes and BBS Bioregions (ID281)	**Grassy woodlands**	**Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South bioregion HU714**	**11.15**	**3**
Derived Speargrass – wallaby grass – wire grass mixed forb grassland mainly in the Coonabarabran – Pilliga – Coolah region (395)[8]	**Grassy woodland**	**Entered in the BCC as** **Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region (ID483). 483 plot data used.** **Could not be selected as an EEC in the BCC.**	**77.26**	**5**
Blue-Leaved Ironbark – Black Cypress Pine Shrubby Sandstone Open Forest in the Southern BBS Bioregion (Benson ID 467)	Dry Sclerophyll Forests (Shrubby sub-formation)	Blue-leaved Ironbark - Black Cypress Pine shrubby sandstone open forest in the southern Brigalow Belt South Bioregion (including Goonoo) HU 682	3.30	2

[7] Not available to be selected in the BCC.

[8] This vegetation type is described and mapped in the biodiversity addendum report. As no benchmark data is available and this community occurs adjacent to Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region ID483 onsite, an additional ID 483 zone was created and ID 483 modified plot data were used in the assessment (overstorey reduced to zero, species richness reduced by two).

Reported as:	Formation	Biometric name	Impact area	Plot number
Inland Scribbly Gum – Red Stringybark – Black Cypress Pine – Red Ironbark Open Forest on Sandstone Hills in the Southern Brigalow Belt South Bioregion and Northern NSW South Western Slopes Bioregion (ID 477)[9]	Dry Sclerophyll Forests (Shrubby sub-formation)	Entered into BCC as Red Ironbark - Black Cypress Pine - stringybark +/- Narrow-leaved Wattle shrubby open forest on sandstone in the Gulgong - Mendooran region, southern Brigalow Belt South Bioregion HU 707	31.51	4
Narrow-leaved Stringybark – Narrow-leaved Wattle Forest (478)	Dry Sclerophyll Forests (Shrubby sub-formation)	Red Ironbark - Black Cypress Pine - stringybark +/- Narrow-leaved Wattle shrubby open forest on sandstone in the Gulgong - Mendooran region, southern Brigalow Belt South Bioregion HU 707	1.20	1
Black Cypress Pine – Ironbark – Wattle Low Open Forest Mainly on Narrabeen Sandstone (ID 480)	Dry Sclerophyll Forests (Shrubby sub-formation)	Black Cypress Pine - ironbark +/- Narrow-leaved Wattle low open forest mainly on Narrabeen Sandstone in the Upper Hunter region of the Sydney Basin Bioregion HU 678	10.32	3
Rough-barked Apple / Blakely's Red Gum / Narrow-leaved Stringybark +/- Grey Gum Sandstone Riparian Grass Fern Open Forest in the Southern BBS and Upper Hunter Regions (ID481)	Dry Sclerophyll Forests (Shrubby sub-formation)	Rough-barked Apple - Blakely's Red Gum - Narrow-leaved Stringybark +/- Grey Gum sandstone riparian grass fern open forest on in the southern Brigalow Belt South Bioregion and Upper Hunter region HU713	30.04	4
Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region (ID483)	**Grassy Woodlands**	**Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley HU690**	**36.16**	**4**

[9] Not available to be selected in the BCC.

Reported as:	Formation	Biometric name	Impact area	Plot number
Narrow-leaved Ironbark – Blakeley's Red Gum shrubby open forest on sandstone low hills (ID468) and Narrow-Leaved Ironbark – Black Cypress Pine – Stringybark – Wattle Shrubby Open Forest on Sandstone (ID 479)[10]	Dry Sclerophyll Forests (Shrubby sub-formation)	Entered as one zone in the BCC as ID 479 in the BCC. Narrow-leaved Ironbark- Black Cypress Pine - stringybark +/- Grey Gum +/- Narrow-leaved Wattle shrubby open forest on sandstone hills in the southern Brigalow Belt South Bioregion and Sydney Basin Bioregion HU 702 479 plot data used.	42.65	4

Table 2-12 Plot data, derived from OEH database benchmarks

Riparian Blakely's Red Gum - box - sedge - grass tall open forest of the central NSW South Western Slopes Bioregion (ID 278); entered in BCC as Blakely's Red Gum - Yellow Box grassy woodland of the New England Tableland Bioregion HU681

278 – 2 plots	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Overstorey regeneration	Total length of fallen logs	Easting	Northing	Zone
1	25	22	10	50	4	10	0	0.8	1	66	111111	1111111	1

Rough-barked Apple - Blakely's Red Gum – Yellow Box Woodland on Alluvial Clay to Loam Soils on Valley Floors in the Northern South-West Slopes and BBS Bioregions (ID281)

281 – 3 plots	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Overstorey regeneration	Total length of fallen logs	Easting	Northing	Zone
1	19	18	10	30	4	10	0	0.8	1	66	111111	1111111	1

Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region (ID483)

[10] As per the Biodiversity Addendum, these vegetation types are combined as one zone. The 479 plot data are entered into the BCC as Narrow-Leaved Ironbark – Black Cypress Pine – Stringybark – Wattle Shrubby Open Forest on Sandstone Hills ID 479, given the benchmark data are slightly higher values and this may be a conservative approach.

483 – 5 plots	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Overstorey regeneration	Total length of fallen logs	Easting	Northing	Zone
1	23	30	30	30	8	20	0	2	1	50	111111	1111111	1

Blue-Leaved Ironbark – Black Cypress Pine Shrubby Sandstone Open Forest in the Southern BBS Bioregion (Benson ID 467)

467 – 2 plots	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Overstorey regeneration	Total length of fallen logs	Easting	Northing	Zone
1	30	22	20	20	20	20	0	2	1	46	111111	1111111	1

Inland Scribbly Gum – Red Stringybark – Black Cypress Pine – Red Ironbark Open Forest on Sandstone Hills in the Southern Brigalow Belt South Bioregion and Northern NSW South Western Slopes Bioregion (Benson Id477)

477 – 4 plots	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Overstorey regeneration	Total length of fallen logs	Easting	Northing	Zone
1	30	22	22	15	15	15	0	2	1	46	111111	1111111	1

Narrow-leaved Stringybark – Narrow-leaved Wattle Forest (478)

478 – 1 plot	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Overstorey regeneration	Total length of fallen logs	Easting	Northing	Zone
1	30	22	20	20	20	18	0	2	1	20	111111	1111111	1

Black Cypress Pine – Ironbark – Wattle Low Open Forest Mainly on Narrabeen Sandstone (Benson Id480)

480 – 3 plots	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Overstorey regeneration	Total length of fallen logs	Easting	Northing	Zone
1	30	30	20	20	20	18	0	2	1	20	111111	1111111	1

Rough-barked Apple / Blakely's Red Gum / Narrow-leaved Stringybark +/- Grey Gum Sandstone Riparian Grass Fern Open Forest in the Southern BBS and Upper Hunter Regions (ID481)

481 – 4 plots	**Native plant species richness**	**Native over-storey cover**	**Native mid-storey cover**	**Native ground cover (grasses)**	**Native ground cover (shrubs)**	**Native ground cover (other)**	**Exotic plant cover**	**Number of trees with hollows**	**Overstorey regeneration**	**Total length of fallen logs**	**Easting**	**Northing**	**Zone**
1	31	30	30	30	30	20	0	1.5	1	10	111111	1111111	1

Narrow-Leaved Ironbark – Black Cypress Pine – Stringybark – Wattle Shrubby Open Forest on Sandstone Hills (Benson Id479)

479 – 4 plots	**Native plant species richness**	**Native over-storey cover**	**Native mid-storey cover**	**Native ground cover (grasses)**	**Native ground cover (shrubs)**	**Native ground cover (other)**	**Exotic plant cover**	**Number of trees with hollows**	**Overstorey regeneration**	**Total length of fallen logs**	**Easting**	**Northing**	**Zone**
1	30	22	20	20	20	18	0	2	1	66	111111	1111111	1

2.3.4 Geographic features

No features were returned by the BCC.

2.3.5 Ecosystem credit species

The following species are all species predicted by the BCC to occur, based on the data entered for the landscape assessment and the geographic and habitat features in the assessment. These constitute all species which will generate ecosystem credits in the credit calculations.

Table 2-13 Species predicted to occur.

• Barking Owl	*Ninox connivens*
• Little Lorikeet	*Glossopsitta pusilla*
• Painted Honeyeater	*Grantiella picta*
• Square-tailed Kite	*Lophoictinia isura*
• Turquoise Parrot	*Neophema pulchella*
• Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*

2.3.6 Threatened species credit species

The following species were returned by the BCC as requiring survey. The table below states whether each species was detected during surveys and furthermore, if impacts are likely.

Table 2-14 Species that generate species credits if impacted.

• *Commersonia procumbens*	*Commersonia procumbens*	Not identified	No impact
• Large leafed Monotaxis	*Monotaxis macrophylla*	Not identified	No impact
• Regent Honeyeater	*Anthochaera phrygia*	Not identified	No impact
• Scant Pomaderris	*Pomaderris queenslandica*	Not identified	No impact

Silky Swainson-pea was recorded in the TLSA in native pasture / White Box-Grey Box Grassy Woodland; one individual. It is not listed above as either predicted to occur or requiring survey. It was entered as being impacted into the BCC.

Additionally, the following species are known to occur and have been entered as being impacted as follows:

- Squirrel Glider *Petaurus norfolcensis* – 19 ha of moderate or better woodland habitat. [11]
- Large-eared Pied Bat *Chalinolobus dwyeri* - 19 ha of moderate or better woodland habitat. [12]

[11] All habitat impacts have been added to the norther section assessment and not split between the southern section impacts.

[12] All habitat impacts have been added to the norther section assessment and not split between the southern section impacts.

- Diamond Firetail *Stagonopleura guttata* –- 19 ha of moderate or better woodland habitat.
- Black-chinned Honeyeater *Melithreptus gularis gularis* - 19 ha of moderate or better woodland habitat.
- Grey-crowned Babbler *Pomatostomus temporalis*- 19 ha of moderate or better woodland habitat.
- Speckled Warbler *Pyrrholaemus sagittatus* - 19 ha of moderate or better woodland habitat. [13]
- Eastern Cave Bat *Vespadelus troughtoni* - 19 ha of moderate or better woodland habitat.
- Corben's Long-eared Bat *Nyctophilus corbeni (*form. *timorensis)* - 19 ha of moderate or better woodland habitat.
- Masked Owl *Tyto novaehollandiae* - 19 ha of moderate or better woodland habitat.
- Glossy Black Cockatoo *Calyptorhynchus lathami* - 19 ha of moderate or better woodland habitat.
- Powerful Owl *Ninox strenu* - 19 ha of moderate or better woodland habitat.
- Dusky Woodswallow *Artamus cyanopteru s*- 19 ha of moderate or better woodland habitat. [14]

If species are identified in consultation with OEH or in subsequent surveys, this information would inform the final offset package to be developed for the project.

2.3.7 Credit statement

The following credit statement was returned from the BCC.

[13] Not available in the BCC to add to the species list.

[14] Not available in the BCC to add to the species list.

Table 2-15 Credit statement for the Hunter / Central Rivers southern section of the proposal

PC type code	Plant community type name	Management zone area (ha)	TS with highest credit req	Ecosystem credits required
HU681	Blakely's Red Gum - Yellow Box grassy woodland of the New England Tableland Bioregion	3.55	Barking Owl	266
HU714	Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	11.15	Barking Owl	836
HU690	Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley	77.26	Barking Owl	6273
HU682	Blue-leaved Ironbark - Black Cypress Pine shrubby sandstone open forest in the southern Brigalow Belt South Bioregion (including Goonoo)	3.3	Barking Owl	242
HU707	Red Ironbark - Black Cypress Pine - stringybark +/- Narrow-leaved Wattle shrubby open forest on sandstone in the Gulgong - Mendooran region, southern Brigalow Belt South Bioregion	31.51	Barking Owl	2511
HU707	Red Ironbark - Black Cypress Pine - stringybark +/- Narrow-leaved Wattle shrubby open forest on sandstone in the Gulgong - Mendooran region, southern Brigalow Belt South Bioregion	1.2	Barking Owl	85
HU678	Black Cypress Pine - ironbark +/- Narrow-leaved Wattle low open forest mainly on Narrabeen Sandstone in the Upper Hunter region of the Sydney Basin Bioregion	10.32	Barking Owl	838
HU713	Rough-barked Apple - Blakely's Red Gum - Narrow-leaved Stringybark +/- Grey Gum sandstone riparian grass fern open forest on in the southern Brigalow Belt South Bioregion and Upper Hunter region	30.04	Barking Owl	2439
HU690	Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley	36.16	Barking Owl	2936
HU702	Narrow-leaved Ironbark- Black Cypress Pine - stringybark +/- Grey Gum +/- Narrow-leaved Wattle shrubby open forest on sandstone hills in the	42.65	Barking Owl	3196

PC type code	Plant community type name	Management zone area (ha)	TS with highest credit req	Ecosystem credits required
	southern Brigalow Belt South Bioregion and Sydney Basin Bio			

Scientific name	Common name	TS offset multiplier	Species credits required
Melithreptus gularis subsp. gularis	Black-chinned Honeyeater (eastern subspecies)	1.3	247
Nyctophilus corbeni	Corben's Long-eared Bat	2.1	399
Stagonopleura guttata	Diamond Firetail	1.3	247
Vespadelus troughtoni	Eastern Cave Bat	1.3	247
Calyptorhynchus lathami	Glossy Black-Cockatoo	1.8	342
Pomatostomus temporalis subsp. temporalis	Grey-crowned Babbler (eastern subspecies)	1.3	247
Tyto novaehollandiae	Masked Owl	3	570
Ninox strenua	Powerful Owl	3	570
Swainsona sericea	Silky Swainson-pea	1.8	18

2.4 CREDIT CONVERSION

The OEH 'credit converter' tool has been used to convert the credit requirements of the development into an estimate of the areas of each vegetation type needed to satisfy those credit requirements.

Table 2-16 Credit conversion: area estimated to achieve offset requirement

Entity requiring offsets		Credit requirement	Area of land required, as determined by the credit calculator (ha)
Northern section: Central West Catchment Management Area			
CW180	River Oak - Rough-barked Apple - red gum - box riparian tall woodland (wetland) of the Brigalow Belt South Bioregion and Nandewar Bioregion	518	55.7
CW111	Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	562	60.4

Entity requiring offsets			Credit requirement	Area of land required, as determined by the credit calculator (ha)
CW304	Silvertop Stringybark - Yellow Box +/- Nortons Box grassy woodland on basalt hills mainly on northern aspects of the Liverpool Range, Brigalow Belt South Bioregion		581	62.5
CW322	White Box grass shrub hill woodland on clay to loam soils on volcanic and sedimentary hills in the southern Brigalow Belt South Bioregion		4078	438.5
CW304	Silvertop Stringybark - Yellow Box +/- Nortons Box grassy woodland on basalt hills mainly on northern aspects of the Liverpool Range, Brigalow Belt South Bioregion		4789	514.9
CW303	Silvertop Stringybark - Forest Ribbon Gum very tall moist open forest on basalt plateau on the Liverpool Range, Brigalow Belt South Bioregion		32	3.4
CW210	White Box - Red Stringybark shrubby woodlands on basalt slopes of the Nandewar Bioregion and Brigalow Belt South Bioregion		210	22.6
CW225	Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion		118	12.7
CW214	White Box - White Cypress Pine shrubby open forest of the Nandewar Bioregion and Brigalow Belt South Bioregion		22	2.4
Subtotal			**10,910**	**1,173.10**
Petaurus norfolcensis		Squirrel Glider	418	70
Chalinolobus dwyeri		Large-eared Pied Bat	247	41
Miniopterus schreibersii subsp. oceanensis		Eastern Bentwing-bat	247	41
Subtotal			**912**	**152.00**
Southern section: Hunter Rivers Catchment Management Area				
HU681	Blakely's Red Gum - Yellow Box grassy woodland of the New England Tableland Bioregion		266	28.6
HU714	Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion		836	89.9
HU690	Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley		6273	674.5
HU682	Blue-leaved Ironbark - Black Cypress Pine shrubby sandstone open forest in the southern Brigalow Belt South Bioregion (including Goonoo)		242	26
HU707	Red Ironbark - Black Cypress Pine - stringybark +/- Narrow-leaved Wattle shrubby open forest on sandstone in the Gulgong - Mendooran region, southern Brigalow Belt South Bioregion		2511	270

Entity requiring offsets		Credit requirement	Area of land required, as determined by the credit calculator (ha)
HU707	Red Ironbark - Black Cypress Pine - stringybark +/- Narrow-leaved Wattle shrubby open forest on sandstone in the Gulgong - Mendooran region, southern Brigalow Belt South Bioregion	85	9.1
HU678	Black Cypress Pine - ironbark +/- Narrow-leaved Wattle low open forest mainly on Narrabeen Sandstone in the Upper Hunter region of the Sydney Basin Bioregion	838	90.1
HU713	Rough-barked Apple - Blakely's Red Gum - Narrow-leaved Stringybark +/- Grey Gum sandstone riparian grass fern open forest on in the southern Brigalow Belt South Bioregion and Upper Hunter region	2439	315.7
HU690	Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley	2936	315.7
HU702	Narrow-leaved Ironbark- Black Cypress Pine - stringybark +/- Grey Gum +/- Narrow-leaved Wattle shrubby open forest on sandstone hills in the southern Brigalow Belt South Bioregion and Sydney Basin Bio	3196	343.7
Subtotal		**19,622**	**2,163.30**
Swainsona sericea	Silky Swainson-pea	18	2
Calyptorhynchus lathami	Glossy Black-Cockatoo	342	52
Melithreptus gularis subsp. gularis	Black-chinned Honeyeater (eastern subspecies)	247	41
Ninox strenua	Powerful Owl	570	90
Nyctophilus corbeni	Corben's Long-eared Bat	399	70
Pomatostomus temporalis subsp. temporalis	Grey-crowned Babbler (eastern subspecies)	247	41
Stagonopleura guttata	Diamond Firetail	247	41
Tyto novaehollandiae	Masked Owl	570	90
Vespadelus troughtoni	Eastern Cave Bat	247	41
Subtotal		**2,887**	**468.00**

Table 2-17 Project credit and area summary

Entity requiring offsets	Credit requirement	Area of land required, as determined by the credit calculator (ha)
Ecosystem credits		
Northern section ecosystem credit subtotal	10,910	1,173.10

Entity requiring offsets	Credit requirement	Area of land required, as determined by the credit calculator (ha)
Southern section ecosystem credit subtotal	19,622	2,163.30
Total	**30,532**	**3,336.40**
Species credits		
Northern section species credit subtotal	912	152.00
Southern section species credit subtotal	2,887	468.00
Total	**3,799**	**620.00**

Combined for the project, approximately 3,336.40 ha would be required to satisfy ecosystem credits. Subject to this area being able to also satisfy species credits, up to an additional 620 ha may be required for species credits.

Note:

The requirements are not cumulative. If species credit requirements are required, an area may concurrently satisfy the vegetation community and one or more threatened species requirements, subject to confirmation that the site provides habitat for the species.

3 PRELIMINARY OFFSET EVALUATION

3.1 CANDIDATE OFFSET SITES

Given the extensive offsets required, a suite of sites is likely to be required if physical offsets are secured for the project, rather than the purchase of credits or payment into and offset fund (refer to Section 4.1 for discussion on options available to satisfy the offset requirement). The intention of this evaluation is to demonstrate that physical offsets are feasible and achievable for the project.

The proponent has indicated a preference to secure offset areas within the project boundary. Involved landowners within the project boundary are able to be involved in the offset package, rather than involving a third party or external site. As they already own the site, no purchase of a BioBanking site is required. Mapping and surveys undertaken to date suggest that there is vegetation within the site boundary that is representative to that being cleared and therefore offers a like for like offset. It is noted that some additional sites outside the project boundary have also been identified as they offer strategic benefits for connectivity to existing reserves.

Based on the preliminary assessment of likely credit requirements in Section 2, ten candidate offset sites have been so far been identified, totalling 3,025 ha. These landowners have been approached and are amenable to further investigation and to having suitable areas managed for conservation in perpetuity. As such, all of the candidate sites so far considered are feasible to include within the offset package for the project, subject to further investigation to verify their suitability.

An overview of the suitability of these sites is presented overleaf, with reference to what is known either from rapid field assessment conducted during the 2015 and 2016 additional surveys, or because of surveys adjacent to these areas Table 3-1. The location of each site is mapped in Appendix A.7 and A.8.

3.2 FINAL SELECTION OF SITES

Use of actual rather than benchmark plot data in this final offset calculations is likely to reduce the credit requirement somewhat as not all parameters of the vegetation to be impacted are expected to be within benchmark. Determining and securing offsets in accordance with the FBA for Major Projects, and in consultation with OEH, is a commitment of this project.

In delineating the final offset site boundaries, a minimum distance from infrastructure would be implemented to ensure the sites are not affected in the long term by indirect impacts. For example:

- 300m from wind turbines (300m from centres);
- 50m from tracks, powerlines and other linear infrastructure (50m from centrelines); and
- 50m from the outer edge of all other infrastructure.

3.3 COMMONWEALTH OFFSET REQUIREMENTS

Commonwealth offsets are not considered specifically in this assessment. It is noted that all vegetation communities and threatened species that could be impacted significantly and therefore required to be offset under the Commonwealth requirements are already included in the NSW assessment. It is further noted that the NSW offset requirements are usually more onerous than the Commonwealth requirements

and therefore, as a preliminary assessment, Commonwealth offset requirements (if needed) are similarly expected to be able to be offset.

Table 3-1 Offset site overview

Site and size	Vegetation	Threatened species	Landscape position / connectivity
1 **262.29 ha**	Vegetation in this area is in good condition and includes: • Narrow-leaved Ironbark – Blakeley's Red Gum shrubby open forest on sandstone low hills (ID468) • Narrow-Leaved Ironbark – Black Cypress Pine – Stringybark – Wattle Shrubby Open Forest on Sandstone (ID 479) • Rough-barked Apple / Blakely's Red Gum / Narrow-leaved Stringybark +/- Grey Gum Sandstone Riparian Grass Fern Open Forest in the Southern BBS and Upper Hunter Regions (ID481) • Derived Speargrass – wallaby grass – wire grass mixed forb grassland mainly in the Coonabarabran – Pilliga – Coolah region (395)	Threatened species recorded from the proposed transmission line that dissects the site include: • Glossy Black Cockatoo • Corbens long eared bat • Speckled warbler	The site is to the immediate west of Curryall State Forest. It provides an important east-west link in an area where woodland habitat narrows and a landscape scale. It is understood OEH have intended to purchase this area and manage it for biodiversity conservation. Occurring adjacent the proposed transmission line, it is expected to be very suitable to offset the vegetation and habitat required to be cleared for the transmission line. If secured, edge effects of these impacts could be best managed and the link's function maintained.
2 **219.65 ha**	Vegetation in this area is in moderate to good condition and includes: • Narrow-leaved Ironbark – Blakeley's Red Gum shrubby open forest on sandstone low hills (ID468) • Narrow-Leaved Ironbark – Black Cypress Pine – Stringybark – Wattle Shrubby Open Forest on Sandstone (ID 479) • Rough-barked Apple / Blakely's Red Gum / Narrow-leaved Stringybark +/- Grey Gum Sandstone Riparian Grass Fern Open Forest in the Southern BBS and Upper Hunter Regions (ID481) • Blue-Leaved Ironbark – Black Cypress Pine Shrubby Sandstone Open Forest in the Southern BBS Bioregion (Benson ID 467)	Threatened species recorded from the proposed transmission line that dissects the site include: • Powerful Owl • Black Cockatoo Fauna habitat includes: • Open forest • Woodland and, • Riparian areas	Occurring adjacent the proposed transmission line, it is expected to be very suitable to offset the vegetation and habitat required to be cleared for the transmission line. If secured, edge effects of the transmission line could be specifically managed.

Site and size	Vegetation	Threatened species	Landscape position / connectivity
3 **17.74 ha**	The vegetation in this area unknown, but based on adjacent vegetation is likely to include: • Narrow-leaved Ironbark – Blakeley's Red Gum shrubby open forest on sandstone low hills (ID468) • Narrow-Leaved Ironbark – Black Cypress Pine – Stringybark – Wattle Shrubby Open Forest on Sandstone (ID 479)	Threatened species recorded from the proposed transmission line nearby include: • Black Cockatoo Fauna habitat includes: • Pasture with scattered trees and, • Woodland	Occurring adjacent the proposed transmission line, it is expected to be very suitable to offset the vegetation and habitat required to be cleared for the transmission line. If secured, edge effects of the transmission line could be specifically managed.
4 **399.42 ha**	Unknown	Unknown	Located along the northern edge of more extensive woodland, management of this large land parcel may reduce edge effects in adjacent habitats to the south and thereby contribute to landscape connectivity.
5 **78.22 ha**	Vegetation in this area is in moderate to good condition. It may contain vegetation including: • Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley HU690, • Blue-leaved Ironbark - Black Cypress Pine shrubby sandstone open forest in the southern Brigalow Belt South Bioregion (including Goonoo) HU682, • Black Cypress Pine - ironbark +/- Narrow-leaved Wattle low open forest mainly on Narrabeen Sandstone in the Upper Hunter region of the Sydney Basin Bioregion HU678 and • N arrow-leaved Ironbark- Black Cypress Pine - stringybark +/- Grey Gum +/- Narrow-leaved Wattle shrubby open forest on sandstone hills in the southern Brigalow Belt South Bioregion and Sydney Basin Bioregion HU702.	Fauna habitat features mapped in this area include • two rocky outcrops and • one hollow bearing tree.	This area is surrounded by Goulburn River National Park. Converting this area to conservation management objectives would consolidate the existing reserve and remove threats that may affect adjacent areas in the park, such as weed or feral animal spread resulting from agriculture. While located within an extensive vegetated area, this location provides a diversity of habitat, from more open woodland to gullies. Ecotonal areas can have higher diversity of flora and fauna.

Site and size	Vegetation	Threatened species	Landscape position / connectivity
6 **186 ha**	Occur adjacent to: • poor condition Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region (ID483), however, the tree cover on the offset candidate site is likely to mean this vegetation is of higher quality than the mapped vegetation. Note: infrastructure buffers would be applied to minimise impacts of infrastructure, if this site is included in the offset package.	Fauna habitat includes: • Woodland	Includes the lower slope and northern bank of a riparian corridor and may therefore enhance local movement corridors if managed for biodiversity conservation.
7 **192 ha**	Occurs adjacent to: • poor – moderate condition Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region (ID483), however, the tree cover on the offset candidate site is likely to mean this vegetation is of higher quality than the mapped vegetation. Note: infrastructure buffers would be applied to minimise impacts of infrastructure, if this site is included in the offset package.	Fauna habitat includes: • Pasture with scattered trees and, • Woodland	Relatively isolated but includes steep slopes and gullies that could provide good habitat if managed for biodiversity conservation.
8 **535 ha**	Includes: • moderate condition River Oak – Rough-barked Apple – red gum – box riparian tall woodland (ID084) as well as • poor condition Rough-barked Apple - Blakely's Red Gum – Yellow Box woodland on alluvial clay to loam soils on valley floors in the northern south-west slopes and BBS Bioregions (ID281) and • poor condition Silvertop Stringybark - Yellow Box – Norton's Box grassy woodland on basalt hills mainly on northern aspects of the Liverpool Range (ID488), based on surveys conducted through this area for a transmission line that has since been rerouted. Note: infrastructure buffers would be applied to minimise impacts of infrastructure, if this site is included in the offset package.	Fauna habitat includes: • Pasture with scattered trees and, • Woodland	Through candidates 9 and 10, this candidate would contribute to a large connected area contiguous with Coolah Tops National Park. Includes steep slopes and gullies that could provide good habitat if managed for biodiversity conservation.

Site and size	Vegetation	Threatened species	Landscape position / connectivity
9 **121 ha**	Occurs adjacent to: • poor – moderate condition Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region (ID483), however, the tree cover on the offset candidate site is likely to mean this vegetation is of higher quality than the mapped vegetation. Note: infrastructure buffers would be applied to minimise impacts of infrastructure, if this site is included in the offset package.	Nearby records include: • Varied Sittella, • Wedge-tailed Eagle, • Nankeen Kestrel and • Brown Falcon. Fauna habitat includes: • Pasture with scattered trees and, • Woodland	Through candidate 10, this candidate would contribute to a large connected area contiguous with Coolah Tops National Park. Includes steep slopes and gullies that could provide good habitat if managed for biodiversity conservation.
10 **1021 ha**	Occurs adjacent to: • moderate condition Silvertop Stringybark - Yellow Box – Norton's Box grassy woodland on basalt hills mainly on northern aspects of the Liverpool Range (ID488) and • poor condition Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region (ID483). Note: infrastructure buffers would be applied to minimise impacts of infrastructure, if this site is included in the offset package.	Nearby records include: • Wedge-tailed Eagle, • Nankeen Kestrel and • Brown Falcon. Fauna habitat includes: • Pasture with scattered trees and, • Woodland	This candidate would contribute to a large connected area contiguous with Coolah Tops National Park. Includes steep slopes and gullies that could provide good habitat if managed for biodiversity conservation.
3,025 ha	**Total**		

4 IMPLEMENTATION

4.1 OPTIONS TO SATISFY THE PROJECT'S CREDIT REQUIREMENT

The proponent commits to securing a formal vehicle to secure and manage the project's offset sites in perpetuity. It is understood that a number of options may be available including:

- Purchase of existing credits from the BioBanking Public Register
- Establishment of BioBanking sites
- Payment into an Offset Fund.

The proponent commits to working with the DPE and OEH to find a suitable security mechanism for the project.

4.2 TIMING OF IMPLEMENTATION

Assuming that not all of the credits can be found on the BioBanking Public Register and that an Offset Fund is not available for the project, this implementation section focusses on identifying and securing physical offset sites from among the project's involved landowners.

It is proposed that the project's offsets requirement should accurately reflect the project's final impact on biodiversity values as much as possible and not be based on concept drawings, as are currently available. This is particularly important for wind farm projects where the detailed design phase can require adjustments to access tracks and turbine locations. Additionally, this will provide a further incentive throughout the detailed design to minimise the clearing impacts of the works and thereby reduce the offset requirement.

The following stages of implementing the final Offset Package for the project are proposed. The aim of this timeline is to provide a clear path to identifying, securing and managing suitable offset lands prior to any construction impact.

Post approval, documented within the project's detailed Offset Plan

1. Determine final credit requirement using the FBA in consultation with OEH, based on:
    a. Detailed construction drawings, (which will be submitted to Department of Planning and Environment (DPE) and deemed by the proponent to be final)
    b. Plot data collected for the project footprint, in accordance with the FBA.
2. Select the final suite of offset sites including accurate calculation of credits able to be retired at each offset site based on plot data collected for the offset sites, in accordance with the FBA.
3. Develop detailed management actions in consultation with the landowners who will be responsible for implementing the actions, referencing the templates provided by OEH for BioBank site management. An example of typical management measures expected to be carried out is provided overleaf, Table 4-1.

After construction

4. Verify that the actual post construction impact area does not exceed that used to calculate the offset requirement in Step 1. Discuss additional offsets in consultation with OEH and DPE if required.
5. Formally secure the offset sites as BioBanking sites, including detailed management plans for each offset site and delineation of the final offset site boundaries. All costs of site assessment and credit purchase will be borne by the proponent.
6. Landowners become responsible for Biobank site management actions in accordance with the site specific management plans, with funding provided by the Biobanking fund, to ensure ongoing biodiversity improvement at the offset sites for the life of the project.

Table 4-1 Example offset site management measures

Management measure	Objective	Justification	Action	Timing
Exclusion of stock	To prevent overgrazing and encourage regeneration of native vegetation and maintenance of tussocks in grasslands.	Grazing would be likely to degrade habitat.	• Install stock proof fencing around the perimeter of the Offset Site.	• At establishment of the Offset Site. • Ongoing repairs as required.
Weed control	To minimise the occurrence of weeds within the Offset Site particularly Weeds of National Significance (WoNS) and listed noxious weeds.	Weeds compete with native species and degrade habitats.	• Survey to identify target locations for weed control. • Weed control using appropriate methodologies considering target species and landscape context.	• At establishment of the Offset Site. • Ongoing as required.
Planting trees in pasture	To enhance connectivity in secondary grasslands.	Planting would provide greater connectivity and potential for hollows in the long term. In turn, it would also increase tree numbers through natural recruitment.	• Plant tube stock trees, appropriate to the vegetation type, in native pasture and derived grasslands • Placement to consider strategic connectivity.	• At establishment of the Offset Site.
Feral animal control	To minimise the risk of the Offset Site becoming a refuge for feral animals.	Feral animals can reduce native vegetation quality, compete with native fauna for resources and/or prey on native fauna.	• Monitor for presence of feral animals.	• Consideration given to action on the basis of monitoring results.

Management measure	Objective	Justification	Action	Timing
			• Conduct control appropriate to the feral animal species detected during monitoring. • Where possible, coordinate control efforts with adjacent landowners to maximise effects	

5 CONCLUSION

This strategy demonstrates means to secure suitable and adequate offsets, prior to any construction impacts, with reference to the Framework for Biodiversity Assessment (FBA, 2016) for Major Projects.

Combined for the project, approximately 3,336.40 ha would be required to satisfy ecosystem credits. Subject to this area being able to also satisfy species credits, up to an additional 620 ha may be required for species credits.

It is understood that several options may be considered for transitional major project offsets:

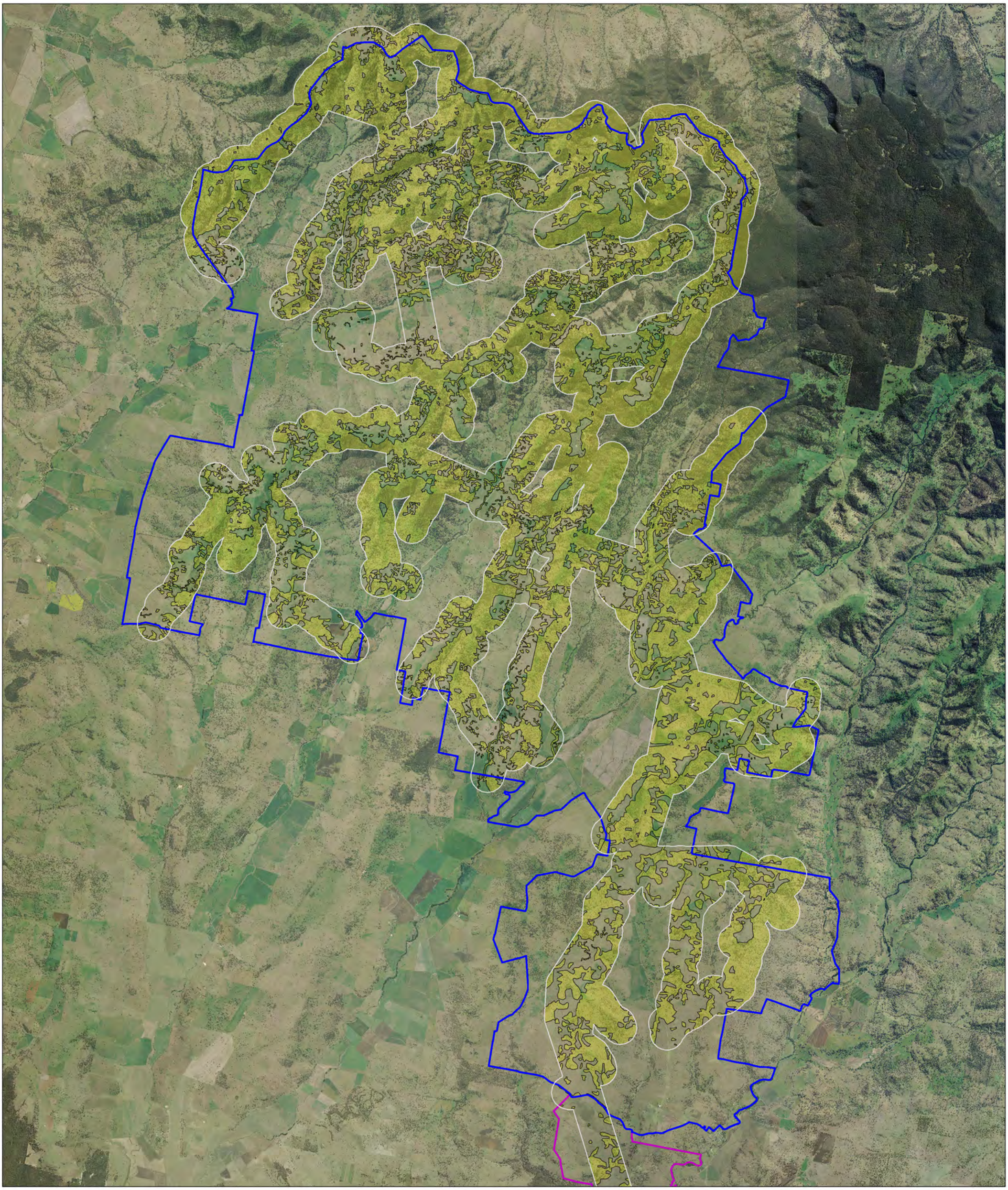
- Purchase of existing credits from the BioBanking Public Register
- Establishment of BioBanking sites
- Payment into an Offset Fund.

Several candidate offset sites have currently been investigated to varying degrees. The offset candidates in total equal 3,025 ha and include vegetation and habitat types required to be offset.

The proponent commits to working with the DPE and OEH to find a suitable in perpetuity security mechanism for the project. Implementation notes are included in this strategy to ensure the final offsets account for the final clearing impacts.

APPENDIX A OFFSET STRATEGY MAP SET

Extent of Native Vegetation Northern Overview Map



550m infrastructure bffer

Site perimeter

Wind Turbine Area

Transmission Area

Additional data

Native vegetation

EPURON

0 1 2 3 4 5

Kilometers

A3 @ 1:120,000

Project: Liverpool Range Wind Farm
Produced by: Virgil Robinson
Date: 7 February 2017
Projection: GDA94 MGA Zone 55

N

Mitchell Landscapes Site Overview Map

Site perimeter
- Wind Turbine Area
- Transmission Area

Mitchell Landscapes
- BBS Liverpool Plains
- BBS Liverpool Range
- BBS Pilliga
- NSS Upper Slopes
- NSS Upper Slopes Granites
- SB Kerrabee

EPURON

0 3 6 9
Kilometers

A3 @ 1:220,000

Project: Liverpool Range Wind Farm
Produced by: Virgil Robinson
Date: 3 February 2017
Projection: GDA94 MGA Zone 55

N