Prepared for
Taurus Energy

Proposed Development of a 30MW Wind Farm on the Cullerin Range, Southern Tablelands,

New South Wales





Biodiversity Assessment

prepared by

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1. INTRODUCTION

This Biodiversity Assessment has been prepared on behalf of Taurus Energy Pty Ltd. It assesses the impacts likely to be associated with the proposed development of wind-farm up to 30mW on the Cullerin Range, approximately 25 kilometres west of Goulburn, New South Wales (Figure 1.1). The proposal would involve excavation works and some removal of native vegetation to install and maintain 15 wind turbines. Inter-turbine connection, the connection of turbines to the electricity grid and the installation of an electrical substation and possible control building would require further excavation associated with the development of a combination of overhead lines and underground cabling.

The proposed works would impact upon flora and fauna in the area potentially including threatened species, a number of which are known to occur in the area. This report characterises the biodiversity attributes of the site and determines the likelihood and level of impact to flora and fauna that may arise during and following site development, pursuant to the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* and the NSW *Threatened Species Conservation Act 1995*.

Recommendations to minimise identified impacts are included in this report.

This report addresses the proposal description as of April, 2006.

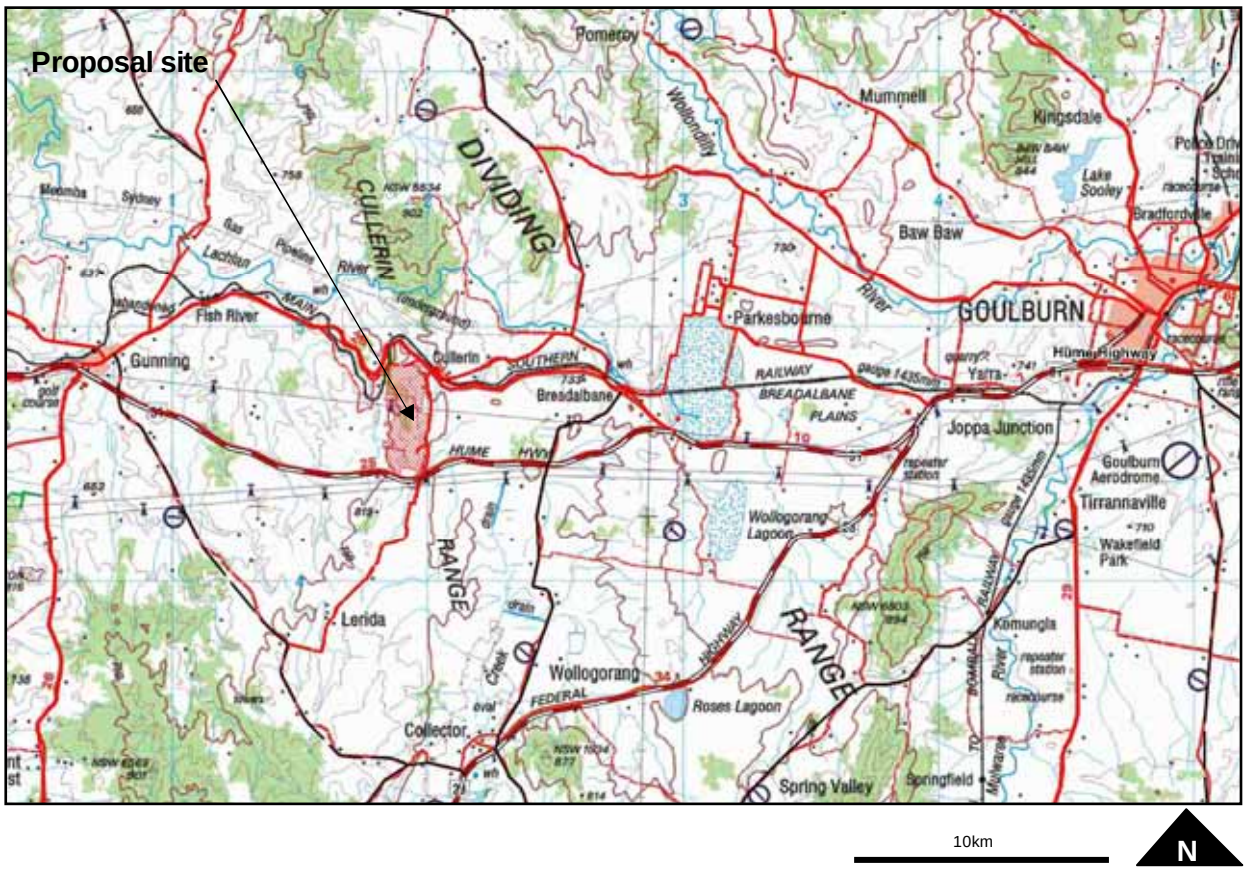

Figure 1.1 Location of the proposed Cullerin Range wind farm

2. THE PROPOSAL

2.1. Description of the site

The site is located on private property within and adjacent to agricultural areas used for sheep and cattle grazing. The north-south ridge where the development would be focused is approximately 3.5km in length.

The site is characterised by grassland ridges and flats with woodland patches of various degrees of size and connectivity on slopes and in gullies. Rock outcrops are small and isolated, occurring predominantly on ridges. Several eroded drainage lines are present onsite, with water bodies to the west (approximately 1km) and east (approximately 4km) of the site.

2.2. Proposed works

The proposal would involve the construction, operation, and eventual decommissioning of:

- 15 wind turbines, each with three blades up to 46m long mounted on a tubular steel tower up to 80m high;
- Electrical connections between wind turbines using underground cable;
- A substation and transmission connection linking the wind turbines to the existing Country Energy 132kV transmission system;
- Access roads around the site, and minor upgrades to access via Lerida Road North and Old Sydney Road, for installation and maintenance of wind turbines;
- An onsite control room and equipment storage facilities;
- Potentially, rock-breaking equipment and a concrete batching plant during the construction phase.

Figure 2.1 illustrates the proposed layout of infrastructure, civil works and electrical connections. This figure shows a 'development envelope' within which turbines would be located.

Seven impact types would result from the development of the proposed wind farm on the Cullerin Range:

1. Vegetation clearing / pruning would be required to facilitate the ingress of large vehicles to and across the site and similarly to lay out turbine blades on the ground prior to mounting them on the turbine hubs.
2. Drainage line impacts. Large and heavy vehicles would be required in close proximity to erosion gullies, such as occur on the north-east of the site.
3. Road works. The works would require upgrades to roads onsite and potentially to public roads enroute to the site. This would involve cut and fill and the laying of road base.
4. Excavation would be required to establish turbine footings, to install underground power cables and footings for power poles (where overhead transmission is adopted) and to install a substation and control building.
5. Construction facilities: a concrete batching plant and / or rock-breaking equipment may be established during the construction period to facilitate the construction of turbine footings, hard stand areas and roads. Water would be sourced offsite.
6. Installation impacts. Noise, dust and vehicle emissions would be generated in carrying out the above mentioned activities. Rock blasting to establish footings may also occur.
7. Ongoing impacts. There is potential for collision (such as bird or bat strike) with turbine blades. Shadow flicker (when the sun is low on the horizon) and noise (including subaural or low frequency noise) are also potential impacts of the turbines on fauna in the immediate

vicinity. Maintenance vehicles would be required with potential for impact to soils and waterways, spills from chemicals brought onsite and collision with animals onsite.

2.3. Approach of this assessment

This report assesses the entire development envelope including road access and power line options identified in Figure 2.1. In compiling this assessment the following approach was adopted:

i) Research.

Information was sourced on the threatened species, populations, and communities having potential to be present onsite and in the immediate area. This was done in consultation with local and state authorities and members of the public (Scott Seymore, DEC, in relation to Mundoonen Nature Reserve; Matthew Rizzuto, EPA, DEC in relation to pollution and environmental degradation; Louise Brody, DEC in relation to Wet Lagoon Nature Reserve, Rodney Falconer, local naturalist, in relation to local species and ecological issues, Chris Davey, CSIRO retired, in relation to avian movements).

The DEC NPWS Wildlife Atlas was consulted for records of threatened species and other species of conservation significance in the study area, based on the Gunning and Goulburn 1:100,000 map sheets. The national EPBC databases search tool was also used to identify known fauna species distributions using a 30 kilometre buffer around the subject site. Existing biodiversity reports and EIS's as well as wind-farm literature were sourced to understand the biodiversity impacts of wind farms.

ii) Field Work

Site assessment was carried out between November 19 and November 23, 2005. During this period, up to three field workers were present onsite, describing vegetation communities and species, conducting faunal searches and trapping transects and describing the habitat values of the site. Activities were focused in areas identified as likely to be directly impacted by the proposal but also included adjacent areas in order to survey all habitat types onsite and thus adequately describe the potential for threatened species (particularly cryptic species) to be present onsite. An additional vehicle-based assessment of the local area was made to understand the context of the site.

iii) Report Compilation.

Following the completion of the field assessment and research, biodiversity attributes of the site were described separately for flora and fauna. The potential impacts of the proposal upon threatened and significant flora and fauna were evaluated and characterised.

Recommendations for minimising biodiversity impacts are presented in Section 6 of this report.

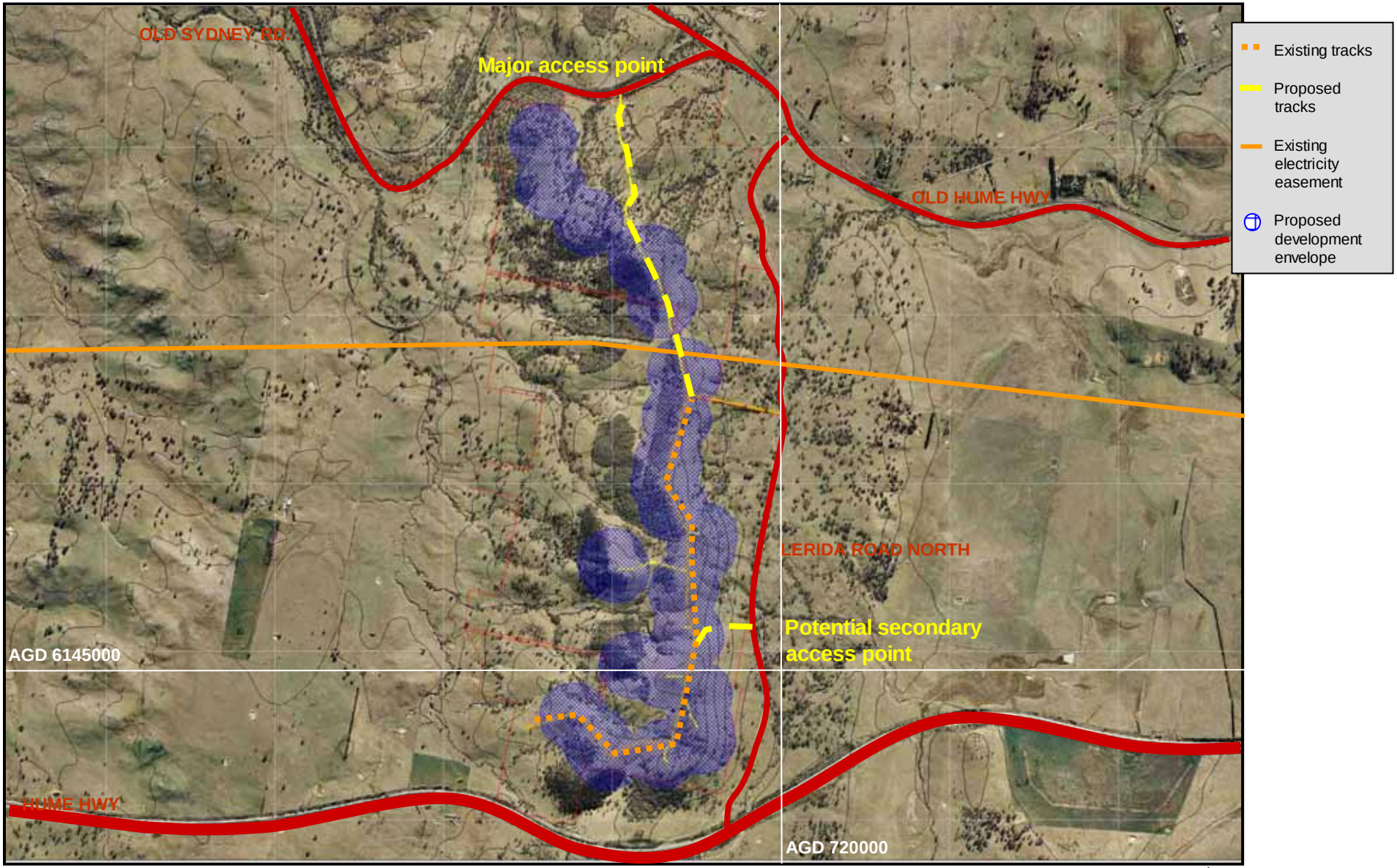

Figure 2.1 Location of the development envelope and access routes

3. REGIONAL CONTEXT

Wind farms and their associated infrastructure have characteristics that make it necessary to examine the broader environmental context when assessing their impact:

- The turbines can be very tall (up to 126m, including blade tips) and can therefore impact migration paths / movement corridors of birds and bats that may not utilise the on-ground areas.
- The transmission easements required to connect the wind farms to the electricity grid can fragment areas of habitat for species of flora and fauna, having potential to generate population level impacts by restricting the movement/dispersal of species.
- Upgrades to roads and access trails to facilitate the movement of large machinery onto the site can disturb offsite road-side vegetation and drainage patterns. Road side areas can often contain remnant native communities, lost to adjacent more intensively utilised lands.

A regional review of habitats in the area was conducted with reference to aerial photography, topographic maps, by vehicle survey, contact with local field naturalists and the Department of Environment and Conservation.

3.1. Regional review

The NSW Southern Tablelands has important natural ecological and biodiversity assets, being diverse within the biogeographical context and representing the limit of distribution for many species (Fallding 2002). The area represents a cross-over point of eastern and western woodland types and of the species associated with them, with the high elevation, up to approximately 800m, resulting in the occurrence of some species or forms of species more commonly associated with alpine areas (pers. com. R. Falconer, 6, 7 Dec. 2005).

Flora

Diverse vegetation communities occur across the Bioregion, varying according to topography, soils and micro-climate. Communities of yellow box (*Eucalyptus melliodora*), Red Box (*Eucalyptus polyanthemos*) and Blakely's Red Gum (*Eucalyptus blakelyi*), and White Box (*Eucalyptus albens*) occupy lower areas. Red Stringybark (*Eucalyptus macrorhyncha*), Broad-leaved Peppermint (*Eucalyptus dives*) and White Gum (*Eucalyptus rossii*) associations dominate hills in the west of the bioregion (NSW NPWS 2005). The Yellow Box, Blakely's Red Gum Woodlands and natural temperate grasslands have been heavily cleared and fragmented by agricultural activities, and are listed as Endangered Ecological Communities.

The Cullerin site occupies dissected ranges and plateaux of the Great Dividing Range, which typically support grassy woodland habitats on flats and low hills and dry shrubby forests on higher hills and ranges. A range of riparian and wetland habitats occur in the bioregion, including river oak forest, heathy swamps and sedgelands. Lower elevation wetlands can be extensively depleted and degraded by draining, salinity, nutrient pollution, grazing, sedimentation and weeds.

The Bioregion has about 726,530 hectares or 14.86 per cent of the bioregion managed in conservation tenures. National parks and nature reserves occupy 596,638 hectares or 12.22 per cent of the bioregion. In addition, landholders on 141 properties have entered into property agreements under the NVC Act 1997, with 6,354 hectares or 0.13 per cent of the bioregion within conservation zones under property agreements. There are 88 plant species listed in the *TSC Act* in the Bioregion, according to the DEC NPWS Wildlife Atlas. Thirty-six are listed as endangered, 50 are listed as vulnerable, and one species is considered extinct.

Fauna

Eighty-eight fauna species from the IBRA South Eastern Highlands Bioregion are listed in the schedules of the *TSC Act* (DEC NPWS Wildlife Atlas); 25 are listed as endangered and 63 are listed as vulnerable. The threatened status of some species is linked to the general depletion, fragmentation and degradation of lowland grassland and grassy woodland habitats. These species include woodland bird species and several reptile species.

Many declines in species number and abundance have followed the European settlement of the region (Falconer 2004). Examples include the brolgas, bettongs, bustards, rock wallabies, koalas, bush stone-curlews, bandicoots, quolls and rat kangaroos.

Consultation with the Goulburn field naturalist society (pers. com. R. Falconer, 6,7 Dec. 2005) produced the following broad description of the fauna in the area surrounding Goulburn, (except where cited otherwise).

The area retains an abundant and broad assemblage of raptors, including Little Eagles, Goshawks, Peregrine Falcons and White Bellied Sea Eagles. White bellied sea eagles are often spotted near large water bodies and may utilise terrestrial as well as riparian movement corridors. Bird numbers fluctuate but species such as Goldfinches, Sparrows, Doublebar Finches, Crested Pigeons, Galahs, Sulphur-Crested Cockatoos and Corellas have been common in the past (Falconer 2004).

Lake Pejar and Lake Sooley have diverse water bird assemblages. Although no species lists are available, anecdotal observations from these areas include Egrets, Grebes, Herons and Black-tailed Native Hens. Ephemeral wetland habitats in the area are critical to maintaining populations of water birds. Native mammals include Swamp Wallabies and Eastern Grey Kangaroos, Echidnas, Swamp Rats and Wallaroos. Platypuses also occur in good numbers (Falconer 2004). Threatened species including the Green and Golden Bell-frog, Powerful Owl, Diamond Firetail, Freckled Duck, Lathams Snipe and Bush-stone Curlew have been recorded in the area.

3.2. Conservation reserves in the area

Three conservation reserves occur within 50km of the site; Tarlo River National Park, Morton National Park and Mundoonen Nature Reserve. Wet Lagoon and Wollogorang Lagoon occur within 10km of the site. Several lakes and rivers occur within 50km of the site; Lake Bathurst, Lake George and Lake Sooley. Rivers, creeks and ephemeral wetlands are also present in the area. Many of these are ephemeral.

3.2.1. Wet Lagoon and Wollogorang Lagoon

Wet Lagoon is located approximately 4km to the east of the site. It consists of an extensive area of native wetland grasses and graminoids, predominantly juncus. It occurs on private land managed by the Pejar Local Aboriginal Land Council and was gazetted as an area to be managed for nature conservation in 1981. Comments accompanying the gazettal refer to the area as an important water bird habitat in relation to the rarity of such habitats on the Southern Tablelands. Bitterns, harriers, ducks, herons and grebes were listed as birds which could utilise the area.

Wollogorang Lagoon is located approximately 10km south-east of the site. It is similarly comprised of native graminoids including juncus and covers a similar sized area. These lagoons form part of a north-south riparian corridor that appears to link up with Lake Bathurst to the south-east.

3.2.2. Mundoonen Nature Reserve

Mundoonen Nature Reserve is located approximately 20 km west of the site, on the Hume Highway. It was gazetted in 1970, with additions gazetted in 2000. It is 1,485 hectares (NSW

NPWS 2005). Although the surrounding country is largely cleared, used for grazing purposes, parts of the reserve and adjoining private land contain forests and woodland producing a total forested area of approximately 3,000 ha (NSW NPWS 2005).

Vegetation within the reserve is dominated by scribbly gum and red stringybark. A small pocket of yellow box / Blakely's red gum woodland occurs within the reserve and remnants of this vegetation type also occur on surrounding land. Flora species of regional conservation significance in the reserve include *Bossiaea foliosa, Argyle apple Eucalyptus cinerea, Viola caleyana* and *Hibbertia calycina*. Fauna surveys have recorded 55 bird, 11 mammal and 6 reptile species. Threatened species recorded include the Koala and Powerful Owl.

3.3. Habitat adjacent to the site

The site is located within a largely cleared landscape, modified for agricultural production by the sowing of exotic grasses for grazing. Native understorey species, woodland and forested areas do occur however, both onsite and adjacent to the site. More extensive areas of woodland and forest occur several kilometres to the north. A wet corridor which may allow for the movement of waterbirds in a north south direction, extends from Lake Bathurst in the south to Wet Lagoon, 4km east of the site, and may continue several kilometres further north. Avian movement corridors have been observed in the past to be present from Lake Bathurst in the south to the Goulburn rubbish tip (Silver Gulls) and from Lake Burrinjuck to the Canberra rubbish tip (Ibis) (C. Davey, pers. comm. 4 November 2005). Although Lake George and Lake Bathurst are dry for extended periods, water birds return following rains.

3.3.1. Vehicle-based survey of the area

On 22nd November 2005, a vehicle-based survey of habitats adjacent to the site was carried out, taking two persons approximately three hours, assessing habitat values, noting particularly the extent and continuity of woodland habitats and wetland habitats. From the site, the survey extended five kilometres to the west, nine kilometres to the east, 13km to the south and ten kilometres to the north, as discussed below.

Travelling east from the site to Breadalbane:

The area is mostly cleared of trees, being mixed native and exotic grassland under agricultural production. The low lying flats appear to be potential ephemeral water bird habitat. Riparian vegetation is often present but of narrow width.

Woodland (mostly very open) is present in patches. Exotic trees dominate the road side vegetation (poplars). Wind breaks occur on several properties, being variably exotic or native as well as a combination of the two. Electricity transmission lines occur on the roadside.

Travelling south to Collector:

North of the Hume Highway: The area is mostly cleared of trees, being mixed native and exotic grassland under agricultural production. Extensive grassland flats are present. These form potential ephemeral wetland habitat. The Wet Lagoon is a particularly extensive area of juncus and other native grasses and graminoids (see discussion on Wet Lagoon in Section 3.2.1). Several white ibis and a swamp harrier were observed at this location.

Pines occur on the ridge, possibly planted as a wind break. Relic red gums with hollows are present as scattered paddock trees. More extensive open woodland occurs on ridges.

South of Hume highway: The grassland is predominantly exotic and appears to provide poor habitat for wetland birds, despite the cleared flats containing several farm dams. It may be used

ephemerally by water birds when inundated, however. While no creek line could be seen from the road the flats are likely to become inundated during high rainfall events.

A travelling stock reserve is located to the east of the Breadalbane-Collector road. Native grass tussocks were noticeable. These areas often provide higher native species diversity due to lesser stocking rates and thereby often harbour potential habitat for threatened flora and provide natural habitat for native fauna.

Open woodland is present in patches along the ridges. Reasonably large areas of contiguous woodland are present. Some trees appear quite old and could be hollow-bearing. Extensive forest can be seen on some ridges, extending down onto the slopes as well.

Federal highway from Collector to the Hume Highway intersection:

Open woodland and grassland occur in a mosaic. Several farm dams were visible from the road. With distance from Collector, the landscape becomes more cleared with only scattered paddock trees. A narrow belt of trees occurs on the ridges. Pine wind breaks are also present on some ridges. A greater number of trees occurs around Roses Lagoon although, many are exotic and they occur only as a fragment of habitat. Extensive woodland / forest becomes apparent to the south-east (Great Dividing Range) on ridges and slopes but not extending onto the plains.

Wollogorang Road, travelling east to west:

Scattered woodland patches and paddock trees occur. Exotic grasses dominate the flats but native juncus is occasionally present, indicating the areas may be periodically inundated. A creek / drainage line is present and an extensive lagoon (Wollogorang Lagoon) of similar composition and extent as Wet Lagoon.

Gurrundah Road from Breadalbane:

The area consists in the majority of cleared flats; exotic grass species predominate. Native juncus is occasionally present, indicating the areas may be periodically inundated. Dams and eroded creek banks are present. Open woodland is present on ridge-tops to the west, appearing from the road to be extensive. Forested ridges become contiguous to the west, providing potential habitat for the larger mobile faunal assemblage (koalas, quolls). A pine plantation adjoins this area. Small hollows are present in roadside vegetation, providing potential habitat for small hollow dependent fauna (nesting birds and microchiropteran bats). Several birds were observed in this area; Nankeen Kestrels, Australian Ravens, Noisy miners, Crimson rosellas, and a Swamp Harrier.

4. FLORA AND ECOLOGICAL COMMUNITIES

4.1. Approach and methodology

4.1.1. Preliminary assessments

The survey fieldwork was preceded by a desktop assessment to identify species and communities of conservation significance which may be present in the study area. Topographic maps, air photographs, previous research and assessments and records contained in national and state databases were consulted to identify known and potential values occurring onsite and in the surrounding district.

4.1.2. Field survey and mapping

The methods and outputs of the assessment are intended to meet the requirements contained in the Draft Assessment Guidelines for Threatened Species Assessment prepared by the Department of Environment and Conservation (DEC 2005a).

The proposed turbine sites, inter-turbine electrical connection routes and proposed offsite substation site were surveyed for flora values on 22 November 2005. A total of 6 person hours was spent on the field component of the survey. Additional time was spent identifying specimens, compiling and entering field data and analysing flora values with respect to vegetation type and conservation significance.

The surveyed area was focused on:

- the ridge crests and upper slopes where turbines are proposed for construction, to a distance of approximately 75 metres either side of the centreline of the ridge (approximately 15 ha);
- the proposed access points to the southern and northern ends of the ridge (existing track off Lerida Road North to the south and proposed turn off from Old Sydney Road to the north);
- additional areas adjacent to proposed works areas.

The subject site was stratified into five survey zones, based on type and quality of habitat and location;

- Ridge (R),
- Northern Slope (NS),
- Southern Slope (SS),
- Eastern Slope (ES),
- Western Slope (WS).

In addition, some offsite areas of roadside verge were investigated as these may be impacted during road upgrades to allow development infrastructure to be brought onto the site.

Species lists were compiled for disturbed/exotic areas and for predominantly natural vegetation communities under three categories:

Low low site quality areas, dominated by exotic pasture grasses (majority of site),

Mod higher proportion of native species in groundcover (composite list from several areas),

Off species recorded adjacent to site in areas which could be affected by the proposal (eg adjacent road verges near access points).

Areas were surveyed using the 'random meander' method (Cropper 1993), rather than quadrats, to maximise opportunities to detect significant plant species. Vascular plant species cover/abundance values and structural data were recorded on foot over the subject site. The relative cover/abundance of all vascular plant species was recorded in each survey zone using a six level Braun-Blanquet scale. Species occurrences were recorded progressively and cover/abundances were then generalised over the extent of the survey zone. Species recorded and their cover/abundance scores are listed in Appendix A: Flora list.

Dedicated searches in specific habitat areas were undertaken for threatened species which were assessed as having at least a moderate potential to be present at the site. Additionally, candidate areas of heavily disturbed habitats or areas carrying mainly exotic species were surveyed to record species composition. Because of their low likely conservation significance, not all of these heavily disturbed areas were inspected in detail.

4.1.3. Threatened species and communities

Threatened species and communities listed under the *Threatened Species Conservation Act 1995* or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* were specifically targeted in the assessment. Threatened species or communities recorded in the study area, or with potential to occur there, were identified prior to site inspection using the DEC NPWS Wildlife Atlas search based on the Gunning 1:100,000 map sheet.

The identification of the White Box, Yellow Box, Blakely's Red Gum Woodland Endangered Ecological Community (EEC) draws on the definition provided in the listing Determination and the NPWS identification guidelines for the EEC. The guidelines include degraded sites in the EEC, even treeless sites and sites which have few native species in the understorey provided the natural soil seed bank is at least partially intact and would respond to assisted regeneration. Judgements have been made in the Biodiversity Assessment about the likelihood of the persistence and integrity of a native seed bank, based on disturbance history, the presence of natural soils and above-ground vegetation present at the sites. A precautionary approach has been adopted where distribution and habitat information is incomplete or uncertain.

4.1.4. Survey limitations

As the site is a large one the approach was to target representative habitat types and likely impact areas. While it is certain that some species will have been overlooked, it is considered unlikely that significant or listed threatened species could occur on the parts of the site which will carry the wind turbines because of the degree of disturbance in these areas.

4.2. Survey Results

4.2.1. Survey zones

The area surveyed was divided into five survey zones. These areas are considered to be representative of the type and condition of vegetation onsite (photographs of these areas are located in Appendix F: Photographs of the site).

Ridge, R

The site consists of a long ridge and two adjacent hill crests. Much of the site has been cleared of trees, but there are some substantial patches of regrowth woodland and forest on steeper slopes below the ridge crest. Most of these will not be directly affected by the proposal, although some potential access routes to the ridge involve passing through open woodland.

The ridge crest also carries occasional patches of open woodland, with most trees being regrowth after earlier clearing. A larger ringbarked dead tree indicates that the original woodland was of generally larger trees than those currently present.

The groundcover over most of the ridge crest has been substantially altered by a long history of grazing and possibly by ploughing and sowing of exotic pasture species in sections. Many areas are dominated by exotic pasture grasses such as barley grass (**Hordeum leporinum*), perennial ryegrass (**Lolium perenne*) and phalaris (**Phalaris aquatica*), with clovers (**Trifolium spp*) also prominent, along with agricultural weeds such as capeweed (**Arctotheca calendula*), sheep sorrel (**Acetosella vulgaris*) and numerous less abundant species.

There are some patches where very shallow stony soils have hindered invasion by exotic plants, and these are generally dominated by the native corkscrew grass (Aust*rostipa scabra ssp falcata*), various wallaby grasses (*Austrodanthonia spp*) and exotics, rat's tail fescue (**Vulpia muralis*) and hairgrass (**Aira sp*), with occasional native forbs *Crassula sieberiana* and *Goodenia hederacea* and an occasional small shrub of *Hibbertia obtusifolia*.

Remnant or regrowth trees encountered on the ridge are Blakely's red gum (*Eucalyptus blakelyi*), yellow box (*E. melliodora*), brittle gum (*E. mannifera*), red stringybark (*E. macrorhyncha*) and broad-leaved peppermint (*E. dives*), with a very small number (only one plant of most species) of black wattle (*Acacia deanei ssp paucijuga*), hickory wattle (*Acacia implexa*), kurrajong (*Brachychiton populneus*) and native cherry (*Exocarpos cupressiformis*). Mistletoes (*Amyema pendulum* and *Muellerina eucalyptoides*) are relatively common on the eucalypts, but the only other shrub species recorded was the low-growing *Hibbertia obtusifolia*, which has persisted on some rocky patches.

Northern Slope, NS

Only two areas were surveyed within the site in which the groundcover was not largely exotic, or, if native, of very low species diversity. One is at the far northern end of the site (NS), where access could be required up a steep slope via a farm gate access, off Old Sydney Road. (The other area is near the southern end of the site (SS) which features woodland with relatively few weeds and fair native species diversity).

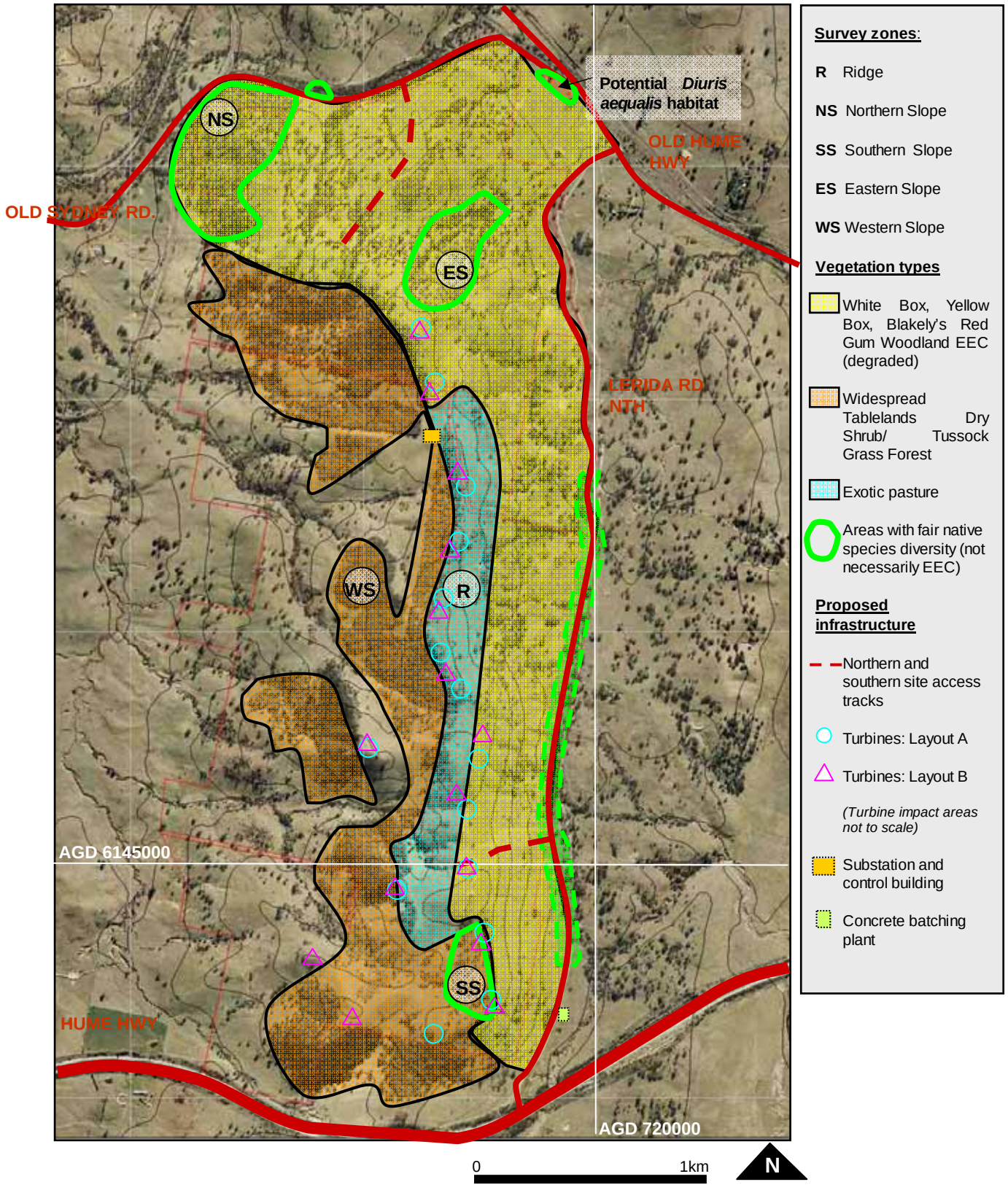

Figure 4.1 Distribution of survey zones and areas which retain fair native species diversity.

The EEC White Box, Yellow Box, Blakely's Red Gum Woodland is technically present though degraded on the eastern and northern slopes while the Widespread Tablelands Dry Shrub/ Tussock Grass Forest is present on the western slopes and substation site. Proposed infrastructure has been superimposed to show the areas of vegetation that would be affected. (More accurate scaling and location of turbines is given in the EA report; Figures 3.8 and 3.9)

This woodland remnant on the northern slope (NS) includes some patches with a fair diversity of native groundcover species, as well as including most of the non-eucalypt tree species recorded on the site (hickory wattle, kurrajong and native cherry). Eucalypts in this area are Blakely's red gum and yellow box. The most common groundcover species is corkscrew grass, with smaller amounts of other native grasses *Microlaena stipoides*, *Elymus scaber*, *Austrodanthonia spp, Austrostipa densiflora* and *Echinopogon ovatus*. Fourteen native forb species were recorded in this area, including *Oxalis perennans, Desmodium varians, Glycine tabacina, Tricoryne elatior, Hydrocotyle laxiflora, Acaena echinata* and *Crassula sieberiana*. Although none are abundant, they do out-number weeds in some areas. The only common weed in this part of the site is the annual quaking grass (**Briza maxima*). This area could be regarded as belonging to White Box, Yellow Box, Blakely's Red Gum Woodland, listed as an Endangered Ecological Community (EEC) under the *Threatened Species Conservation Act 1995*.

Southern Slope, SS

This area is located in the saddle about 300m south of the telecommunications tower. The trees in this area are brittle gum, red stringybark and broad-leaved peppermint, with a grassy groundcover which, in the highest quality patches includes grasses *Poa sieberiana, Austrodanthonia spp* and *Elymus scaber*, graminoids L*uzula densiflora* and *Lomandra filiformis ssp coriacea* and forbs *Gonocarpus tetragynus, Goodenia hederacea, Stellaria pungens* and *Wahlenbergia luteola* with small numbers of *Chrysocephalum apiculatum, Scleranthus fasciculatus, Hydrocotyle laxiflora, Triptilodiscus pygmaeus,* mosses and lichens. There are also patches within this saddle which are dominated by or consist entirely of exotic grasses and forbs. This area does not belong to the White Box, Yellow Box, Blakely's Red Gum Woodland EEC, due to the absence of any indicator tree species. Despite a somewhat similar groundcover, the presence of brittle gum, red stringybark and broad-leaved peppermint indicates that the vegetation in this area is derived from a grassy or shrubby woodland dominated by these tree species, which generally occurs higher in the landscape than the Yellow Box, Blakely's Red Gum Woodland EEC. This community has been less cleared for agriculture as it often occurs on poor, stony soils, and so is not listed as an EEC. It has been described as Widespread Tablelands Dry Shrub/ Tussock Grass Forest (Forest Ecosystem 109 of Thomas, Gellie and Harrison, 2000).

Eastern Slope, ES

The less steep slopes on the eastern side of the site are intermediate between Widespread Tablelands Dry Shrub/ Tussock Grass Forest (Forest Ecosystem 109 of Thomas, Gellie and Harrison, 2000) and the Yellow Box, Blakely's Red Gum Woodland EEC, including elements of both communities. However, given the liberal interpretation recommended by NSW NPWS (undated), these areas would have to be included within the EEC, despite the presence of trees other than yellow box and Blakely's red gum.

Widespread Tablelands Dry Shrub/ Tussock Grass Forest is generally more shrubby than grassy and is still relatively intact in the less developed parts of the Goulburn region. It is characterised by an overstorey of brittle gum, red stringybark and broad-leaved peppermint, with an understorey including the shrubs *Hibbertia obtusifolia, Daviesia leptophylla, Brachyloma daphnoides* and *Melichrus urceolatus*, the tussock grasses *Joycea pallida* and *Poa sieberiana* and forbs *Gonocarpus tetragynus* and *Dianella revoluta*. The roadside remnant near the Old Sydney Road junction with the Old Hume Highway is an example of this community.

An area of woodland in a drainage line through which were initially considered for a transmission line (since dropped from the proposal) also includes yellow box and Blakely's red gum, as well as red stringybark, brittle gum and broad-leaved peppermint and a single apple box (*E. bridgesiana*) and native cherry. Some parts of this area, particularly a low ridge between two branches of the gully, have a groundcover in which native grasses and forbs are dominant. However, only a few of the groundcover species present are specifically listed as indicator species for White Box Yellow Box Blakely's Red Gum Woodland, and three of the six eucalypt species in this area are not components of the community either, so the evidence is somewhat equivocal as to whether this area is part of the EEC.

Western Slope, WS

The remnant forest or woodland on the steeper slopes on the western side of the Cullerin site is Widespread Tablelands Dry Shrub/ Tussock Grass Forest (Forest Ecosystem 109 of Thomas, Gellie and Harrison, 2000). (This area was reassessed in January 2006 to confirm the distribution of this community). The components of this community have been described above (Eastern Slopes).

In general, parts of the site with a more exposed aspect tend to be dominated by brittle gum and more sheltered areas by yellow box and Blakely's red gum, although there are exceptions to this generalisation. The lower slopes surrounding the site still carry less disturbed patches of woodland which are in sufficiently good condition to be regarded as being examples of the EEC, such as areas scattered along Lerida Road North (shown dotted on Figure 4.1). Additional surveying was carried out in this area in January 2006 to properly characterise this impact.

The community dominated by brittle gum has been substantially degraded by grazing (as has the White Box, Yellow Box, Blakely's Red Gum Woodland) onsite. Off-site, there are two remnants in good condition in close proximity to the site, which may be affected by road works to facilitate the transportation of infrastructure. One occurs on the top of a cutting above the railway line immediately south of the proposed substation site, and one on the verge of the unsealed road near the junction with Old Sydney Road at the northern end of the site. Although small, both these remnant patches are in good condition, which appears unusual in the vicinity of Cullerin.

4.2.2. Vegetation communities of conservation significance

White Box, Yellow Box, Blakely's Red Gum Woodland is listed as an Endangered Ecological Community in NSW under the *Threatened Species Conservation Act 1995* and is covered by the national listing of Grassy White Box Woodland under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. It is also listed, as Yellow Box Red Gum Grassy Woodland in the ACT under the *Nature Conservation Act 1980*, reflecting a high degree of destruction or modification by grazing, and in the ACT, loss of substantial areas to housing.

This community probably formerly occupied much of the flats and lower slopes in the Goulburn district, from which it has mostly been completely cleared. Some remnants remain in a few areas, particularly on road verges, and remnant paddock trees indicate some areas where the community previously occurred.

The Final Determination of the NSW Scientific Committee states that:

> "Some remnants of the community may consist only of an intact overstorey or an intact understorey, but may still have high conservation value due to the flora and fauna they support…..Disturbed remnants are still considered to form part of the community including remnants where the vegetation, either understorey, overstorey or both, would, under appropriate management, respond to assisted natural regeneration, such as where the natural soils and associated seed bank are still at least partially intact".

This is quite a liberal interpretation of the community, suggesting that even substantially degraded remnants should be considered as belonging to the EEC. The identification guidelines for the Yellow Box, Blakely's Red Gum Woodland EEC (NSW NPWS undated) take this even further, indicating that size or age of the remnant are not determining factors in whether it is or is not the EEC. If the remnant in question occurs within the geographical area (tablelands and slopes) defined as the habitat of the community, carries, or is likely to have formerly carried, white box, yellow box or Blakely's red gum, is mainly grassy rather than shrubby and includes any of the indicator species listed in the determination (either as plants or in the soil seedbank), and if degraded, is considered to have potential for natural regeneration of the overstorey or understorey, then it is regarded as being part of the EEC.

The only area on the Cullerin site which is unequivocally part of the EEC is the steep slope at the northern end of the site (NS), where Yellow Box, Blakely's Red Gum Woodland occurs with a grassy understorey which still includes a substantial number of native grasses and forbs, although it is somewhat degraded by grazing and weed invasion. This area is of moderate conservation significance, as it has only low native species diversity, with many native forbs and grasses present as only a small number of plants.

Under the interpretation of the EEC provided by NSW NPWS however, any area carrying either yellow box or Blakely's red gum, regardless of the nature of the understorey, and any area with a substantially native groundcover which appears likely to have formerly carried these trees, must be included within the EEC, including where the groundcover is substantially altered, if it might be considered that the soil seedbank still includes many native species. The Yellow Box, Blakely's Red Gum Woodland Fact Sheet (NSW NPWS, undated) further states that the three characteristic tree species may occur either as pure stands or in mixtures with other trees including apple box (*E. bridgesiana*), brittle gum (*E. mannifera*), candlebark (*E. rubida*) and red stringybark (*E. macrorhyncha*). Broad-leaved peppermint is not mentioned, but might be assumed, since it is a common associate of brittle gum and red stringybark. These three species occur on the Cullerin site, including in association with yellow box and/or Blakely's red gum.

The decision as to whether the EEC is present appears to hinge on the state of the soil seedbank and, if the groundcover is substantially exotic, whether it has any potential to regenerate to a more native species composition. The breaking of the 2002-05 drought in the Goulburn area in the spring during which the survey was conducted provided ample opportunity to assess the state of the seedbank, since prior to the botanical assessment the site had been observed to be largely bare. Following rains in July and subsequent months substantial recovery of the groundcover occurred, and the level of grazing on the site appeared to be light at the time of the survey, so is unlikely to have much affected the species composition of the groundcover. In many areas, particularly in treeless parts of the ridge tops, this consists entirely of exotics, so the seedbank in these areas could be assumed to have no regeneration potential. However, in areas with shallow, rocky soils and among trees, there are patches where native grasses (mostly *Austrostipa scabra ssp falcata* and *Austrodanthonia spp*) are dominant. Despite relatively low species diversity, these areas must be regarded as being part of the Yellow Box, Blakely's Red Gum Woodland EEC under the DEC guidelines.

Such areas occur in the large gully through the Eastern Slopes (ES) survey zone, along Lerida Road North, in areas which may be used to provide access to the site, and in scattered locations along the ridge crest. In some of these areas (only two of which were assessed in detail) the EEC still appears to include a moderate degree of native species diversity and these patches would be of moderate conservation significance. Occurrences along the ridge crest are small and fragmented by areas of exotic vegetation. They are also of very low native plant species diversity, so despite falling within the definition of the EEC, would be of relatively low conservation significance.

The area in a saddle south of the telecommunications tower, despite having patches with a predominantly native groundcover, carries only the trees brittle gum, red stringybark and broad-leaved peppermint. Whether this area is included within the EEC would be open to interpretation. The groundcover is predominantly grassy not shrubby, as it would be in the Widespread Tablelands Dry Shrub/ Tussock Grass Forest, and it is in a landscape which has been substantially cleared it is not possible to say whether red gum or yellow box might formerly have also occurred in this location with the three tree species which still remain there. However, there is no direct evidence, other than a grassy understorey, which could have been created by the impacts of grazing on a formerly shrubby understorey, to suggest that this location carries the Yellow Box, Blakely's Red Gum Woodland EEC.

4.2.3. Species recorded at the site

A total of 116 vascular plant species was recorded during the flora survey, including 39 exotic species. A full list of species recorded and their cover/abundance is provided in Appendix A: Flora list. This list is not exhaustive due to the extensive nature of the survey area, and the omission of some species which flower outside the survey period.

4.2.4. Species of conservation significance

No plant species listed as threatened in Schedules 1 and 2 of the *Threatened Species Conservation Act 1995* were found on or near the site.

An on-line search of the DEC NPWS Wildlife Atlas database for the Gunning 1:100,000 map sheet produced only one threatened plant species which has been recorded in the region. Consequently the search area was enlarged to include the surrounding Yass, Crookwell, Taralga, Goulburn and Canberra map sheets and this resulted in the addition of some grassy woodlands or grasslands on the Southern Tablelands, producing a total of twenty-two threatened species for the wider region. This table is presented in Appendix C: Threatened species evaluation, C.1 Flora, and outlines what is known of the habitat requirements of each species and the likelihood of these occurring locally. This assessment has identified that little or no potential habitat for threatened plant species occurs on the site, due to the level of disturbance from clearing, grazing, "pasture improvement" and weed invasion over most of the site.

One area on a nearby road verge has been identified as carrying potential habitat for the Buttercup Doubletail orchid (*Diuris aequalis*), listed as endangered in NSW under the *Threatened Species Conservation Act 1995* and vulnerable under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (area indicated on Figure 4.1). The Buttercup Doubletail orchid is a conspicuous species when in flower, with up to 5 large (3cm diameter) pure yellow to orange flowers on a stem to 45cm in height (Bishop, 1996). It is readily distinguished from most other members of the donkey orchids (*Diuris spp*) by the lack of brown markings on the flowers and the erect but strongly backswept petals and recurved green lateral sepals which are often concealed by the labellum.

Bishop states that it grows in drier woodlands or montane forest with a grassy-heathy understorey, on the tablelands between the Blue Mountains and Braidwood, although the Department of Conservation and Environment website states that it may grow in forest, open woodland or secondary grassland (NSW NPWS undated). There are six records from Kanangra-Boyd National Park in the Blue Mountains, but the bulk of the records are from private property or road reserves, so the species is poorly reserved in NSW, and does not occur in any other state. All known populations are small. Information on the DEC website states that a total of 200 plants are known from 20 populations. However, numbers will vary from year to year depending on conditions. The population on the Wombeyan Caves Road consisted of 200 plants or more in 2005, as numbers recovered after the 2002-04 drought (K. McDougall, pers. comm.).

Of the total of 20 sites recorded for this species on the DEC NPWS Wildlife Atlas database, 8 are located around the Braidwood district, and all of these are relatively recent records (1976 to 2001), whereas some of those elsewhere are historical and have not been relocated more recently (Goulburn 1904, Oberon 1955, Federal Highway 21km south of Goulburn 1961). Near Braidwood, typical habitat consists of brittle gum and broad-leaved peppermint woodland, with an open understorey dominated by low shrubs, principally *Daviesia mimosoides*, and the tussock grass *Joycea pallida* (J. Miles, pers. obs.). Habitat similar to this occurs on the road verge between the northern end of the site and the proposed substation site, at the junction of Old Sydney Road and the unsealed road which runs along the northern edge of the site. Brittle gum is the main tree species on this site, with the shrub *Daviesia leptophylla* and various native grasses.

If road widening were required to facilitate moving materials onto the site during the construction phase, this area could be affected. This vegetation, in fair to good condition, occupies about 100m west from the junction with Old Sydney Road, with another area of road verge close to the northern end of the site. The area near the road junction was surveyed, and no orchids were found. The survey was conducted during the flowering period for this species (it had been observed flowering near Braidwood on 4 November). However, as not all individuals flower in every season, the possibility remains that the species occurs on the road verge in this location. This is a relatively undisturbed brittle gum (*E. mannifera*) woodland remnant with good native species diversity and relatively few weeds. Protection of this remnant should be achieved.

An Assessment of Significance was carried out (Appendix D) to characterise the potential impact of the proposal on this species and on Yellow Box, Blakely's Red Gum Woodland. This assessment determined that unacceptable impact can be avoided through careful positioning of infrastructure and access routes and the adoption of standard weed and sediment erosion controls.

4.2.5. Disturbance and weeds

As discussed above, most of the site is highly disturbed, by clearing, sowing of introduced pasture grasses and legumes, grazing and weed invasion. A few areas are less affected, some within the site and some around the edges of the site, where they may be affected by the proposal during the construction phase. These areas have been discussed above.

The only weed species declared noxious in Goulburn-Mulwaree Local Government Area detected on the site was Scotch thistle, which is present in small numbers in a few locations.

4.3. Impact assessment

4.3.1. Construction impacts

The impacts of the proposed development to onsite vegetation would almost entirely be confined to the construction phase. Soil disturbance, vegetation trampling and vegetation removal would occur during road establishment and the installation of infrastructure including 15 wind turbines, a substation and potentially a control room and concrete batching plant (as located on Figure 4.1. Degradation of habitat may occur through soil loss and the introduction of weeds.

The areas that would be removed as a result of these works are tabulated below. As boundaries between vegetation types are rarely sharply defined, where an item falls on the boundary, tree cover and contours have been used to place the turbine in the more representative zone.

Table 4.1 Areas of impact within each survey zone

Item	Survey zone	Quantity	Area per item (m^2)	Total area (m^2)
Hardstand areas beneath turbines				
Layout A	RIDGE	8 turbines	900.0	7,200.0
	EASTERN SLOPE	3 turbines	900.0	2,700.0
	WESTERN SLOPE	4 turbines	900.0	3,600.0
Layout B	RIDGE	6 turbines	900.0	5,400.0
	EASTERN SLOPE	3 turbines	900.0	2,700.0
	WESTERN SLOPE	6 turbines	900.0	5,400.0
Substation building	RIDGE	1 building	5,625	4,900.0
Control building	RIDGE	1 building		150.0
Bushfire Asset Protection Zone (APZ) for substation and control building **35m APZ = 25m IPA + 10m OPA**				
Inner protection area (IPA)	RIDGE	25m		1,875.0
Outer protection area (OPA)	WESTERN SLOPE	10m		750.0
Concrete batching plant	EASTERN SLOPE	1 plant		3,750.0

Table 4.2 Areas of impact by vegetation type

Totals by survey zone	Vegetation type and comment	Total under Layout A (m^2)	Total under Layout B (m^2)
RIDGE	Exotic pasture. Largely cleared of trees with occasional regrowth. Most turbines, in both layouts have been placed in existing cleared areas on the ridge. The substation and control building would be located in existing cleared areas. The bushfire IPA is located within existing cleared areas and continued grazing is likely to be sufficient to maintain this area. The ridge area is the most disturbed, in terms of previous clearing, as well exotic ground cover. Concentration of infrastructure in this area is considered to be the most appropriate.	14,125.0	12,325.0
EASTERN SLOPE	Intermediate between Widespread Tablelands Dry Shrub/ Tussock Grass Forest and the Yellow Box, Blakely's Red Gum Woodland EEC. Given the liberal interpretation	6,450.0	6,450.0

Totals by survey zone	Vegetation type and comment	Total under Layout A (m^2)	Total under Layout B (m^2)
	recommended by NSW NPWS (undated), these areas would have to be included within the EEC, despite the presence of trees other than yellow box and Blakely's red gum. Turbines have been located in existing cleared areas. Areas identified as having better native species diversity have been avoided (these include the northern slope, eastern gully and areas alongside Lerida Road North). The concrete batching plant will be an extension of the existing disturbed area and will not result in the clearing of shrubs or trees. Although vegetation may fall within the broad definition of the EEC, these areas have been considered to have low conservation value.		
WESTERN SLOPE	Widespread Tablelands Dry Shrub/ Tussock Grass Forest. Some tree clearance would be required for turbines and the bushfire OPA. The turbines can be manoeuvred into place during installation so that clearing would be lessened. The bushfire OPA would require removal of dead limbs, ground level litter and dead material in shrubs, as well as removal of some trees and shrubs to open out the understorey. Mowing or brush-cutting the understorey would be required to maintain a maximum height of 100 mm. This vegetation type is still relatively intact in the less developed parts of the Goulburn region. The clearing and underscrubbing would be on peripheral vegetation only and would not contribute to fragmenting areas of habitat.	4,350.0	6,150.0

To reduce the impacts of the construction phase on vegetation onsite to an acceptable level, the following recommendations are made:

- The Northern Slope contains an area of higher quality EEC where Yellow Box, Blakely's Red Gum Woodland occurs with a grassy understorey. This area is of moderate conservation significance and should be protected from any impact during the proposed works (NS, Figure 4.1).

- The Yellow Box, Blakely's Red Gum Woodland EEC may be interpreted as being present elsewhere onsite (illustrated on Figure 4.1) in areas with shallow, rocky soils and among trees, where native grasses (mostly *Austrostipa scabra ssp falcata* and *Austrodanthonia spp*) are dominant. These remnants are small and scattered and would be very difficult to map. They have low species diversity and are regarded by this assessment to be of lower conservation significance.

  In general, if infrastructure placement and access trails were placed to avoid treed areas and isolated paddock trees, impact to this community would be largely avoided. However, as this remnant vegetation still fits within the definition of the EEC, additional surveying should be conducted once road access route options are pegged and the required road width is determined. The placement of access trails and installation of infrastructure in better quality areas could then be avoided. Target areas to survey would be the southern access point (the first 50m from

Lerida Road North turnoff) as well as any works proposed on Lerida Road North and Old Sydney Road.

- The southern road verge of the Old Sydney Road from the corner of the Old Hume Highway extending 100m west should be protected from impact during road works to access the northern end of the site. This area (mapped on Figure 4.1) potentially provides habitat for the Buttercup Doubletail *Diuris aequalis* and is a relatively undisturbed Widespread Tablelands Dry Shrub/ Tussock Grass Forest remnant with good native species diversity and relatively few weeds. Some areas on the northern road verge also have potential, particularly west of the gully crossing on Old Sydney Road (mapped on Figure 4.1) and should be avoided (further survey work described by the previous point will cover this area also, if it will be impacted by works).

- Weed and sediment erosion controls should be implemented to prevent onsite habitat degradation during and following the proposed works.

- After the installation of the infrastructure, disturbed soil should be rehabilitated as soon as practicable in order to resist erosion and colonisation by weeds. This may require restricting stock access and implementing revegetation activities.

4.3.2. Operational impacts

Regular maintenance visits will utilise standard vehicles. Atypical maintenance (such as replacement of parts) may require larger machinery. Operational impacts are not anticipated to generate unacceptable impacts to onsite flora, if risks are thoroughly mitigated. This would include:

- All vehicles onsite would follow established trails and minimise onsite movements.

- Weed controls (including long-term monitoring) should be implemented to prevent onsite habitat degradation during the proposed works.

- Chemicals, including fuels and lubricants, would be stored and handled as per manufacturer's instructions. Where practical, they would be stored offsite. Where they must be stored onsite, they would be housed in a secure building bunded to contain any leakages.

- Turbines would be bunded to accommodate the full capacity of the fuels and lubricants contained within.

4.3.3. Decommissioning impacts

Decommissioning of the wind turbines would involve similar onsite equipment and activities to the construction phase however, a reduced level of impact is anticipated as all below-ground structures would remain insitu; including footings, concrete slabs, underground cabling. The potential for erosion and habitat degradation would relate primarily to vehicle tracks and hard stand areas. It is recommended that:

- Weed and sediment erosion controls should be implemented to prevent onsite habitat degradation during and following the proposed works.

- Disturbed soil would be stabilised and rehabilitated as soon as practicable after works.

5. FAUNA

5.1. Approach and methodology

5.1.1. Preliminary assessments

A preliminary assessment of fauna habitat values and the likelihood of the presence of threatened fauna was undertaken based on species distribution records and known habitat requirements, prior to field work onsite. The results of previous fauna survey work in the region were also reviewed for threatened fauna records. Habitat requirements were drawn from a range of sources, including reference books, scientific papers and local research.

5.1.2. Field surveys and mapping

Survey timing and conditions

Faunal surveying was carried out for nocturnal and diurnal terrestrial vertebrates between November 19 and November 22, 2005. The late spring timing of the fauna survey, and warm weather during the fieldwork, was favourable for recording frogs, reptiles and microchiropteran bats, as well as birds and mammals. The weather was variable during the surveying however, ranging from very warm to cold days and nights. Wind speeds and precipitation were also variable for the duration of the surveys. Rain was light and was not heavy enough to impede survey work (refer to Table 5.1) at any time.

Table 5.1 Weather conditions during surveys

Weather conditions were noted on data sheets at the beginning of each survey (does not include trapping surveys). Summarised information is provided below.

	Temperature	Wind	Precipitation
November 19, 2005 AM	17^{o}C	None to light	None
PM	17-18^{o}C	None	None
November 20, 2005 AM	14-25^{o}C	Light to moderate	None
PM	15-16^{o}C	Light to moderate	None - drizzle
November 21, 2005 AM	16-18^{o}C	Light to moderate	None
PM	14-15^{o}C	Light	None

Survey methodologies and effort

Survey effort was distributed among habitat types (open woodland, grassland, dams) and landscape positions (ridges, flats, gullies), being most intensive on the ridges that would be most impacted by the proposed works.

Mammals, reptiles, birds and amphibians were targeted. The survey routine included setting and checking cage and elliot traps (7-10am), birds and reptile searches, (10am-5pm), frog searches, call play-back, spotlighting and anabat recording (~8.30pm-). Survey methods included the following:

- Eight trapping transects were established. Each transect consisted of 12 traps (two cage traps and ten Elliot type A traps). Traps were spaced 10-20m apart in microhabitats suitable for catching medium (cage traps) and small (Elliot traps) mammals, respectively. Peanut butter and rolled oats baits were uses.

- Bird censuses were 30-60 minutes and recorded the height and number of each species observed.

- Reptile searches were 30-60 minutes and targeted representative habitat types. Rocks, rock outcrops, fallen timber and tussocks were actively searched.

- Frog searches and identification of frog calls were undertaken at selected water-bodies onsite. Recordings were taken in some instances to be identified by comparison to pre-identified calls.

- Vocalisations of the threatened Powerful Owl, Masked Owl and Squirrel Glider were each carried out after a 5 minute acclimation period at suitable locations. Calls for each species were played for 2.5 - 5 minutes. Listening for responses was carried out for an additional ten minutes. Spotlighting followed call play-back sessions.

- Foot-based and vehicle-based spotlight transects were conducted to identify nocturnal mammals onsite. Foot-based transects were a minimum of 30 minutes in duration. The length of vehicle-based transects was determined by length of track suitable for spotlighting.

- Anabat recordings were taken from locations suitable for microchiropteran bat roosting or foraging (near woodlands, adjacent to paddock trees and water bodies). The anabat was left at a different location at dusk each night and retrieved the following morning.

- Searches for sign of fauna (including scratchings and scats) were carried out opportunistically while conducting other surveys. Scats were collected and identified. Selected predator scats were sent for laboratory analysis to determine prey species via hair samples.

The survey effort is detailed in Table 5.2 and illustrated in Figure 5.1.

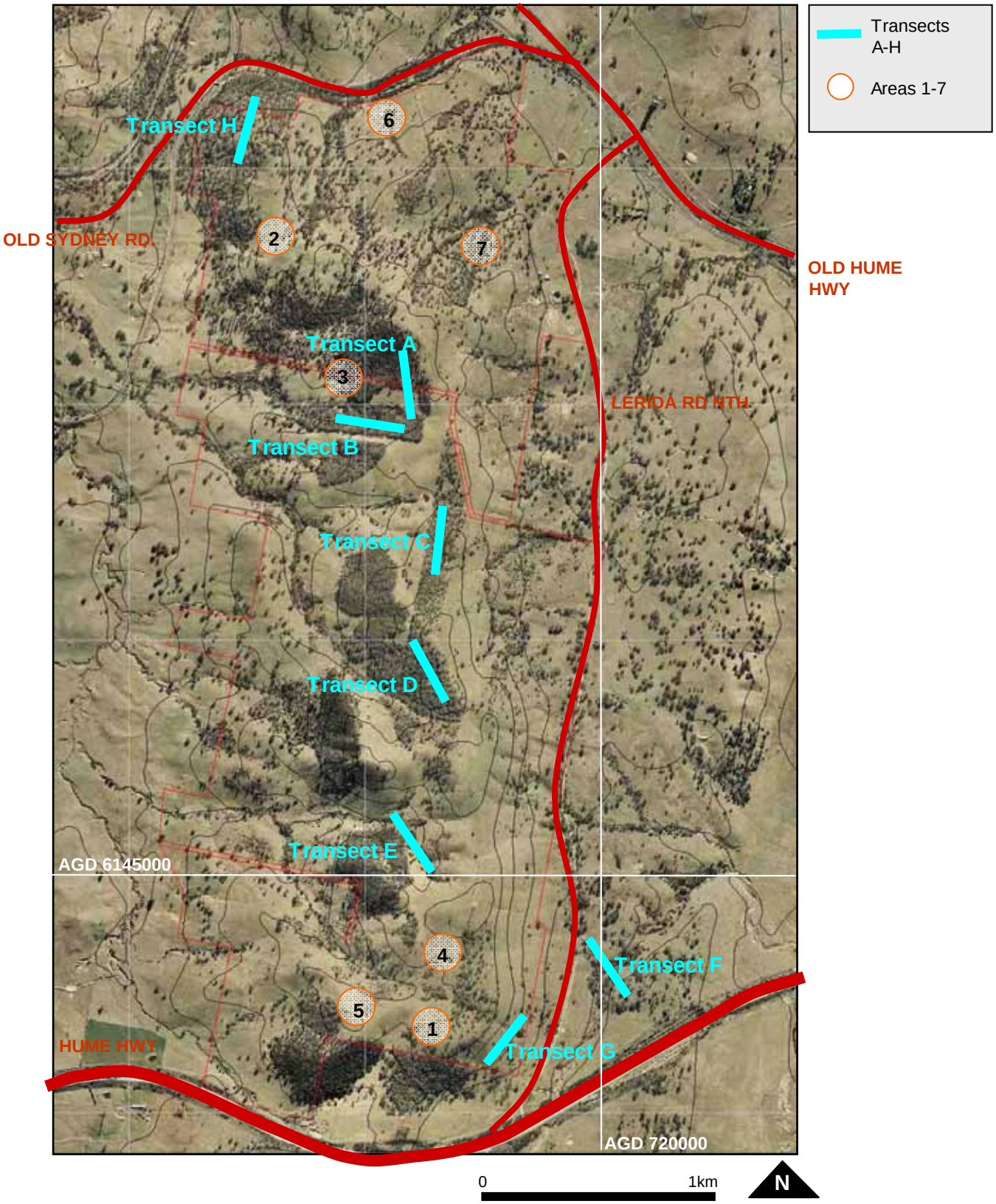

Figure 5.1 Faunal survey effort by area.

Table 5.2 Faunal survey effort by habitat type

Areas and transects located on Figure 5.1.

Habitat type and location	Survey effort
Woodland slope Area 3 Transect A, B, D, E and H	Bird census x 5 sites Reptile search x 4 sites Trapping transect x 5 sites
Woodland ridge Transect C	Trapping transect x 1 site Bird census x 1 site Call playback x 1 site Spot light x 1 site Reptile search x 1 site Frog search x 1 site Anabat x 1 site
Gully Area 7 Transect F	Call playback x 2 sites Spot light x 2 sites Trapping transect x 1 site Frog search x 1 site Anabat x 1 site
Grassland slope Area 1 and 5 Transect G	Bird census x 1 site Call playback x 1 site Spot light x 1 site Reptile search x 1 site Trapping transect x 1 site
Grassland flat Area 6	Reptile search x 1 site Spotlight x 1 site Frog search x 1 site Anabat x 1 site
Grassland ridge Area 2 and 4	Bird census x 1 site Reptile search x 1 site Frog search x 1 site

5.1.3. Threatened and other significant species

The DEC NPWS Wildlife Atlas was consulted for records of threatened species and other species of conservation significance in the study area, based on the Gunning and Goulburn 1:100,000 map sheets. The national EPBC databases search tool was also used to identify known fauna species distributions using a 30 kilometre buffer around the subject site. A list of threatened fauna with potential to occur at the site was compiled to assist with field survey design and targeting.

5.1.4. Survey limitations

The late spring timing of the fauna survey, and warm weather during the fieldwork, was favourable for recording frogs, reptiles and microchiropteran bats, as well as birds and mammals. Tall grass however, reduced the visibility of basking reptiles and ground birds. The limited duration and intensity of the survey may have resulted in the omission of some sparsely distributed, ephemeral or seasonal species. However, considering the quality and diversity of habitats at the site, the selected survey methods and intensity are considered appropriate to the assessment of the wind farm proposal. A precautionary approach has been adopted when evaluating the potential for species to utilise the site or where impact is uncertain.

5.2. Survey results

5.2.1. Fauna habitat in the study area

Four broad habitat types were identified, providing different habitat resources for fauna onsite.

- Woodland ridges

  These ridges have high exposure to strong winds. The trees are regrowth and provide few if any small hollows. The understorey is mixed native and exotic species and is grazed. The woodland was fragmented and considered to provide poor habitat for small and medium sized mammals, having greater potential for larger mammals, birds and reptiles.

- Woodland slopes

  The wooded slopes had a greater degree of protection from climate and were generally more vegetated (with the western slope more treed than the eastern slope) with a greater proportion of native species in the understorey. While still fragmented, the contiguous wooded areas were larger, providing greater habitat resources for small, medium and large mammals, birds and reptiles. Wattle, mistletoe and ribbon gum represented foraging resource for birds and arboreal mammals in these areas.

- Grassland

  Much of the site has been cleared for grazing. Exotic species dominate grassland areas. Ridges are more exposed to the weather than slopes and flats. The amount of biomass varied considerably during 2005, from very little ground cover in August (observed during an initial site visit) to tall grass in November. Seasonally, these areas provide soft palatable grass forage as well as rocky outcrops and vegetation refuge to small, medium and large mammals, birds and reptiles.

- Wetlands

  Several farm dams are present onsite. The surrounding vegetation ranged from abundant juncus to bare clay banks. Several erosion gullies were present. Most of these gullies were dry during surveying but one held small ponds that could harbour frogs and be used by larger fauna.

(Refer to Appendix F for photographs of the site).

5.2.2. Survey results

A diverse faunal assemblage was recorded and it is anticipated that more cryptic species are also present, going undetected due to the limited duration of surveying. In total, 76 species were identified. This included six amphibian species, 46 species of bird, 16 mammal species and eight reptiles (Appendix B, Table B.1: Faunal species list for the site).

Amphibians

Six amphibian species were detected near dams and drainage lines. Many individuals were calling during surveying, allowing identification via call as well as visual identification of captured individuals. The identified species are common in the region. Works would largely avoid these areas however, a small dam may be impacted in the vicinity of Transect C.

Birds

Several avian guilds were observed onsite. These can be divided into species inhabiting the woodland areas, its edges and more open areas. Woodland birds included pardalotes, thornbills and bronze-wings. On the woodland edge as well as within it, the larger species dominated, including ravens, magpies, currawongs and White-winged Choughs. Parrots were also observed on the woodland edge and in cleared areas including flocks of Sulphur-crested Cockatoos, rosellas and Galahs. In cleared areas, diurnal birds of prey (eagles and kestrels) and other species such as pipits and waterbirds including ducks and herons were also present. No nocturnal birds of prey were recorded although the abundance of Ring-tail Possums suggests the area may be attractive to Powerful Owls.

Species observed at heights above 30m (and therefore with potential to collide with moving turbines blades) included the White-faced Heron, Australian Raven, Wedged-tailed Eagle, Nankeen Kestrel, Sulphur-crested Cockatoo, Galah. Of these, species observed to flock in numbers greater than three or four were the Australian Raven, White-winged Chough, Sulphur-crested Cockatoo and Galah. Also at risk, are species at low density in the landscape such as the Wedged-tailed Eagle and Nankeen Kestrel. A pair of Wedged-tail Eagles was recorded only once during surveys. Nankeen Kestrels were recorded several times, once in a pair.

Mammals

Of the sixteen mammals recorded, three are introduced (excluding livestock species). A very low incidence of small mammals was recorded during mammal trapping; only four captures from 288 trap nights. This included four antechinus from two traps so is likely to have involved recaptures. Low levels of refuge and the small fragmented areas of available habitat are likely to have resulted in low abundance of small mammals onsite.

Three macropods were recorded, the Swamp Wallaby, Eastern Grey Kangaroo and Wallaroo. The palatable grasses and mosaic of cleared and wooded areas is optimal habitat for these species that probably move to other areas when onsite vegetation has been reduced through drought and / or grazing.

Brush-tail and Ring-tail Possums are abundant onsite. The former is likely to be a strong competitor for the few hollows observed onsite.

The timing during warm weather in late November was good for detecting microchiropteran bats. There are predominantly small hollows onsite, suitable for roosting and a drainage line to the east of the ridge that may maintain permanent water. No caves are present however, several species can make use of house rooves and similar structures for roosting in the area. Four hundred and eighteen calls were obtained over three nights from which seven species were identified. These

included common species such as the Chocolate Wattled Bat, Gould's Wattled Bat, Large Forest Bat, Southern Forest Bat or Little Forest Bat (unable to be differentiated on the basis of call) and White-striped Freetail Bat as well as the threatened Large-footed Myotis.

Reptiles

Eight reptile species were recorded. Stumpy-tailed Lizard and Blue-tongued Lizard were the most ubiquitous. It is likely that several more skink species occur on site and were not identified due to the limited extent of surveying.

5.2.3. Sensitive habitat features

Important habitat features onsite included hollow-bearing trees (which were rare), gully systems, wetlands and the connectivity between woodland remnants. Much of the site has been cleared for grazing and the remaining trees are largely of a young age. Hence, the number of hollow-bearing trees and recruits to replace these as they senesce is very low. Although severely eroded, gullies and drainage lines onsite often harboured more mature trees and therefore, have an important role in hollow-provision to hollow-dependent fauna. Several farm dams are present onsite, while these appear to have been constructed, they nonetheless provide a resource to aquatic and terrestrial fauna. Although it is fragmented by cleared areas, on a broad scale the wooded areas represent a linear corridor that may facilitate the movement of highly mobile species across the site and to other areas offsite, particularly to the north where woodland and forest are more extensive. The development should seek to maintain or improve these habitat features.

5.2.4. Threatened species

One threatened species was recorded during field work, the Large-footed Myotis *Myotis adversus*, listed as Vulnerable under the NSW Threatened Species Conservation Act 1995. An evaluation of other threatened species with potential to occur onsite was conducted for species listed under the NSW *Threatened Species Conservation Act 1995* by the Department of Environment and Conservation (DEC NPWS Wildlife Atlas, accessed 12 Dec. 2005 - Goulburn and Gunning 1:100,000 map sheets) and/or the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (Matters of national significance web tool, accessed 13 Dec. 2005 – 30km buffer from the site).

For each species, the likelihood of occurring onsite as well as the likelihood of being impacted by the proposal was considered. A potential impact rating was achieved for each species. For example, a species likely to occur onsite in an area where works would occur would be given a high impact rating; a species unlikely to occur on-site and whose habitat requirements do not coincide with areas that would be impacted by works would be given a low impact rating. This table is presented in full Appendix C. One species was found to have a high potential impact rating, 14 were found to have a moderate potential impact rating and the remainder, as having low potential to be impacted. Entries for species categorised as high or moderate are extracted below.

Table 5.3 Threatened species with potential to be impacted by the proposal

Threatened species listed under the NSW Threatened Species Conservation Act 1995 and / or the Commonwealth Environmental Protection and Biodiversity Conservation Act 1999 (Gunning and Goulburn 1:100,000 map sheets, and 30km site buffer respectively).

Species	Habitat requirements and study area suitability	Potential to be impacted
Superb Parrot *Polytelis swainsonii* TSC V EPBCv	Nesting habitat on SW Slopes of NSW is often open Yellow Box, Blakely's Red Gum Woodland or isolated paddock trees. Species known to be used are Blakely's Red Gum, Yellow Box, Apple Box and Red Box. Nest in small colonies, often with more than one nest in a single tree. May forage up to 10 km from nesting sites. Feed in trees and understorey shrubs and on the ground and their diet consists mainly of grass seeds and herbaceous plants. West of Yass forms part of core breeding population in region. Migrates north in winter to the upper Namoi and Gwydir Rivers. Local record from less than 5 km north-east of site in road verge.	Marginal potential foraging and nesting habitat is present due to previous and ongoing site disturbance. Collision and avoidance impacts may apply to this flocking species. Only minimal woodland would be impacted by the proposal. **High potential impact.**
Green and Golden Bell Frog *Litoria aurea* TSC E	Occurs in or near water or very wet areas. It is present in forests, woodlands and shrublands, in open or disturbed areas (Hero *et al.* 1991). Breeding takes place in permanent lakes, swamps and dams with still water (Hero *et al.* 1991).	Marginal potential habitat occurs onsite in the form of farm dams. Habitat may be lost if dams are filled to reduce water bird collision. **Moderate potential impact.**
Eastern False Pipistrelle *Falsistrellus tasmaniensis* TSC V	Roosts and breeds in large trees, in a range of habitats including dry and wet sclerophyll forest, appearing to prefer wet sclerophyll (Hall and Richards 1979). May travel large distances between foraging and roosting sites. The site may contain potential foraging habitat, but unlikely to provide hollows for roosting/breeding. May travel over the site during long distance movements. Therefore this species may be subject to collision or avoidance impacts. This species does not migrate or roost in groups so individuals only would be at risk.	Marginal potential foraging and nesting habitat is present due to previous and ongoing site disturbance. Only minimal woodland would be impacted by the proposal but collision / avoidance impacts may apply. **Moderate potential impact.**
Eastern Bent-wing Bat *Miniopterus schreibersii* TSC V EPBCcd	Found in a wide range of habitats, but is constrained by its requirement for caves, man-made tunnels or stormwater channels in which it breeds (Strahan et al. 1995) – not present onsite. Typically, the species forages in well timbered habitats, above the tree canopy (Dwyer, in Strahan *et al.* 1995). Local records occur 15km south of Goulburn and in the Shoalhaven.	Potential foraging habitat is present and wind farm structures may provide roosting opportunities. Only minimal woodland would be impacted by the proposal but collision / avoidance impacts may apply. **Moderate potential impact.**
Eastern Long-eared bat *Nyctophilus timoriensis* EPBC v	Inhabits a variety of vegetation types, including mallee, bulloke but more commonly box/ironbark/cypress-pine. Slow flying agile bat, utilising the understorey to hunt non-flying prey (especially caterpillars and beetles) and will even hunt on the ground. The species roosts in tree hollows, and under loose bark. No regional records. Foraging pattern suggests collision risk is low but avoidance impacts may apply while migrating.	Only minimal woodland would be impacted by the proposal. Potential impact may occur when moving between areas of habitat. **Moderate potential impact.**

Species	Habitat requirements and study area suitability	Potential to be impacted
Long-footed Myotis *Myotis adversus* TSC V	This species forages on the surface of water bodies such as rivers, lakes and swamps and roosts in caves, mine, tunnels and old buildings (Hall & Richards 1979). No local records occur, although this species was identified by call onsite. This species may forage and migrate in groups, placing it at greater risk of collision with ridge-top turbines.	Foraging habitat is present in the drainage line to the east of the site. This area would not be impacted. Collision / avoidance impacts may apply. **Moderate potential impact.**
Square-tailed Kite *Lophoictinia isura* TSC V	Preferred habitat is open eucalypt forest and woodland (Schodde and Tidemann 1986). The species hunts for passerine birds in the tree tops of the forest (Klippel 1992). Habitat at the site is marginal due to scarcity of forest cover. Recorded in Mundoonen Nature Reserve.	Potential habitat is marginal due to young age of trees and fragmentation but collision / avoidance impacts may apply. Only minimal woodland would be impacted by the proposal. **Moderate potential impact.**
Powerful Owl *Ninox strenua* TSC V	Breeding pairs defend large (up to 1000 ha), permanent territories (Blakers *et al.* 1984), usually centred around gullies (Fleay 1968). Nests in large tree hollows (Emison *et al.* 1987). Arboreal mammals form about 80% of the diet of this species (birds form most of the rest), with the Common Ringtail Possum, Greater Glider and Sugar Glider being the most favoured species (Blakers *et al.* 1984). Known from the Mundoonen Nature Reserve and near Collector.	Potential foraging habitat present onsite. Collision / avoidance impacts may apply. Only minimal woodland would be impacted by the proposal. **Moderate potential impact.**
Grass Owl *Tyto capensis* TSC V	Inhabits tall grassy areas, grassy woodlands, swampy areas, coastal heaths, sedges, cumbungi and crops such as sorghum, sugar cane and grain. It nests in grass tussocks or low shrubs (Pizzey and Knight 2003). Its core distribution is coastal, from northern NSW through QLD, although inland records occur particularly in QLD and NT (Pizzey and Knight 2003).	Suitable swampy habitat occurs to the east of the site, at Wet Lagoon. No potential habitat onsite. Potential impact may occur when moving between areas of habitat. **Moderate potential impact.**
Gang-gang Cockatoo *Callocephalon fimbriatum* TSC V	Feeds in pairs or small flocks on seeds of eucalypts and wattles, primarily in forest, but occasionally towns and farming areas for artificial food resources such as berry-bearing exotic shrubs. It is a seasonal altitudinal migrant. Nesting is in large tree hollows. Recorded approximately 6km south of the site.	Potential foraging habitat is marginal due to young age of trees and fragmentation but collision impacts may apply. Only minimal woodland would be impacted by the proposal. **Moderate potential impact.**
Swift Parrot *Lathamus discolour* EPBCe	A non-breeding winter migrant to southern and eastern NSW, where it inhabits eucalypt forests and woodlands (Blakers et al 1984). Feeds on eucalypt blossom and psyllids. No local records.	Marginal potential foraging and nesting habitat is present due to previous and ongoing site disturbance. Only minimal woodland would be impacted by the proposal. Collision and avoidance impacts may apply. **Moderate potential impact**.

Species	Habitat requirements and study area suitability	Potential to be impacted
Diamond Firetail *Stagonopleura guttata* TSC V	Occurs predominantly west of the Great Dividing Range (Blakers et al. 1984, Schodde and Mason 1999) although local populations are known. Feeds predominantly on the ground on grass seeds, in groups from 5 to 150 individuals (Schodde and Tidemann 1986), nesting in pairs or communally in shrubs and small trees. Restricted largely to ungrazed or lightly grazed woodland remnants of grassy eucalypt woodlands, including Box-Gum and Snow Gum Woodlands, and grassland and riparian areas, and sometimes lightly wooded farmland. May form large flocks during winter and autumn.	Potential foraging habitat is present. Collision and avoidance impacts may apply to this flocking species. Only minimal woodland would be impacted by the proposal. **Moderate potential impact.**
Speckled Warbler *Chthonicola sagittata* TSC V	Inhabits woodlands and dry forests, generally in inland Australia, particularly those with grassy understorey, often on ridges or gullies. Sedentary, living in pairs or trios and nests on the ground in grass tussocks, dense litter and fallen branches. Forages on the ground and in the understorey for arthropods and seeds. Occupy small remnants, but are yet to be recorded breeding in revegetated areas. Requires relatively intact woodland areas with litter and fallen timber. Locally recorded approximately 18km north of the site.	Marginal potential foraging and nesting habitat is present due to previous and ongoing site disturbance. Collision and avoidance impacts may apply. Only minimal woodland would be impacted by the proposal. **Moderate potential impact.**
Brown Treecreeper *Climacterus picumnus* TSC V	Occurs in eucalypt woodlands, mallee and drier open forest of eastern Australia, preferring woodlands lacking dense understorey (Schodde and Tidemann 1986). Feeds on insects in the leaf litter and trunks of trees. Nests in tree hollows, stumps or rotted fence posts. Requires relatively intact woodland areas, nesting in a tree hollow. Locally recorded in Mundoonen Nature Reserve.	Marginal potential foraging and nesting habitat is present due to previous and ongoing site disturbance. Collision and avoidance impacts may apply. Only minimal woodland would be impacted by the proposal. **Moderate potential impact.**
Regent Honeyeater *Xanthomyza phrygia* E EPBCe	Distributed through the eastern third of New South Wales, where it inhabits eucalypt forests and woodlands (Blakers et al. 1984). A generalist forager, feeding mainly on the nectar from a wide range of eucalypts (particularly prolifically flowering box and ironbark species) and mistletoes but also eats invertebrates and exotic fruits (Blakers et al. 1984). Key eucalypt species include Yellow Box and Blakely's Red Gum and Red Stringybark, which occur onsite. Large numbers can appear in an area to take advantage of a food source. Recorded locally at Goulburn.	Marginal potential foraging and nesting habitat is present due to previous and ongoing site disturbance. Collision and avoidance impacts may apply to this flocking species. Only minimal woodland would be impacted by the proposal. **Moderate potential impact.**

*Class

TSC E	listed as Endangered in NSW in Schedule 1 of the *Threatened Species Conservation Act 1995*
TSC V	listed as Vulnerable in NSW in Schedule 2 of the *Threatened Species Conservation Act 1995*
EPBCv	listed as nationally Vulnerable in the Commonwealth *Environment Protection Biodiversity Conservation Act 1999*
EPBCe	listed as nationally Endangered in the Commonwealth *Environment Protection Biodiversity Conservation Act 1999*
EPBCce	listed as nationally Critically Endangered in the *Environment Protection Biodiversity Conservation Act 1999*
EPBCcd	listed as nationally Conservation Dependent in the *Environment Protection Biodiversity Conservation Act 1999*

For these 15 species, an Assessment of Significance was conducted (Appendix D), as is required to characterise the impact of the proposal, under the *NSW Environmental Planning and Assessment Act* and the Commonwealth *Environmental Protection and Biodiversity Conservation Act*.

Significant impact is not anticipated as a consequence of the development for these species. For the Green and Golden Bell Frog, this assessment concluded that a high level of impact can be avoided through careful positioning of infrastructure and access routes and the adoption of standard weed and sediment erosion controls.

For the microchiropteran bats, birds of prey and woodland birds considered, risk of population level impacts exists through ongoing collisions with turbines. The surrounding habitat and local records as well as consideration of mortalities at existing wind farms suggest that the expected levels of collisions would not generate a population level impact however, given the paucity of long-term data available and the lack of rigour in monitoring at many existing wind farms, a level of uncertainty remains. The proposal should incorporate rigorous and properly timed monitoring of collision impacts and protocols so that action can be taken if unacceptable levels of mortalities occur onsite. Risks are discussed in more detail in Section 5.3.

5.2.5. Matters of national significance (EPBC Act)

Matters of national significance listed under the *Environment Protection and Biodiversity Conservation Act 1999* within a 30 kilometre buffer of the study site were investigated using the EPBC Act search tool (accessed 13 December 2005). As the works would not occur near nor affect creeks or rivers, only terrestrial species were investigated.

Threatened species returned from the search included:

- Swift Parrot
- Superb Parrot
- Australian Painted Snipe
- Regent Honeyeater
- Yellow-spotted Bell Frog
- Golden Sun Moth
- Pink-tailed Worm Lizard
- Striped Legless Lizard

The potential for these species to be impacted by the proposal was considered in Appendix C, Table C.2. All species were rated as low potential to be impacted by works except for the Swift Parrot (high potential impact), Superb Parrot (moderate potential impact) and Regent Honeyeater (moderate potential impact). An Assessment of Significance was carried out for these three species, Appendix D.2, in order to characterise the significance of the potential impact.

Significant impact is not anticipated as a consequence of the development for these species. The surrounding habitat and local records as well as consideration of mortalities at existing wind farms suggest that the expected levels of collisions would not generate a population level impact however, given the paucity of long-term data available and the lack of rigour in monitoring at many existing wind farms, a level of uncertainty remains. The proposal should incorporate rigorous and properly timed monitoring of collision impacts and protocols so that action can be taken if unacceptable levels of mortalities occur onsite. Risks are discussed in more detail in Section 5.3.

Non-threatened species returned from the search, including those listed as migratory species, include:

- White-bellied Sea-Eagle *Haliaeetus leucogaster (habitat may occur within the area)*
- White-throated Needletail *Hirundapus caudacutus (habitat may occur within the area)*
- Satin Flycatcher *Myiagra cyanoleuca (breeding likely to occur within the area)*
- Latham's Snipe *Gallinago hardwickii (habitat may occur within the area)*
- Painted Snipe *Rostratula benghalensis s. lat. (habitat may occur within the area)*
- Fork-tailed Swift *Apus pacificus (habitat may occur within the area)*
- Great Egret *Ardea alba (habitat may occur within the area)*
- Cattle Egret *Ardea ibis (habitat may occur within the area)*
- Rainbow Bee-eater *Merops ornatus (habitat may occur within the area)*

The potential for these species to be impacted by the proposal has been investigated in Appendix E: Bird impact risk assessment. The assessment also included other species known from the area and considered to be at risk. A species would be considered to have a high potential to be impacted if it were known from the area, could be considered to depend on the site (for either foraging or breeding) and displayed characteristics that placed it at risk of a population level impact (for example: flocking behaviour or low reproductive capacity).

No migratory species was categorised as having high potential to be impacted. The **Fork-tailed Swift** and **White-throated Needle-tail** were the only listed migratory species categorised as having greater than low potential to be impacted by the proposal (moderate and low-moderate potential, respectively).

Birds known from the area (but not returned on the Matters of National Significance search) which were categorised as having greater than a low potential to be impacted included the **Nankeen Kestrel, Brown Falcon, Australian Hobby and Wedge-tailed Eagle.**

Significant impact is not anticipated as a consequence of the development. For raptors, risk was related primarily to foraging activity. For the Fork-tailed Swift and White-throated Needle-tail the risk was related more to risk of collision during migration or long-distance movements. The latter risk is a non-mitigateable risk, although the presence of the turbines may deter individuals from the immediate danger area, and woodland exists to the immediate west (on the western slope of the site) that may provide a preferred movement corridor. The low quality of surrounding habitat as well as consideration of mortalities at existing wind farms suggest that the expected levels of collisions would not generate a population level impact however, given the paucity of long-term data available and the lack of rigour in monitoring at many existing wind farms, a level of uncertainty remains. The proposal should incorporate rigorous and properly timed monitoring of collision impacts and protocols so that action can be taken if unacceptable levels of mortalities occur onsite. Risks are discussed in more detail in Section 5.3.

5.3. Impact assessment

5.3.1. Construction impacts

Loss of habitat and habitat degradation are the key impacts of the construction phase. The development footprint of the proposed wind farm does not contain limiting or particularly significant breeding or foraging habitat for bird species. The site is dominated by birds of woodland edges (magpies, ravens) and also parrots whose foraging and nesting habitat would

only be minimally affected by the works. The turbine ridge sites have become a raptor hunting ground primarily due to the presence of rabbits and reptiles, which are common and widespread throughout the agricultural areas of the region.

Megachiropteran bats feed primarily on plant material (fruit, nectar or pollen) and roost in camps, usually near water, to take advantage of the microclimate. Onsite habitat is poor for megachiropteran bats. Fruit crops can attract megachiropteran bats; no fruit crops are present within close proximity of the site. No local records exist for any *Pteropus* species however, they can be wide ranging in response to fluctuating resources and it is possible they may occasionally travel over the site or utilise flowering eucalypts onsite for foraging.

Quality habitat does exist onsite for microchiropteran bats. These species can forage for insects in and around the canopy as well as high above the canopy. Suitable foraging habitat is present on the wooded slopes and ridges of the site. Even isolated paddock trees in farm land are used extensively as foraging resources for these species and this may have benefits in terms of regulating herbivorous insects on these trees (Lumsden and Bennett 2004). Abundant insect activity was observed across the site during survey work. The types of roost sites preferred vary dependent on species and include tree hollows, crags in rocks, caves as well as built structures including bridges and houses. While the woodland vegetation onsite is regrowth, some hollows in mature eucalypts were observed in the gullies near Transect E and Areas 6 and 7, providing roost sites for several species of bat that may occur onsite. No caves or rock crags were observed onsite.

As the turbine locations are proposed for sites that are largely cleared of vegetation (refer to Figure 4.1), the impact to the amount and quality of foraging and roosting habitat onsite would be minimal. However, turbine locations near Transects C and H appear to encroach on potential habitat. While Transect C has limited potential due to its age and previous disturbance, Transect H provides more intact native habitat and occurs near potential roost sites (Area 6).

Assessment of the significance of impact has determined that only a low level of impact would occur as a consequence of activities that would alter habitat onsite. Habitat degradation resulting from the construction of the project is readily avoided and controlled using standard best-practice mitigation methods (sediment and erosion controls, noise controls, weed controls). This would minimise the impact to fauna onsite during construction.

In general, if the locations of works (including temporary activities such as the concrete batching plant) are situated in already cleared areas featuring largely exotic vegetation (which provides low habitat resources) loss of habitat as a result of the works will be low. It is recommended that:

- Measures should be implemented to reduce the impact on native vegetation, as detailed in Section 4.3.
- Dams and wet depressions on the ridge line should be filled to remove the potential to attract microbats, waterbirds and prey for raptors.
- The existing disturbance (slab and cleared area) 400m from the intersection with the Hume Highway on the east of Lerida Road North, could be used for a concrete batching plant. The site is located at the northern end of the first EEC patch. A few yellow box saplings and one or two trees less than 20 years old overhang the existing slab and may need to be lopped, plus one mature red stringybark with branches leaning towards the road. The understorey here is dominated by annual exotic grasses with the better quality groundcover present on the western side of the road.
- Avoid clearing woodland (particularly near Transects E and H and in Areas 6 and 7).

- Avoid clearing isolated paddock trees (these can be used extensively for foraging in fragmented landscapes).
- Retain all hollow bearing trees and locate infrastructure at the maximum distance possible from them, to avoid disturbance to roosting individuals (particularly near Transect E and Areas 6 and 7).

5.3.2. Operational impacts

The key impacts anticipated to affect native fauna are related to the operational phase of the wind farm. While construction impacts can be quantified in terms of impact area before site development, operational impacts are largely speculative, being drawn on past experiences at other sites and from what is known of the ecology of different species at risk of collision with wind farm infrastructure.

When considering faunal impacts of operational wind farms, bird and bat strike are the foremost concerns, as inappropriately located turbines have the potential to cause frequent and large numbers of mortalities, and may lead to population level impacts. For species that occur at low density in the landscape, relatively low mortality rates can also constitute a threat to a local population. Impacts on birds and bats are discussed separately, below.

Bird impacts

The following discussion presents a brief review of relevant experiences at other wind farm development sites, in Australia and overseas, and an assessment of risk to birds from the proposed wind farm development on the Cullerin Range. The assessment draws on the Interim Standards for Risk Assessment relating to birds and wind farms (Brett Lane and Associates 2005), the Australian Standards for Risk Assessment (AS/NZS 4360) and Environmental Risk Management (HB203:2000).

The risks from the operational wind farm to birds at the Cullerin site are considered in two categories:

- Direct impacts of blade strike;
- Indirect impacts on habitat and habitat utilisation.

The assessment focuses on bird groups which have been shown to be at particular risk in studies at other wind farms (raptors, waterbirds, migratory species) or are threatened or protected species identified in relation to the study area.

Direct impacts (blade strike)

A number of factors may operate which affect risk by contributing to either the likelihood of collision with blades, or the significance of the consequences of blade strike (for example, the likelihood of a population level impact due to high numbers of mortalities). These factors may be related to the characteristics of particular species, sites or development designs.

Behavioural traits and biology/physiology

Some aspects of bird behaviour may increase the risk of blade strike. Because of the predominantly cleared character of the surrounding landscape, species at most risk are those which forage or fly over open farm country at blade height (32-126m above the ground).

This includes species foraging, moving between foraging habitats, or making seasonal or nomadic long-distance movements. Risks are heightened when flying occurs during periods of reduced visibility, such as dusk or night travel. Some waterbirds gather and form large circling flocks at night or dusk. Birds may be at greater risk if flight behaviour involves large and/or tight flocking patterns.

In studies of bird mortalities from colliding with powerlines in the Hunter Valley, species most at risk were identified as those with large bodies and awkward flight characteristics, species which fly in tight and/or fast-moving flocks and night-flying species (URS 2004). In this case, powerlines were located close to a major roosting/nesting site, and 12-42 metres above the ground. Pelicans, White Ibis and Swans were most affected.

Some species groups appear disproportionately vulnerable to blade strike. Ravens for example only rarely collide with turbines, while other species (such as raptors) seem to be disproportionately affected (Anderson *et al.* 1999, Thelander *et al.* 2003). Northern hemisphere studies point to three groups which are most vulnerable to blade strike; gulls, raptors and migrant songbirds (Airiola 1987, cited in Canada Bird Studies 2001).

For biological or physiological reasons, it has been suggested that some species may not be able to see rotating blades ('motion smear'). Raptors appear to have no difficulty avoiding turbines when simply flying or soaring (Canada Bird Studies 2001). It has been suggested that some raptors may focus intensely on prey beyond the turbine without perceiving the blades (Thelander *et al.* 2003), although raptor eyes do have two foveal regions allowing focusing on the horizon as well as downwards (Hodos *et al.* 2001, in Canada Bird Studies 2001).

Population factors and conservation status

Species which are rare or declining, or which are naturally distributed at low density in the landscape (such as top order raptors) may be at greater risk because, while collision rates may be low, each mortality has a higher significance. Similarly, species with low reproductive rates, or poor capacity to disperse and recolonise habitats may be at greater risk of significant impacts from blade collisions at the population scale.

Local weather patterns

Many studies have shown that poor weather conditions increase the occurrence of turbine collisions (Canada Bird Studies 2001). Weather conditions which reduce the ability of birds to perceive the turbine blades or avoid collisions (such as fog and strong winds) add to risks for susceptible species. In the case of strong winds, turbines would be shut down, thereby greatly reducing the risk however, turbines will be located in high topographic positions in the landscape and will therefore be subject to low cloud cover, reducing visibility.

Relative location of habitat and prey sources

The relative location of key habitat areas (such as updraft zones, prey populations, wetlands and nesting sites) and natural diurnal and seasonal migration routes also affects risks to birds. The capacity of bird populations to 'habituate' to the turbines, and adjust life cycle behaviours accordingly, appears to vary between areas and species.

One Wedge-tailed Eagle was observed close to the proposed turbine ridges at the site. It was noted that the site supports active rabbit and hare populations, which are likely to form a major proportion of the diet of this species in the area. Prey would be reduced by not grazing lambs near the ridges and by ongoing rabbit control. Small farm dams and ephemeral wetland habitats are present in the immediate area and surrounding farmland. Possible flight paths for waterbird species in the wider study area, based on topography, connectivity and habitat, are indicated on Figure 5.2. Woodland remnants are present onsite and particularly to the north of the site as well as scattered paddock trees and linear treed border along some roads. The principal flight paths for woodland species are likely to follow contiguous woodland, particularly where they occur in valleys and lowland areas carrying water sources. These are rare in the area, with grasslands predominating on the flats.

Development structural factors

Structural characteristics of the development, such as the presence of guy lines (Erickson *et al.* 2001), aerial cabling and perching opportunities may also be critical factors affecting the frequency of bird collision. Lattice structures in particular attract perching species such as raptors (Bird Studies Canada 2001). At Altamont Pass in the United States, 55% of raptors were killed by striking a blade, 8% from electrocution, 11% from wire collision and 26% from unknown causes (Orloff and Flannery 1992, cited in Canada Bird Studies 2001). In the US, some warning lights on towers have been shown to attract migrating birds at night (Cochran and Graber 1958, cited in Canada Bird Studies 2001), possibly because they are used as references for navigation or because they attract insect prey. Kerlinger and Kerns (2003) found that red flashing lights did not attract night migrating birds and that turbines could have lower collision rates than other telecommunications and power infrastructure due to the absence of guy wires.

Experiences at existing wind farms

Wind farm impacts are usually site-specific and species-specific. Nonetheless, there are a growing number of studies and monitoring programs in Australia and overseas which provide some insight into the nature and scale of potential risks to birds from wind farms.

A recent review of overseas wind farms showed low mortality rates for most wind farms (Langston and Pullen 2002). On average for all birds, new power generation projects in the US (outside California) have recorded three fatalities per megawatt per year (Erikson *et al.* 2001). A review of European and North American wind farms indicates that most wind farms in agricultural settings affect between two and four birds per generator per year (Lane and Associates 2004). However, the most commonly recorded bird group to collide with European and North American generators were night-migrating songbirds, of which there are comparatively few in Australia.

Looking at wind farms in Europe, Winkelman (1994) produced an estimated average of 0.04 to 0.09 mortalities per turbine per day. Winkelman (1994) concluded that the number of birds killed per unit of energy produced is low compared to other human-related causes of death (for example, vehicle collision and power line electrocution).

Monitoring research at the three operational wind farms in Victoria has recorded no rare, threatened or endangered birds or bats killed by wind turbines to date. Searches conducted by Biosis Research for dead birds around seven turbines at the Codrington Wind farm (Victoria) showed three bird deaths and one bat death, attributable to impact with wind turbines. The species concerned were the introduced skylark (1), Richard's pipit (1), Australian magpie (1) and white-striped mastiff bat (1), all of which occur onsite at Cullerin. Incidental carcass finds showed two further deaths; one adult brown falcon and one white-striped mastiff bat. The estimated total number of deaths likely from Codrington's 14 turbines over one year is 18 to 38 birds, or 1.2 to 2.7 birds per turbine per year (Brett Lane and Associates 2005). This is a similar sized wind farm, although collision numbers can be expected to be site specific.

At the Toora Wind Farm in Victoria, no bird carcasses were found during a year of monitoring or during informal inspections. Wedge-tailed Eagles were regularly observed before and after operations began at this site. Eagles were observed to avoid the turbines by flying around or between them (Brett Lane and Associates 2005). A study at Codrington also found that all birds approaching the turbines were observed to take avoidance action, by flying over, around or under the rotating turbine blades (Biosis Research 2002). However, a Wedge-tailed Eagle mortality was recorded at a wind farm in Tasmania during inclement weather (Woolnorth, Hydro Tasmania).

Indirect impacts (habitat utilisation)

In Europe, the indirect effects of wind farms on habitat utilisation are considered to have a greater impact on birds than collision mortality. European studies suggest that most displacement involves migrating, resting and foraging birds (Strickland 2004). Studies have reported displacement effects ranging from 75 metres to as far as 800 metres away from turbines.

Winkelman (1994) found that resident birds avoided turbines at distances of 250-500 metres. This is likely to reduce the risk of bird mortality but may restrict birds from accessing nearby resources. Habituation to turbines over time has also been recorded (Still *et al.* 1995, cited in Lane and Associates 2004). In contrast, a study of raptors' responses to wind development show a similar number of raptor nests before and after wind plant construction at Montezuma Hills, California (Howell and Noone 1992, cited in Strickland 2004).

Wind farm developments have the potential to indirectly affect bird populations by:

- Alienating and fragmenting breeding or foraging habitat,
- Altering migration behaviour.

The proposal is unlikely to influence the movement of waterbirds along wet corridors (most likely route occurs 4km to the east; refer to Figure 5.2) but may be more likely to influence the movement of woodland birds who travel in a north-south direction along the Cullerin Range. The site represents the southern limit of woodland which extends several kilometres north into forest and woodland of the Great Dividing Range. Thus, the proposal would not fragment but may restrict the length of the habitat available for woodland birds, if they avoid the woodland onsite due to the presence of the turbines. While little information is available pertaining to the seasonal and diurnal migration routes for bird species at the site, it is not known to be a migration corridor for waterbirds or woodland species. Furthermore, the fragmented habitat and abundance of aggressively territorial species (magpies, white winged choughs, ravens) suggests the area would not be preferred habitat for other woodland birds.

A range of mitigation measures is available for incorporation into the site selection, development design, construction and operational stages. Some of these measures are speculative and have not been rigorously tested.

- Mature and hollow-bearing trees should be avoided.
- Power poles and overhead powerlines should be bird-safe using flags or marker balls, large wire size, wire insulation, wire and conductor spacing.
- Marker lights, if required should be minimised in number and fitted to reduce their ability to attract migrating birds and insects. Red lights are preferred, with the least number of flashes per minute. Cowls may also shield the light when viewed from the ground and reduce potential to attract wetland birds taking off at dusk.
- Guy lines should not be fitted to towers or associated structures, where possible.
- The turbine towers should not provide perching opportunities.
- Electrical connection lines should be installed underground where possible.
- To reduce the attractiveness of the ridge to foraging raptors, rabbits should be controlled on the turbine ridges, carrion should be removed from the site as quickly as possible, and young lambs should not graze on the turbine ridges.
- Ongoing and regular inspection and monitoring should be undertaken to document mortalities and remove carcasses and assess the effectiveness of rabbit control.

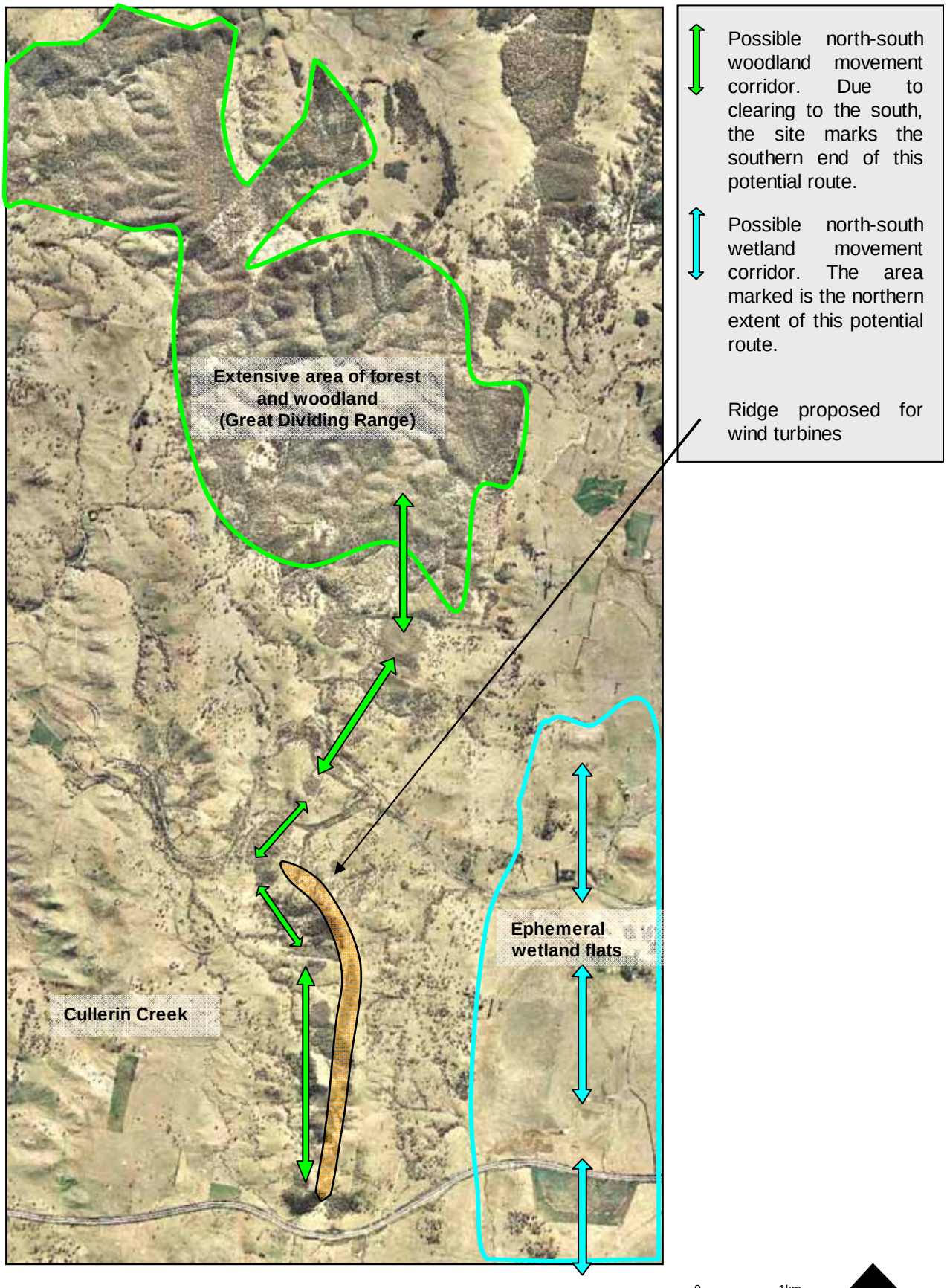

Figure 5.2 Possible flight paths of migrating birds

The site appears to mark the end of the north-south vegetated corridor linking to the more dense and extensive woodland and forest to the north. The wetland corridor to the east of the site may extend further south to Lake Bathurst and Lake George.

- If mortalities exceed a pre-determined threshold, additional mitigation measures should be considered, such as diversion structures, blade painting (refer Hodos *et al.* 2001), turning off turbines at critical times, further turbine ridge habitat modification and enhancement of off-site habitats and prey populations.

Bat impacts

Foraging and roosting behaviour as well as long-distance movements are key issues to consider when assessing the impact of operational wind farms on bats (Australian Bat Society Newsletter, Nov. 2005). Mega and microchiropteran species can both be expected to be affected.

Collision

The likelihood of collision can be assumed to relate to both the characteristics of the species of bat as well as to environmental factors. Characteristics which may affect the susceptibility to collision of an individual include its manoeuvrability, foraging height, long-distance flying height and reaction to the new infrastructure. External variables which may affect the potential for collision include wind speeds and weather, proximity to foraging and roosting resources and proximity to other landscape features which may affect the movements of bats.

Internal factors

Bats niche partition within their foraging habitat; some forage low in the canopy, some within or just above the canopy and others 100m or more above the canopy. Wing morphology reflects the difference in manoeuvrability required in these different environments. Bats that fly rapidly but are not very manoeuvrable are suggested to be less able to avoid collisions with wind farms (Erickson *et al.* 2002). Bat collision with wind turbines was first documented in Australia, where 22 White-striped Freetail bats (*Tadarida australis*) collided with wind turbines over a 4-year period (Hall and Richards 1972, cited in Erickson *et al.* 2002.). This species occurs onsite and may be uniquely vulnerable to wind turbine collisions due to its high flight and a low rate of echolocation call emission (Herr and Klomp 1997, cited in Rhodes 2001).

Vision, as well as manoeuvrability, affects the risk of collision. Erickson *et al.* (2002) suggest that individuals most at risk appear to be migrating bats; migrating bats may navigate without use of echolocation, depending on vision, rather than echolocation.

> "If bats are flying through wind farms by sight only, then causes of bat mortality could be similar to causes of avian collision mortality at wind plants" (Erickson *et al.* 2002).

Monitoring of wind farms has shown that bats investigate the blades and blade area of turbines and that, while collisions do occur, bats are able to avoid the blades on most occasions (Australian Bat Society 2005). Therefore, it appears that bats foraging and investigating turbines and using echolocation appear more able to avoid turbines that those migrating by sight alone over less familiar territory.

Many microchiropteran bat species hibernate or aestivate during cold periods to reduce their energetic requirements when resources are low. In a compilation of survey results for wind farms in the United States, most bat mortality documented occurred in late summer and autumn (nearly 90% from mid-July through mid- September) with most fatalities attributed to migratory tree bats with no pattern in distribution to suggest the victims were local bats commuting from roosting to foraging areas (Erickson *et al.* 2002). Resource abundance at this time would be expected to be high and bats requiring fat stores for aestivation would need to take advantage of the resource pulse and may migrate in order to do so. Cold periods are likely to pose less of a collision risk than summer and autumn months.

External factors

Many species use linear features in the landscape while commuting (Limpens and Kapteyn 1991, cited in Erickson *et al.* 2002) and migrating (Humphrey and Cope 1976, Timm 1989, cited in Erickson *et al.* 2002). German studies have shown higher collision rates from turbines located near hedgerows (Australian Bat Society 2005). It is possible that the Cullerin Range is one such linear feature potentially used by migrating bats.

Although the association between other structures and bats is not well understood, evidence suggests that most bat collisions with other man-made structures occur during migration and that these are normally associated with inclement weather (Erickson *et al.* 2002). A feature of wind turbines is that in very high wind speeds, when risk of collision could be assumed to be higher, turbines shut down and blades remain stationary, thereby also mitigating against the increased risk of collision with species on the wing.

Lights on turbines may increase the probability of bat collisions, as insect abundance is higher under lights (Erickson *et al.* 2002). This is also able to be mitigated against in many circumstances, by using low wattage, red, intermittent lighting and using the least number of lights required.

Avoidance of habitat

It is unlikely that the proposal would affect the amount or quality of habitat onsite to a large degree however, it is possible that the noise and turbulence around turbines may preclude species from using areas close to the turbines. Infrastructure that is lit at night may even increase the abundance of insects and therefore the number of bats the site is able to support. As discussed above, this would not be desirable, as it could increase the risk of collision.

For the reasons stated above, it is more likely that migrant bats will be affected by avoidance impacts, if they should occur. If the Cullerin Range represents a linear movement corridor for migrating bats, avoidance has the potential to adversely impact a large number of individuals, through increased energetic cost, for example. Seen in the aerial photo (refer to Figure 5.3), the woodland pockets give the ridge a fragmented appearance. Nonetheless, to highly mobile species such as bats, it could represent the southern limit of a woodland corridor. Without extensive seasonal surveying (which may still be inadequate due to the height of migrating individuals) it is difficult to determine whether the range is utilised as a migration path and therefore to quantify the risks.

Population level impacts

Little quantitative research exists about collision or avoidance risks to bats in Australia. The limited and disparate survey effort generally completed for impact assessment prior to project developments is inadequate to answer broader research questions such as the locations of migration paths, which species are most vulnerable, what deterrent options are available (Australian Bat Society Newsletter, Nov. 2005) which in turn restricts the ability of environmental assessors to rule out significant impact to these species.

While onsite foraging and roosting resources can be preserved and while the threat to resident bats appears low, the potential to impact migrating bats which use visual means over echolocation to navigate along linear features in the landscape, appears much higher. If these individuals are migrating to maternity roosts, the potential to affect the local population would be greater still.

Erickson *et al. (*2002) in a North American study, state that based on available data bat collisions during the breeding season are virtually non-existent. Further, North American research has shown that most bat collisions have occurred with adult bats, hence collisions were not thought to be

attributed to juveniles dispersing (Australian Bat Society 2005). These observations suggest that a population level impact would be unlikely however, due to the paucity of information available on the migration paths of Australian bats, it is difficult to quantify the impact.

To minimise impacts related to bats, the following recommendations should be implemented:

- Monitor collision rates in summer and autumn. This is the time of year when many species migrate and therefore would provide information on the upper level of impact generated by the proposal.
- If mortalities exceed a pre-determined threshold, additional mitigation measures should be considered, such as turning off turbines at critical times.
- Marker lights, if required should be minimised in number and fitted to reduce their ability to attract insects. Red lights are preferred, with the least number of flashes per minute.

5.3.3. Decommissioning impacts

Decommissioning of the wind turbines would involve similar impact types to the construction phase. A reduced level of impact is anticipated however, as all below-ground structures (footings, concrete slabs, underground cabling) would remain insitu reducing the amount of excavation required and associated environmental impacts to soil, water and native vegetation. The required stabilisation of disturbed soil would relate primarily to the redevelopment of vehicle tracks and hard stand areas.

To minimise impacts, the following recommendations should be implemented:

- Weeds and sediment erosion control principles should be developed and implemented.
- Disturbed ground should be stabilised and rehabilitated as soon as practicable after works.

6. CONCLUSION AND RECOMMENDATIONS

The proposed development has potential to generate environmental gains, primarily through positively addressing a process recognised in New South Wales as a Key Threatening Process; Anthropogenic Climate Change. Climate change will add to existing stresses on biodiversity, contributing to degradation and fragmentation of natural ecosystems, increased fire frequency, soil erosion and dryland salinity, causing some systems to exceed critical thresholds (Pittock 2003). However, through clearing and installation of infrastructure, direct and indirect impacts as a consequence of the development of the wind farm could be generated to onsite and local biodiversity.

The potential of the proposal to adversely affect the biodiversity of the site and locality and particularly those species, populations and communities listed as threatened has been considered by this report. In conclusion, the key constraints and mitigation strategies considered necessary to reduce the potential impacts to an acceptable level are outlined below. Impacts would be predominantly in the short-term for flora while ongoing impacts are more relevant to fauna on the wing.

6.1. Flora

In general, impacts on the Yellow Box, Blakely's Red Gum Woodland EEC and threatened species habitat will be minimal on the ridge top and substation site, due to the degraded state of remnants in these areas. However, better quality remnants occur onsite and access routes should be developed in consideration of this limitation. There is scope to avoid these sensitive areas when planning the access routes. Specific strategies to reduce impacts to an acceptable level are summarised below for each phase of the development:

6.1.1. Construction

- The Northern Slope contains an area of higher quality EEC where Yellow Box, Blakely's Red Gum Woodland occurs with a grassy understorey. This area is of moderate conservation significance and should be protected from any impact during the proposed works (NS, Figure 4.1).
- The Yellow Box, Blakely's Red Gum Woodland EEC may be interpreted as being present elsewhere onsite (illustrated on Figure 4.1) in areas with shallow, rocky soils and among trees, where native grasses (mostly *Austrostipa scabra ssp falcata* and *Austrodanthonia spp)* are dominant. These remnants are small and scattered and would be very difficult to map. They have low species diversity and are regarded by this assessment to be of lower conservation significance.

  In general, if infrastructure placement and access trails were placed to avoid treed areas and isolated paddock trees, impact to this community would be largely avoided. However, as this remnant vegetation still fits within the definition of the EEC, additional surveying should be conducted once road access route options are pegged and the required road width is determined. The placement of access trails and installation of infrastructure in better quality areas could then be avoided. Target areas to survey would be the southern access point (the first 50m from Lerida Road North turnoff) as well as any works proposed on Lerida Road North and Old Sydney Road.

An addendum was completed in January 2006, addressing this point. Recommendations for specific parts of the proposed route are made in order to avoid unacceptable impacts on the EEC (Appendix G: Follow-up assessment of access routes).

- The southern road verge of the Old Sydney Road from the corner of the Old Hume Highway extending 100m west should be protected from impact during road works to access the northern end of the site. This potentially provides habitat for the Buttercup Doubletail *Diuris aequalis* (mapped on Figure 4.1), and is a relatively undisturbed Widespread Tablelands Dry Shrub/ Tussock Grass Forest remnant with good native species diversity and relatively few weeds. Some areas on the northern road verge also have potential, particularly west of the gully crossing on Old Sydney Road (mapped on Figure 4.1) and should be avoided (further survey work described by the previous point will cover this area also, if it will be impacted by works).
- The existing disturbance (slab and cleared area) 400m from the intersection with the Hume Highway on the east of Lerida Road North, could be used for a concrete batching plant. The site is located at the northern end of the first EEC patch. A few yellow box saplings and one or two trees less than 20 years old overhang the existing slab and may need to be lopped, plus one mature red stringybark with branches leaning towards the road. The understorey here is dominated by annual exotic grasses with the better quality groundcover present on the western side of the road.
- Weed and sediment erosion controls should be implemented to prevent onsite habitat degradation during and following the proposed works.
- After the installation of the infrastructure, disturbed soil should be rehabilitated as soon as practicable in order to resist erosion and colonisation by weeds. This may require restricting stock access and implementing revegetation activities.

6.1.2. Operation

- All vehicles onsite would follow established trails and minimise onsite movements.
- Weed controls (including long-term monitoring) should be implemented to prevent onsite habitat degradation during the proposed works.
- Chemical, including fuels and lubricants, would be stored and handled as per manufacturer's instructions. Where practical, they would be stored offsite. Where they must be stored onsite, they would be housed in a secure building bunded to contain any leakages.
- Turbines would be bunded to accommodate the full capacity of the lubricants contained within.

6.1.3. Decommissioning impacts

- Weed and sediment erosion controls should be implemented to prevent onsite habitat degradation during and following the proposed works.
- Disturbed soil would be stabilised and rehabilitated as soon as practicable after works.

6.2. Fauna

Although the site is considered only marginal habitat due to its fragmentation, low amount of mature vegetation and low native species diversity, potential habitat for fifteen threatened fauna species and two migratory species occurs on or close to the subject site. Habitat degradation can be minimised through careful positioning of infrastructure and access routes and the adoption of standard weed and sediment erosion controls. However, for several microchiropteran bats, birds of prey and woodland birds, potential for population level impacts exists through collisions with turbines. The surrounding habitat and local records as well as consideration of mortalities at existing wind farms suggest that the expected levels of collisions would not generate a population level impact however, given the paucity of long-term data available and the lack of rigour in monitoring at many existing wind farms, a level of uncertainty remains. Threatened species identified by this report as being at increased risk include the Eastern False Pipistrelle, Eastern Bent-wing Bat, Eastern Long-eared bat, Large-footed Myotis, Square-tailed Kite, Powerful Owl, Grass Owl, Gang-gang Cockatoo, Swift Parrot, Superb Parrot, Diamond Firetail, Speckled Warbler, Brown Treecreeper and Regent Honeyeater. Migratory species at increased risk include the Fork-tailed Swift and White-throated Needle-tail. Specific strategies to reduce impacts to an acceptable level are summarised below for each phase of the development:

6.2.1. Construction

- Important habitat features onsite included hollow-bearing trees, gully systems, wetlands and the connectivity between woodland remnants. The development should seek to maintain or improve these habitat features.
- Several farm dams are present onsite, while these appear to have been artificially constructed, they nonetheless provide a resource to aquatic and terrestrial fauna. Two occur near the ridge and would be better filled in so that microbats, water birds and prey for raptors are not unduly attracted to the ridge. Replacement dams could be constructed further from the ridge (approximately 200m) to retain the site's habitat resources and stock watering points.
- Clearing of woodland (particularly near Transects E and H and in Areas 6 and 7; Figure 5.1) and isolated paddock trees should be avoided. These can be used extensively for foraging in fragmented landscapes.
- Power poles and overhead powerlines should be bird-safe using flags or marker balls, large wire size, wire insulation, wire and conductor spacing.
- Marker lights, if required should be minimised in number and fitted to reduce their ability to attract migrating birds and insects. Red lights are preferred, with the least number of flashes per minute. Cowls may also shield the light when viewed from the ground and reduce potential to attract wetland birds taking off at dusk.
- Guy lines should not be fitted to towers or associated structures, where possible.
- The turbine towers should not provide perching opportunities.
- Electrical connection lines should be installed underground where possible.

6.2.2. Operation

- A population level impact to species on the wing would not happen in a short time frame; ongoing collision events would be required. The uncertainty about a population level impact should be addressed through rigorous and properly timed monitoring of collision impacts and development of protocols so that action can be taken if unacceptable levels of mortalities occur onsite.

- If mortalities exceed a pre-determined threshold, additional mitigation measures should be considered, such as diversion structures, blade painting (refer Hodos *et al.* 2001), turning off blades at critical times, further turbine ridge habitat modification and enhancement of off-site habitats and prey populations.
- To reduce the attractiveness of the ridge to foraging raptors, rabbits should be controlled on the turbine ridges, carrion should be removed from the site as quickly as possible, and young lambs should not graze on the turbine ridges.

6.2.3. Decommissioning impacts

- Weed and sediment erosion control principles should be developed and implemented.
- Disturbed soil should be stabilised and rehabilitated as soon as practicable after works.

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APPENDIX A: FLORA LIST

A.1: Plant species list for the site

Relative abundance is given by a cover abundance scale (modified Braun-Blanquet):

1 1 to a few individuals present, less than 5% cover

2 many individuals present, but still less than 5% cover

3 5 - < 20% cover

4 20 - < 50% cover

5 50 - < 75% cover

6 75 - 100% cover

Cover/abundance scores relate to general abundance over the entire site, not to representative quadrats. *Introduced species are preceded by an asterisk.

Location:

Low low site quality areas, dominated by exotic pasture grasses (majority of site)

Mod higher proportion of native species in groundcover (composite list from several areas)

Off species recorded adjacent to site in areas which could be affected by the proposal (eg adjacent road verges near access points)

Table A.0.1 Flora species list

Scientific name	**Common name**	**Family**	**Abundance**		
			Low	**Mod**	**Off**
TREES					
Acacia deanei ssp. paucijuga	green wattle	Fabaceae	1		1-3
Acacia implexa	lightwood or hickory	Fabaceae		1	
Brachychiton populneus	kurrajong	Sterculiaceae		1	
Eucalyptus blakelyi	Blakely's red gum	Myrtaceae	1	1	0-3
Eucalyptus bridgesiana	apple box	Myrtaceae		1	
Eucalyptus dives	broad-leafed peppermint	Myrtaceae	0-2	0-2	0-3
Eucalyptus macrorhyncha	red stringybark	Myrtaceae	0-2	0-2	0-2
Eucalyptus mannifera	brittle gum	Myrtaceae	0-2	0-3	1-4
Eucalyptus melliodora	yellow box	Myrtaceae	0-2	0-2	0-3
Exocarpos cupressiformis	native cherry	Santalaceae		1	1
SHRUBS, SUB-SHRUBS					

Scientific name	**Common name**	**Family**	**Abundance**		
			Low	**Mod**	**Off**
Acacia dealbata ssp dealbata	silver wattle	Fabaceae	1		1-2
Acacia gunnii	ploughshare wattle	Fabaceae			1
Amyema pendulum	a mistletoe	Loranthaceae	1	1	
Brachyloma daphnoides	daphne heath	Epacridaceae			0-2
Cassinia arcuata	sifton bush	Asteraceae			1
Daviesia leptophylla		Fabaceae			1-3
Dillwynia sericea		Fabaceae			1
Hibbertia obtusifolia	guineaflower	Dilleniaceae		0-2	1-3
Melichrus urceolatus	urn heath	Epacridaceae			1
Muellerina eucalyptoides	a mistletoe	Loranthaceae	1	1	
Pimelea curviflora var sericea	curved rice-flower	Thymeleaceae		1	1-4
**Rubus ulmifolius*	blackberry	Rosaceae	1		
VINES AND TWINERS					
Convolvulus erubescens	bindweed	Convolvulaceae			1
Glycine tabacina		Fabaceae		1	1
Hardenbergia violacea	native sarsaparilla	Fabaceae			2
FORBS					
Acaena echinata		Rosaceae		0-2	
**Acetosella vulgaris*	sheep sorrel	Polygonaceae	0-3	0-2	
**Arctotheca calendula*	capeweed	Asteraceae	1-4	0-2	
Calocephalus citreus	lemon beautyheads	Asteraceae			1
**Carduus pycnocephalus*	slender thistle	Asteraceae	1		
**Carduus tenuiflorus*	winged slender thistle	Asteraceae	1		
**Carthamus lanatus*	saffron thistle	Asteraceae	1		
**Cerastium glomeratum*	chickweed	Caryophyllaceae	0-2		
Cheiranthera cyanea	finger flower	Pittosporaceae			0-2
**Chondrilla juncea*	skeleton weed	Asteraceae	1		
Chrysocephalum apiculatum	yellow buttons	Asteraceae		1	0-4

Scientific name	**Common name**	**Family**	**Abundance**		
			Low	**Mod**	**Off**
Cotula alpina		Apiaceae	1	1	
Crassula sieberiana	Australian stonecrop	Crassulaceae		0-2	
Cynoglossum australe	hound's tongue	Boraginaceae		1	
Desmodium varians	slender tick trefoil	Fabaceae		1	
Dianella revoluta	blue flax lily	Phormiaceae			0-4
Drosera peltata ssp peltata	sundew	Droseraceae		0-2	
**Echium plantagineum*	Paterson's curse	Boraginaceae	1		
Einadia nutans		Chenopodiaceae		1	
**Erodium cicutarium*	common storksbill	Geraniaceae	2		
Euchiton gymnocephalus	slender cudweed	Asteraceae		1	
**Galium aparine*	cleavers	Rubiaceae		1	
Gonocarpus tetragynus	raspwort	Haloragaceae		0-2	1-2
Goodenia hederacea ssp hederacea		Goodeniaceae		1-2	1-2
Goodenia pinnatifida		Goodeniaceae			1
Hydrocotyle laxiflora	stinking pennywort	Apiaceae	1	0-3	1-2
**Hypochaeris radicata*	cat's ear, flatweed	Asteraceae	2	2	
Leptorhynchos squamatus ssp A	scaly buttons	Asteraceae			1
**Onopordum acanthium*	Scotch thistle	Asteraceae	0-2		
Oxalis perennans	native oxalis	Oxalidaceae		1	
**Parentucellia latifolia*	red bartsia	Scrophulariaceae	1		
**Petrorhagia nanteuilii*	proliferous pink	Caryophyllaceae	0-2	0-2	
Plantago varia		Plantaginaceae		1	
Poranthera microphylla		Euphorbiaceae		0-2	0-2
Rumex brownii	native dock	Polygonaceae	2	2	
Scleranthus fasciculatus	knawel	Caryophyllaceae		1	
**Silene gallica*	French catchfly	Caryophyllaceae	1		
**Silybum marianum*	variegated thistle	Asteraceae	1		
Solenogyne dominii		Asteraceae		1	
**Sonchus asper*	prickly sow thistle	Asteraceae	1		

Scientific name	**Common name**	**Family**	**Abundance**		
			Low	**Mod**	**Off**
**Spergularia rubra*	sand spurry	Caryophyllaceae	1		
**Stellaria media*	common chickweed	Caryophyllaceae	1		
Stellaria pungens	prickly starwort	Caryophyllaceae		0-4	0-3
Stylidium graminifolium	trigger plant	Stylidiaceae		1	
Tricoryne elatior	yellow rush lily	Anthericaceae		0-2	0-4
**Trifolium arvense*	hare's foot clover	Fabaceae	1	1	
**Trifolium campestre*	hop clover	Fabaceae	0-4	0-2	
**Trifolium dubium*	suckling clover	Fabaceae	0-4	0-2	
**Trifolium glomeratum*	ball clover	Fabaceae	1		
**Trifolium spp*	unidentified clovers	Fabaceae	0-5	1	
Triptilodiscus pygmaeus		Asteraceae		1	1
Wahlenbergia communis	tufted bluebell	Campanulaceae	1	0-2	
Wahlenbergia gracilis	sprawling bluebell	Campanulaceae		1	
Wahlenbergia luteola		Campanulaceae		0-2	
Wahlenbergia multicaulis	Tadgell's bluebell	Campanulaceae	1		
GRASSES					
**Aira sp.*	hair grass	Poaceae	1-4	1-4	
Aristida ramosa		Poaceae		1	
Austrodanthonia auriculata	wallaby grass	Poaceae	0-2	0-4	
Austrodanthonia carphoides	wallaby grass	Poaceae	0-2	0-4	
Austrodanthonia eriantha	wallaby grass	Poaceae	0-3	0-3	
Austrodanthonia pilosa var. pilosa	wallaby grass	Poaceae	1	1	
Austrodanthonia racemosa var. racemosa	wallaby grass	Poaceae	0-2	0-2	
Austrostipa densiflora		Poaceae		1	
Austrostipa scabra ssp falcata	corkscrew grass	Poaceae	0-2	0-3	
**Briza maxima*	quaking grass	Poaceae	0-3	0-4	0-4

Scientific name	**Common name**	**Family**	**Abundance**		
			Low	**Mod**	**Off**
**Briza minor*	shivery grass	Poaceae	1	1	1
**Bromus diandrus*	giant brome	Poaceae	1		
**Bromus ?hordaceus*	soft brome	Poaceae	0-4	1	
**Bromus rubens*	red brome	Poaceae	1		
**Dactylis glomerata*	cocksfoot	Poaceae	1		
Dichelachne crinita	longhair plumegrass	Poaceae		1	1
Echinopogon ovatus	hedgehog grass	Poaceae		1	
Elymus scaber	common wheat grass	Poaceae	1	0-3	
**Holcus lanatus*	Yorkshire fog	Poaceae	0-3		
**Hordeum leporinum*	barley grass	Poaceae	1-6	1	
Joycea pallida	robust wallaby grass	Poaceae		1	
**Lolium perenne*	perennial ryegrass	Poaceae	1-6		
Microlaena stipoides	weeping grass	Poaceae		0-2	
**Phalaris aquatica*	phalaris	Poaceae	0-4		
**Poa pratensis*	Kentucky bluegrass	Poaceae	1		
Poa sieberiana var. cyanophylla		Poaceae		1	
Poa sieberiana var. sieberiana		Poaceae		1-4	
**Polypogon monspeliensis*	annual beardgrass	Poaceae	0-2	0-2	
**Vulpia sp.*	rat's tail fescue	Poaceae	1-4	1-3	
GRAMINOIDS					
Carex inversa	knob sedge	Cyperaceae	1		
Isolepis inundata	swamp club-rush	Cyperaceae		1	
Juncus sp.		Juncaceae		0-2	
Lomandra filiformis ssp coriacea		Lomandraceae		1	0-2
Lomandra multiflora ssp multiflora		Lomandraceae		1	1
Luzula meridionalis var. densiflora		Juncaceae	0-2		
Luzula ovata		Juncaceae		1	

APPENDIX B: FAUNA LIST

B.1: Faunal species list for the site

Table B. 0.1 Faunal species list

*Species observed on or within close proximity of the site. * indicates introduced species.*

Scientific name	Common name
AMPHIBIANS	
Litoria peronii	Peron's Tree Frog
Crinia signifera	Common Froglet
Crinia parinsignifera	Plains Froglet
Limnodynastes dumerilii	Southern Bullfrog
Limnodynastes tasmaniensis	Spotted Marsh Frog
Uperoleia laevigata	Smooth Toadlet
AVES	
Acanthiza chrysorrhoa	Yellow-rumped Thornbill
Acanthiza pusilla	Brown Thornbill
Acanthiza reguloides	Buff-rumped Thornbill
Smicrornis brevirostris	Weebill
Aquila audax	Wedge-tailed Eagle
Hieraaetus morphnoides	Little Eagle
Circus approximans	Swamp Harrier
Chenonetta jubata	Australian Wood Duck
Anas castanea	Chestnut Teal
Anas superciliosa	Pacific Black Duck
Egretta novaehollandiae	White-faced Heron
Cracticus torquatus	Grey Butcherbird
Gymnorhina tibicen	Australian Magpie
Strepera graculina	Pied Currawong
Strepera versicolor	Grey Currawong
Cacatua roseicapilla	Galah
Cacatua galerita	Sulphur-crested Cockatoo
Calyptorhynchus funereus	Yellow-tailed Black-Cockatoo
Coracina novaehollandiae	Black-faced Cuckoo-shrike
Cormobates leucophaeus	White-throated Treecreeper
Corcorax melanorhamphos	White-winged Chough
Corvus coronoides	Australian Raven

Scientific name	**Common name**
Grallina cyanoleuca	Magpie-lark
Myiagra cyanoleuca	Satin Flycatcher
Rhipidura fuliginosa	Grey Fantail
Rhipidura leucophrys	Willie Wagtail
Falco berigora	Brown Falcon
Falco cenchroides	Nankeen Kestrel
Dacelo novaeguineae	Laughing Kookaburra
Hirundo neoxena	Welcome Swallow
Malurus cyaneus	Superb Fairy-wren
Anthochaera carunculata	Red Wattlebird
Melithreptus lunatus	White-naped Honeyeater
Philemon corniculatus	Noisy Friarbird
Daphoenositta chrysoptera	Varied Sittella
Anthus novaeseelandiae	Richard's Pipit
Colluricincla harmonica	Grey Shrike-thrush
Pachycephala rufiventris	Rufous Whistler
Pardalotus punctatus	Spotted Pardalote
Pardalotus striatus	Striated Pardalote
Microeca fascinans	Jacky Winter
Platycercus elegans	Crimson Rosella
Platycercus eximius	Eastern Rosella
Psephotus haematonotus	Red-rumped Parrot
Threskiornis molucca	Australian White Ibis
Sturnus vulgaris	Common Starling
Cincloramphus mathewsi	Rufous Songlark
MAMMALS	
Canis vulpes	*Red Fox
Antechinus stuartii	Brown Antechinus
Lepus capensis	*Brown Hare
Oryctolagus cuniculus	*European Rabbit
Wallabia bicolor	Black Wallaby
Macropus giganteus	Eastern Grey Kangaroo
Macropus robustus robustus	Eastern Wallaroo

Scientific name	**Common name**
Pseudocheirus peregrinus	Common Ringtail Possum
Nyctinomus australis	White-striped Freetail Bat
Chalinolobus morio,	Chocolate Wattled Bat
Chalinolobus gouldii	Gould's Wattled Bat
Mormopterus species (unknown),	
Myotis adversus	Large-footed Myotis
Vespadelus darlingtoni	Large Forest Bat
Vespadelus regulus or V. vulturnus	Southern Forest Bat or Little Forest Bat (unable to differentiate based on call)
REPTILES	
Amphibolurus muricatus	Tree Dragon
Notechis scutatus	Tiger Snake
Tiliqua nigrolutea	Blotched Blue-tongued Lizard
Morethia boulengeri	Boulenger's Skink
Egernia cunninghami	Cunningham's Skink
Lampropholis delicata	Delicate Skink
Tiliqua rugosa	Stumpy-tailed Lizard
Hemiergis decresiensis	Three-toed Skink

APPENDIX C: THREATENED SPECIES EVALUATION

C.1 Flora

Table C.0.1 Threatened flora that may be impacted by the proposal

Flora recorded from the Gunning, Goulburn, Canberra, Yass, Crookwell and Taralga 1:100,000 map sheets or elsewhere on the Southern Tablelands in grassy woodland habitat

Species	Class*	Habitat required
Grevillea iaspicula, shrub (Proteaceae)	E, e	Known only from the Wee Jasper area where it grows on limestone outcrops. Suitable habitat is not present.
Kunzea cambagei, shrub (Myrtaceae)	V, v	Only record in the region is from the Blue Mountains National Park east of Oberon, where it grows in heath. Suitable habitat is not present.
Pomaderris cotoneaster Shrub (Rhamnaceae)	E, e	Recorded from a few rocky or riparian sites in Bungonia State Conservation Area and the adjacent parts of Morton National Park (J. Miles, pers. obs.). No suitable habitat occurs on the site and the species was not recorded.
Pomaderris delicata Shrub (Rhamnaceae)	E	This species has been recorded only in two sites between Goulburn and Bungonia, and between Braidwood and Bungonia, in dry sclerophyll forest on shallow soils. It was not seen on the site and is unlikely to have been overlooked.
Pomaderris pallida Shrub (Rhamnaceae)	V, v	This shrub grows in rocky sites in open forest or shrubland near rivers in a few locations on the Southern Tablelands. No suitable habitat is present.
Caladenia tessellata, Terrestrial orchid (Orchidaceae)	E, v	The Thick-lip Spider Orchid has been recorded near Braidwood, with an old record (1942) near Queanbeyan. Near Braidwood it grows on very poor stony soils, in woodland with little understorey, most likely dominated by *Eucalyptus dives* and *E. macrorhyncha* (K. McDougall, pers. comm.). Although these tree species occur on the site, the degree of prior disturbance and absence of any records from the Goulburn area makes it very unlikely that this species would occur on the site.
Diuris aequalis, Terrestrial orchid (Orchidaceae)	E, v	In the Braidwood area this species is generally found in drier woodland dominated by *Eucalyptus dives* and *E. mannifera*, although further north it may occur in association with snow gum, *E. pauciflora* (R Rehwinkel, pers. comm.). There is a single old record from the Goulburn area and it still occurs near Wombeyan Caves. Suitable habitat is probably not present on the site due to the level of disturbance, but there is one section of adjacent road verge which could provide suitable habitat, being dominated by *E. mannifera* and still in quite good condition. However, this was surveyed during the orchid's flowering period and none were seen. Not all individual orchid plants flower every year, so it is not impossible that this species occurs on this single section of road verge, though it is unlikely.
Diuris pedunculata Terrestrial orchid (Orchidaceae)	E, e	Small Snake Orchid grows in moist grassland, often in stony soils on low ridges or moist flats. Recorded on the Southern Tablelands at higher elevations (>1000m ASL) at Adaminaby, Bago State Forest and Snowy Plain. Flowers August-September on the Northern Tablelands (Bishop 1996), but flowering in late November at Snowy Plains (J. Miles, pers. obs.). There is no suitable habitat (moist grassland) on the site, and the survey timing was appropriate for detecting this species, which was not recorded.
Diuris tricolor (syn. *D. sheaffiana*) Terrestrial orchid (Orchidaceae)	V, v	Sporadically distributed from Narrandera across the western slopes to northern NSW. Usually in grassy *Callitris* woodland on sandy soils in flat country or on top of small hills (Bishop, 2000). Soils are not sandy and the area is outside the usual range of this species, although there is an old (1906) record from the Goulburn area.

Species	Class*	Habitat required
Prasophyllum petilum Terrestrial orchid (Orchidaceae)	E, e	Known from three sites at Boorowa, Hall and Captain's Flat, growing in Natural Temperate Grassland, Yellow Box, Blakely's Red Gum Woodland or moist grassy flats, with kangaroo grass or wallaby grasses (*Austrodanthonia spp*). The Captains Flat population occurs in an area with a high watertable. Flowers Oct-Nov (Bishop 1996). Potential habitat for this species may have once occurred on the site, but the degree of prior disturbance makes it very unlikely that this species would occur on the site.
Ammobium craspedioides, forb (Asteraceae)	V, v	Yass Daisy grows in sclerophyll forest, woodland and secondary grassland, chiefly in the Yass district, though extending from near Crookwell to near Wagga Wagga. Typical associated tree species are *E. blakelyi, E. melliodora, E. bridgesiana, E. dives, E. macrorhyncha, E. mannifera* and *E. rubida*, many of which occur on the site. However, the species is relatively conspicuous and flowers in spring, so it should have been detected if present. The degree of prior disturbance and absence of any records from the Goulburn area makes it very unlikely that this species would occur on the site.
Calotis glandulosa forb (Asteraceae)	V, v	Mauve Burr-daisy grows in montane or subalpine grassland or grassy woodland on the tablelands and western slopes, including disturbed areas. Most of its distribution is south of Canberra, but with a single record from the Oberon area. The species is perennial and distinctive and should have been detectable if present. It was not recorded. The degree of prior disturbance and absence of any records from the Goulburn area makes it very unlikely that this species would occur on the site.
Goodenia macbarronii Annual forb (Goodeniaceae)	V, v	Grows in damp sandy soils on the tablelands and slopes, flowering Oct-Mar. It often occurs in disturbed sites including grazed paddocks and roadside drains (DEC 2005b). The nearest records on the DEC Atlas are well to the west of the Goulburn area. There is no suitable habitat (seepage areas) on the site.
Lepidium hyssopifolium forb (Brassicaceae)	E, e	This species is known from only three sites on the NSW Tablelands, near Bathurst, Crookwell and Bungendore, growing in grassy woodland and grassland. In Victoria it is also rare and only known currently from two localities in grassland on the basalt plains north and north-east of Melbourne. Suitable habitat for this species occurs on the site, but the degree of prior disturbance makes it very unlikely that this species would occur on the site.
Lepidium pseudopapillosum forb (Brassicaceae)	E, v	This species occurs in Victoria and South Australia in black box/buloke or grey box woodland or open forest. The single atypical population recorded from the Canberra region has been described as *Lepidium ginninderrense*, so *L. pseudopapillosum* is no longer regarded as occurring in NSW.
Lepidium ginninderrense forb (Brassicaceae)	v	Occurs on a single site on Belconnen Naval Transfer Station, in grassland. Suitable habitat may be present, but the degree of prior disturbance makes it very unlikely that this species would occur on the site.
Leucochrysum albicans ssp albicans var. tricolor forb (Asteraceae)	v	Hoary sunray may be locally common on the Southern Tablelands, and is therefore not listed as threatened in NSW. It grows in natural and secondary grasslands and grassy woodlands, often colonising disturbed sites such as road verges. It is a conspicuous species which should have been detected if present, and was not recorded on the site.
Rutidosis leptorhynchoides forb (Asteraceae)	E, e	Button Wrinklewort grows in grassland and woodland of the ACT and Monaro region. Suitable habitat was probably formerly present on the site but the degree of prior disturbance and absence of any records from the Goulburn area makes it very unlikely that this species would occur on the site.

Species	Class*	Habitat required
Swainsona recta forb (Fabaceae)	E, e	Known in the region mostly south from Canberra and Queanbeyan, where it grows in secondary grassland and woodland, often on rocky slopes. Suitable habitat is present, but the degree of prior disturbance and absence of many more common native forbs makes it very unlikely that this species would occur on the site.
Swainsona sericea forb (Fabaceae)	V	A declining small perennial pea recorded in grassland and grassy woodland from the northern to southern tablelands, and western slopes and plains. Flowers Oct-Dec. All Southern Tableland records in the DEC Atlas are from south of Canberra. Suitable habitat (grassy woodland) is present but the degree of prior disturbance makes it very unlikely that this species would occur on the site.
Thesium australe, forb (Santalaceae)	V, v	This species has not been recorded from the Goulburn area, but as it is a very inconspicuous plant it could occur in the area undetected. It is a partial parasite on kangaroo grass (*Themeda triandra*), preferring moist sites in grassland or grassy woodland. No kangaroo grass was recorded on or near the site which suggests that *Thesium* is unlikely to be present.
Baloskion longipes, sedge (Restionaceae)	V, v	Grows in a range of wet habitats, with the nearest record from the Blue Mountains National Park, east of Oberon. No wetland habitat occurs on the site.

E listed as Endangered under Schedule 1 of the NSW *TSC Act 1995*

e listed as Endangered under the Commonwealth *EPBC Act 1999*

V listed as Vulnerable under Schedule 2 of the NSW *TSC Act 1995*

v listed as Vulnerable under the Commonwealth *EPBC Act 1999*

C.2 Fauna

Table C.0.2 Threatened fauna that may be impacted by the proposal

Threatened species considered to have potential to occur onsite were derived from the DEC NPWS Wildlife Atlas listings for the Gunning 1:100,000 and Goulburn 1:100,000 map sheets and the EPBC Act using a 30km buffer from the site. As the works would not impact creeks or rivers, only terrestrial species have been considered.

Species are categorised in terms of low, medium and high potential impact dependant on the likelihood that they would utilise the site and if so, the likelihood they would be impacted by the proposal.

For highly mobile species particularly, a conservative approach has been adopted due to the potential for migrating species to periodically utilise or travel through or over the site.

Species	Class *	Habitat requirements and study area suitability	Potential to be impacted
AMPHIBIANS			
Green and Golden Bell Frog *Litoria aurea*	TSC E	Occurs in or near water or very wet areas. It is present in forests, woodlands and shrublands, in open or disturbed areas (Hero *et al.* 1991). Breeding takes place in permanent lakes, swamps and dams with still water (Hero *et al*. 1991).	Marginal potential habitat occurs onsite in the form of farm dams. Habitat may be lost if dams are filled to reduce water bird collision. **Moderate potential impact.**
Yellow-spotted Bell-frog *Litoria castanea*	EPBC e	Requires large permanent dams or slow flowing streams with plenty of emergent vegetation such as bulrushes. Not recorded in the wild since the 1970s.	No suitable habitat occurs onsite. **Low potential impact.**
AVES			
Speckled Warbler *Chthonicola sagittata*	TSC V	Inhabits woodlands and dry forests, generally in inland Australia, particularly those with grassy understorey, often on ridges or gullies. Sedentary, living in pairs or trios and nests on the ground in grass tussocks, dense litter and fallen branches. Forages on the ground and in the understorey for arthropods and seeds. Occupy small remnants, but are yet to be recorded breeding in revegetated areas (Greening Australia in NPWS 2002). Requires relatively intact woodland areas with litter and fallen timber. Locally recorded approximately 18km north of the site.	Marginal potential foraging and nesting habitat is present due to previous and ongoing site disturbance. Collision and avoidance impacts may apply. Only minimal woodland would be impacted by the proposal. **Moderate potential impact.**
Blue-billed Duck *Oxyura australis*	TSC V	Requires wetland habitats, preferring well vegetated freshwater swamps, large dams, lakes (Pizzey and Knight 1997).	Suitable habitat occurs to the east of the site, at Wet Lagoon. No potential habitat onsite. Movements would be more likely restricted to the wet corridor west of the site, therefore low collision risk. **Low potential impact.**
Square-tailed Kite *Lophoictinia isura*	V	Preferred habitat is open eucalypt forest and woodland (Schodde and Tidemann 1986). The species hunts for passerine birds in the tree tops of the forest (Klippel 1992). Habitat at the site is marginal due to scarcity of forest cover. Recorded in Mundoonen Nature Reserve.	Potential habitat is marginal due to young age of trees and fragmentation but collision / avoidance impacts may apply. Only minimal woodland would be impacted by the proposal. **Moderate potential impact.**

Species	Class *	Habitat requirements and study area suitability	Potential to be impacted
Freckled Duck *Stictonetta naevosa*	TSC V	Endemic to south eastern and south western Australia. It inhabits plankton rich wetlands, and is typically gregarious. Hydrological changes and clearance of habitat are threats to this species (NSW NPWS 1999b). Known from the area.	Suitable habitat occurs to the east of the site, at Wet Lagoon. No potential habitat onsite. Movements would be more likely restricted to the wet corridor west of the site, therefore low collision risk. **Low potential impact.**
Magpie Goose *Anseranas semipalmata*	TSC V	A wetland species, only vagrant in southern NSW.	Suitable habitat occurs to the east of the site, at Wet Lagoon. No potential habitat onsite. Movements would be more likely restricted to the wet corridor west of the site, therefore low collision risk. **Low potential impact.**
Australasian Bittern	TSC V	Inhabits dense reeds, rushes or cane grass in freshwater wetlands, including swamps, lakes, impoundment's, rivers or creeks. They may also be seen in flooded rank pastures and along drainage ditches or channels (Blakers *et al.* 1984; Emison *et al.* 1984). Known from Lake George.	Suitable swampy habitat occurs to the east of the site, at Wet Lagoon. No potential habitat onsite. Movements would be more likely restricted to the wet corridor west of the site, therefore low collision risk. **Low potential impact.**
Australian Painted Snipe *Rostratula benghalensis australis*	EPBC v	Little is known of the behaviour of this cryptic waterbird. May be nomadic as it has been observed occupying ephemeral wetlands. Seeds and invertebrates are foraged for on the waters edge.	Suitable habitat occurs to the east of the site, at Wet Lagoon. No potential habitat onsite. Movements would be more likely restricted to the wet corridor west of the site, therefore low collision risk. **Low potential impact.**
Gang-gang Cockatoo *Callocephalon fimbriatum*	TSC V	Feeds in pairs or small flocks on seeds of eucalypts and wattles, primarily in forest, but occasionally towns and farming areas for artificial food resources such as berry-bearing exotic shrubs. It is a seasonal altitudinal migrant. Nesting is in large tree hollows. Recorded approximately 6km south of the site.	Potential foraging habitat is marginal due to young age of trees and fragmentation but collision impacts may apply. Only minimal woodland would be impacted by the proposal. **Moderate potential impact.**
Glossy Black Cockatoo *Calyptorhynchus lathami*	TSC V	A species of open forests and woodland, dependent mainly on the seeds of Allocasuarina trees as a food source (Blakers *et al.* 1984). Large trees with hollows are required for breeding sites (Emison *et al.* 1987). Competition for hollows increases with openness of habitat and can be a threat to this species. May prefer to travel long distances over treed rather than open landscapes.	No suitable habitat onsite. Collision impacts may apply. Only minimal woodland would be impacted by the proposal. **Low potential impact.**

Species	Class *	Habitat requirements and study area suitability	Potential to be impacted
Brown Treecreeper *Climacterus picumnus*	TSC V	Occurs in eucalypt woodlands, mallee and drier open forest of eastern Australia, preferring woodlands lacking dense understorey (Schodde and Tidemann 1986). Feeds on insects in the leaf litter and trunks of trees. Nests in tree hollows, stumps or rotted fence posts. Requires relatively intact woodland areas, nesting in a tree hollow. Locally recorded in Mundoonen Nature Reserve.	Marginal potential foraging and nesting habitat is present due to previous and ongoing site disturbance. Collision and avoidance impacts may apply. Only minimal woodland would be impacted by the proposal. **Moderate potential impact.**
Diamond Firetail *Stagonopleura guttata*	TSC V	Occurs predominantly west of the Great Dividing Range (Blakers *et al.* 1984, Schodde and Mason 1999) although local populations are known. Feeds predominantly on the ground on grass seeds, in groups from 5 to 150 individuals (Schodde and Tidemann 1986), nesting in pairs or communally in shrubs and small trees. Restricted largely to ungrazed or lightly grazed woodland remnants of grassy eucalypt woodlands, including Box-Gum and Snow Gum Woodlands, and grassland and riparian areas, and sometimes lightly wooded farmland. May form large flocks during winter and autumn.	Potential foraging habitat is present. Collision and avoidance impacts may apply to this flocking species. Only minimal woodland would be impacted by the proposal. **Moderate potential impact.**
Regent Honeyeater *Xanthomyza phrygia*	E EPB Ce	Distributed through the eastern third of New South Wales, where it inhabits eucalypt forests and woodlands (Blakers *et al.* 1984). A generalist forager, feeding mainly on the nectar from a wide range of eucalypts (particularly prolifically flowering box and ironbark species) and mistletoes but also eats invertebrates and exotic fruits (Blakers *et al.* 1984). Key eucalypt species include Yellow Box and Blakely's Red Gum and Red Stringybark, which occur onsite. Large numbers can appear in an area to take advantage of a food source. Recorded locally at Goulburn.	Marginal potential foraging and nesting habitat is present due to previous and ongoing site disturbance. Collision and avoidance impacts may apply to this flocking species. Only minimal woodland would be impacted by the proposal. **Moderate potential impact.**
Hooded Robin *Melanodryas cucullata*	TSC V	Widespread, occurring in pairs or solitary in lightly timbered country (Schodde and Tidemann 1986). Spends much of its time on the ground in woodland foraging for insects. It frequents places with dead trees and fallen timber (Schodde and Tidemann 1986), nesting on dead limbs or stumps. Populations are unable to survive in remnants smaller than 100-200 hectares (NPWS 2004).	No suitable habitat onsite. Only minimal woodland would be impacted by the proposal. **Low potential impact.**
Superb Parrot *Polytelis swainsonii*	V EPB Cv	Nesting habitat on SW Slopes is often open Yellow Box, Blakely's Red Gum Woodland or isolated paddock trees. Species known to be used are Blakely's Red Gum, Yellow Box, Apple Box and Red Box. Nest in small colonies, often with more than one nest in a single tree. May forage up to 10 km from nesting sites. Feed in trees and understorey shrubs and on the ground and their diet consists mainly of grass seeds and herbaceous plants. West of Yass forms part of core breeding population in region. Migrates north in winter to the upper Namoi and Gwydir Rivers. Local record from less than 5 km north-east of site in road verge.	Marginal potential foraging and nesting habitat is present. Collision and avoidance impacts may apply to this flocking species. Only minimal woodland would be impacted by the proposal. **High potential impact.**

Species	Class *	Habitat requirements and study area suitability	Potential to be impacted
Swift Parrot *Lathamus discolor*	EPB Ce	A non-breeding winter migrant to southern and eastern NSW, where it inhabits eucalypt forests and woodlands (Blakers et al 1984). Feeds on eucalypt blossom and psyllids. No local records.	Marginal potential foraging habitat is present. Only minimal woodland would be impacted by the proposal. Collision and avoidance impacts may apply. **Moderate potential impact.**
Powerful Owl *Ninox strenua*	TSC V	Breeding pairs defend large (up to 1000 ha), permanent territories (Blakers *et al.* 1984), usually centred around gullies (Fleay 1968). Nests in large tree hollows (Emison *et al.* 1987). Arboreal mammals form about 80% of the diet of this species (birds form most of the rest), with the Common Ringtail Possum, Greater Glider and Sugar Glider being the most favoured species (Blakers *et al.* 1984). Known from the Mundoonen Nature Reserve and near Collector.	Potential foraging habitat present onsite. Collision / avoidance impacts may apply. Only minimal woodland would be impacted by the proposal. **Moderate potential impact.**
Grass Owl *Tyto capensis*	TSC V	Inhabits tall grassy areas, grassy woodlands, swampy areas, coastal heaths, sedges, cumbungi and crops such as sorghum, sugar cane and grain. It nests in grass tussocks or low shrubs (Pizzey and Knight 2003). Its core distribution is coastal, from northern NSW through QLD, although inland records occur particularly in QLD and NT (Pizzey and Knight 2003).	Suitable swampy habitat occurs to the east of the site, at Wet Lagoon. No potential habitat onsite. Potential impact may occur when moving between areas of habitat. **Moderate potential impact.**
Golden Sun Moth *Synemon plana*	EPBC ce	A day-flying moth inhabiting native grasslands and Box gum Woodlands. Populations separated by distances of greater than 200m are effectively isolated. Larvae are thought to feed almost exclusively on Wallaby grass (*Austrodanthonia* spp.) roots. Bare ground between the tussocks is thought to be an important microhabitat feature. Distributed between Queanbeyan, Gunning, Young and Tumut. All of the known sites are less than 720 m above sea level (Clarke 2001).	Wallaby grass occurs in patches onsite but is degraded due to grazing and pasture improvement. It is highly unlikely that suitable habitat occurs onsite. **Low potential impact.**
MAMMALS			
Eastern Pygmy Possum *Cercartetus nanus*	V	Occurs at elevations of 300m to above 1,000m. In southern NSW, this species is principally recorded in drier forest and heath, often with a diverse shrubby ground cover. Myrtaceous trees, Banksia and hollows are potential resources for this species. Potential habitat is not present at the site. One local record exists from Mundoonen Nature Reserve.	Potential habitat is marginal due to lack of shrub strata and preferred species. Only minimal woodland would be impacted by the proposal. **Low potential impact.**
Tiger or Spotted-tailed Quoll *Dasyurus maculatus*	V EPB Ce	Found in a variety of forest types, although generally preferring moister environments such as rainforest and wet sclerophyll forest (Victorian Department of Conservation and Environment 1992). Large areas of undisturbed habitat which provide a variety of key food and other resources such as large hollow logs, or small caves at ground level for dens are required.	Potential habitat is marginal due to poor habitat structure and drier vegetation type. Only minimal woodland would be impacted by the proposal. **Low potential impact.**

Species	Class *	Habitat requirements and study area suitability	Potential to be impacted
Yellow-bellied Glider *Petaurus australis*	TSC V	Restricted to tall mature eucalypt forest (Russell 1983), where it uses tree hollows for shelter and feeds on plant and insect exudates and arthropods, collected mostly under exfoliating bark. It may prefer forest of high species diversity. Eucalypts that provide hollows, sap flow and that flower in winter are preferred by this species. These include ribbon gum and bloodwood (*Eucalyptus viminalis* and *Corymbia gummifera)* and winter flowering ironbarks. It is principally distributed on the coast although several inland records exist. No local records.	Potential habitat is marginal due to loss of hollows, young age of trees and fragmentation. Only minimal woodland would be impacted by the proposal. **Low potential impact.**
Squirrel Glider *Petaurus norfolcensis*	TSC V	Inhabits dry sclerophyll forest and woodland, distributed largely along the east coast and immediate inland districts. Feeds on insects, nectar and exudates from leaves and trees (*Eucalyptus* and *Acacia*). No local records.	Potential habitat is marginal due to loss of hollows, young age of trees and fragmentation. Only minimal woodland would be impacted by the proposal. **Low potential impact.**
Koala *Phascolarctos cinereus*	TSC V	Solitary with distinct home ranges. Consumes a diverse range of eucalypts (Strahan 1995) typically present on high nutrient soils (Klippel, 1992). Large areas of continuous forest or woodland are required by this species. Known from Mundoonen Nature Reserve are in reserve near Collector. Species preferred by this species are present onsite however, habitat structure is poor being degraded and non continuous and generally isolated and heavily fragmented.	Potential habitat is marginal due to poor habitat structure. Only minimal woodland would be impacted by the proposal. **Low potential impact.**
Eastern False Pipistrelle *Falsistrellus tasmaniensis*	TSC V	Roosts and breeds in large trees, in a range of habitats including dry and wet sclerophyll forest, appearing to prefer wet sclerophyll (Hall and Richards 1979). May travel large distances between foraging and roosting sites. The site may contain potential foraging habitat, but unlikely to provide hollows for roosting/breeding. May travel over the site during long distance movements. Therefore this species may be subject to collision or avoidance impacts. This species does not migrate or roost in groups so individuals only would be at risk.	Potential foraging habitat is present. Only minimal woodland would be impacted by the proposal but collision / avoidance impacts may apply. **Moderate potential impact.**
Eastern Bent-wing Bat *Miniopterus schreibersii*	TSC V EPB Ccd	Found in a wide range of habitats, but is constrained by its requirement for caves, man-made tunnels or stormwater channels in which it breeds (Strahan *et al.* 1995) – not present onsite. Typically, the species forages in well timbered habitats, above the tree canopy (Dwyer, in Strahan et al 1995). Local records occur 15km south of Goulburn and in the Shoalhaven. Potential foraging habitat may be present. Structures should be designed so as not to provide roosts.	Potential foraging habitat is present. Only minimal woodland would be impacted by the proposal but collision / avoidance impacts may apply. **Moderate potential impact.**

Species	Class *	Habitat requirements and study area suitability	Potential to be impacted
Long-footed Myotis *Myotis adversus*	TSC V	This species forages on the surface of water bodies such as rivers, lakes and swamps and roosts in caves, mine, tunnels and old buildings (Hall & Richards 1979). No local records occur, although this species was identified by call onsite. This species may forage and migrate in groups, placing it at greater risk of collision with ridge-top turbines.	Foraging habitat is present in the drainage line to the east of the site. This area would not be impacted. Collision / avoidance impacts may apply. **Moderate potential impact.**
Eastern Long-eared bat *Nyctophilus timoriensis*	EPBC v	Inhabits a variety of vegetation types, including mallee, bulloke but more commonly box/ironbark/cypress-pine. Slow flying agile bat, utilising the understorey to hunt non-flying prey (especially caterpillars and beetles) and will even hunt on the ground. The species roosts in tree hollows, and under loose bark. No regional records. Foraging pattern suggests collision risk is low but avoidance impacts may apply while migrating.	Only minimal woodland would be impacted by the proposal. Potential impact may occur when moving between areas of habitat. **Moderate potential impact.**
REPTILES			
Eastern Earless Dragon *Tympanocryptis pinguicolla*	EPBC e	Found in naturally treeless native tussock grassland on black clay, brown clay loams, and podzolic soils (Cogger *et al*. 1993). It prefers ungrazed or lightly grazed grasslands on gentle slopes dominated by wallaby grasses, spear grasses, Snow Grass, and Kangaroo grass. Recorded from the ACT, Cooma, Bathurst, SE Qld.	No suitable habitat occurs onsite. **Low potential impact.**
Striped Legless Lizard *Delma impar*	TSC V EPBC v	Inhabits temperate lowland grasslands and secondary grasslands, including some areas dominated by introduced species (such as *Phalaris aquatica, Nasella trichotoma* and *Hypocharis radicata*), and sites with a history of grazing and pasture improvement (Coulson 1995; Dorrough 1995; Smith and Robertson 1999). Shelters in grass tussocks, thick ground cover, soil cracks, under rocks, spider burrows, and under ground debris such as timber. Feeds on arthropods, most commonly wolf spiders, jumping spiders, crickets, grasshoppers, Lepidopteran larvae and cockroaches.	Marginal potential habitat occurs onsite due to ongoing disturbance (grazing). Works would impact a small amount of potential habitat in the long term. **Low potential impact.**
Pink-tailed Legless Lizard *Aprasia parapulchella*	EPBC v	Inhabits open grassland habitats that have a substantial cover of small rocks (Osborne and Jones 1995). Show a preference for sunny aspects, avoiding south facing slopes, only at sites with good numbers of invertebrates under rocks (Barrer 1992). Most sites have relatively open vegetation (Osborne and McKergow 1993), including grassland sites supporting no native grasses. Shelters under small rocks which are exposed to sunlight and shallowly embedded in the soil. Known from four sites in eastern Australia: near Canberra in the ACT, Tarcutta and Bathurst in NSW, and near Bendigo in Vic.	Marginal potential habitat occurs onsite due to ongoing disturbance (grazing). Works would impact a small amount of potential habitat in the long term. **Low potential impact.**

*Class TSC E listed as Endangered in NSW in Schedule 1 of the *Threatened Species Conservation Act 1995*
TSC V listed as Vulnerable in NSW in Schedule 2 of the *Threatened Species Conservation Act 1995*
EPBCv listed as nationally Vulnerable in the Commonwealth *Environment Protection Biodiversity Conservation Act 1999*
EPBCe listed as nationally Endangered in the Commonwealth *Environment Protection Biodiversity Conservation Act 1999*
EPBCce listed as nationally Critically Endangered in the *Environment Protection Biodiversity Conservation Act 1999*
EPBCcd listed as nationally Conservation Dependent in the *Environment Protection Biodiversity Conservation Act 1999*

APPENDIX D: ASSESSMENT OF SIGNIFICANCE

D.1 *TSC Act* Assessment of significance

Section 5A of the *Environmental Planning and Assessment Act 1979* (*EP&A Act*) specifies seven factors to be taken into account in deciding whether a development is likely to significantly affect threatened species, populations or ecological communities, or their habitats.

The following Assessment of Significance assesses the significance of the likely impacts associated with the Cullerin Wind Farm proposal on Endangered Ecological Communities and threatened flora and fauna species declared under the *Threatened Species Conservation Act 1995*. The Assessment has been undertaken in accordance with Threatened *Species Assessment Guidelines* issued by the Department of Conservation and Environment (DEC 2005a), under section 94A of the *Threatened Species Conservation Act 1995*. Subject communities and species are listed below.

Endangered ecological communities

Parts of the site and areas which may provide access to it carry remnant native vegetation which falls within the description of the Endangered Ecological Community, White Box, Yellow Box, Blakely's Red Gum Woodland, listed under both the Threatened Species Conservation Act and the Commonwealth Environmental Protection and Biodiversity Conservation Act (as Grassy White Box Woodland).

Threatened flora species

Assessment of habitat requirements of threatened flora species indicated that because of the degree of prior disturbance over most of the site there are no threatened flora species for which the area could potentially be providing habitat. However, one species, the Buttercup Doubletail (*Diuris aequalis*) could occur on some sections of road verge near the northern end of the site, which could be affected if road widening is required during the construction phase.

Threatened fauna species

Assessment of habitat requirements of threatened fauna species indicated that 14 species have potential to either utilise the site or be impacted by the proposal when moving through the area. These species include one amphibian, three microchiropteran bat species and ten bird species (Green and Golden Bell Frog, Eastern False Pipistrelle, Eastern Bent-wing Bat, Eastern Long-eared bat, Large-footed Myotis, Square-tailed Kite, Powerful Owl, Grass Owl, Gang-gang Cockatoo, Swift Parrot, Superb Parrot, Diamond Firetail, Speckled Warbler, Brown Treecreeper and Regent Honeyeater.

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Threatened flora species: Buttercup Doubletail (*Diuris aequalis*)

Distribution and conservation

The Buttercup Doubletail orchid is a conspicuous species when in flower, with up to 5 large (3cm diameter) pure yellow to orange flowers on a stem to 45cm in height (Bishop, 1996). Bishop states that it grows in drier woodlands or montane forest with a grassy-heathy understorey, on the tablelands between the Blue Mountains and Braidwood, although the Department of Conservation and Environment website states that it may grow in forest, open woodland or secondary grassland (DEC 2005c). There are six records from Kanangra-Boyd National Park in the Blue Mountains, but the bulk of the records are from private property or road reserves, so the species is poorly reserved in NSW, and does not occur in any other state. All known populations are small. Information on the DEC website states that a total of 200 plants are known from 20 populations. However, numbers will vary from year to year depending on conditions. The population on the Wombeyan Caves Road alone consists of 200 plants or more in 2005, as numbers recover after the 2002-04 drought (K. McDougall, pers. comm.). Of the total of 20 sites recorded for this species on the DEC NPWS Wildlife Atlas database, 8 are located around the Braidwood district, and all of these are relatively recent records (1976 to 2001), whereas some of those elsewhere are historical and have not been relocated more recently (Goulburn 1904, Oberon 1955, Federal Highway 21km south of Goulburn 1961). Near Braidwood, typical habitat consists of brittle gum and broad-leaved peppermint woodland, with an open understorey dominated by low shrubs, principally *Daviesia mimosoides*, and the tussock grass *Joycea pallida* (J. Miles, pers. obs.).

Proposal impacts

Habitat similar to that required by this species occurs on the road verge between the northern end of the site and the proposed substation site, at the junction of Old Hume Highway and Old Sydney Road which runs along the northern edge of the site. Brittle gum is the main tree species on this site, with the shrub *Daviesia leptophylla* and various native grasses. The proposed development has the potential to impact on this threatened species if the patches of remnant brittle gum (*E. mannifera*) woodland occurring along the unsealed road west from its junction with Old Sydney Road were to be substantially disturbed or eliminated as a result of road widening to provide access to the site. Presumably, the large component parts of the turbines will be difficult to manoeuvre onto the site along narrow, winding roads, and if this route were used to provide access to the northern end of the site, some road widening may be required.

There is no evidence that the orchid occurs on the verges of this road, but the habitat appears suitable in some places, and there is a record of the species from the Goulburn area (albeit an old record from 1904), so it is possible that it could occur there. Road widening has the potential to eliminate a population of this species, should it occur in the vicinity. The species is known from only about 20 small populations, so the loss of one population would be a significant loss. It would therefore be preferable to avoid road widening or other activities which might damage roadside vegetation along this unsealed road. This would remove the potential to impact the lifecycle of this species near the site, should it occur.

Threatened fauna species

Fifteen threatened species were identified as having potential to be impacted by the proposal. The habitat requirements of these species and potential for the proposal to generate lifecycle impacts are outlined in Table D.1.

Table D.1 Threatened fauna and their potential lifecycle impacts

Species	Habitat requirements and study area suitability	Potential life cycle impacts
Amphibians **Green and Golden Bell Frog**	This species occurs in or near water or very wet areas and can tolerate disturbed and man-made habitat. Marginal potential habitat occurs onsite in the form of farm dams. The dams that may be impacted by works occur in high topographic positions, least preferred by this species. This species was not observed during survey work. The survey work was carried out after rain when this species is known to call, hence it is considered very unlikely that it occurs onsite.	Although unlikely, potential habitat and potentially a population may be lost if dams on the ridge are filled to reduce water bird collision. While additional dams can be constructed to replace lost habitat, mortalities caused by the filling of the dam may cause a local population to become extinct. Risk is considered to be extremely low. **Unlikely to generate a lifecycle impact.**
Microchiropteran bats **Eastern False Pipistrelle** **Eastern Bent-wing Bat** **Eastern Long-eared bat** **Large-footed Myotis**	While the former two species roost in trees hollows which are available onsite, the latter require caves, tunnels, stormwater channels or roof structures in which to roost (Strahan et al. 1995). Structures are present (houses and sheds) onsite. All four are insectivorous species with potential to forage onsite. The Eastern False Pipistrelle forages high above the canopy, up to 200m. The Eastern Bent-wing Bat and Eastern Long-eared bat forage within the tree canopy. The Large-footed Myotis forages above water bodies, usually slow moving streams but also farm dams. The greatest risk of impact has been identified as during long distance movements when individuals use visual rather than echolocation navigation (refer to discussion, Section 5.3). For the Large-footed Myotis, riparian corridors may be preferred to ridgelines, reducing the risk of collision. While the Eastern False Pipistrelle is known to be solitary, the latter three species migrate to large maternity roosts. For the Eastern Bent-wing Bat, known maternity roosts occur at Wee Jasper and Bungonia Gorge. This colonial behaviour increases the impact that collision with turbines may have on the local population.	Collision: Individuals may collide with turbines while foraging or travelling over the site. Although there is a low amount of information available on bat migration routes, the site does not appear to be on a migration path. Mortalities would impact the lifecycles of these species but would be unlikely to place a local population at risk of extinction due to the low numbers of collisions anticipated. The risk of impact is higher for the latter three species which may forage or roost in groups. Due to the speculation involved in the assessment, post-construction monitoring should be rigorously carried out to ensure turbines are shut down if large numbers of a threatened species are impacted. **Unlikely to generate a lifecycle impact.** Avoidance: Individuals may avoid the area, increasing the energetic cost of foraging and travelling between breeding sites. This is unlikely to generate a lifecycle impact as there is better quality habitat to the north of the site. The site is not regarded as optimal habitat, given the fragmentation and level of past clearing. **Unlikely to generate a lifecycle impact.**

Species	Habitat requirements and study area suitability	Potential life cycle impacts
Birds of prey **Square-tailed Kite** **Powerful Owl** **Grass Owl**	While marginal potential foraging habitat is present onsite for the former two species, the latter is unlikely to be present onsite but may utilise grasslands either side of the site. Potential exists for collision and avoidance impacts for all three species.	Collision: Individuals may collide with turbines while foraging. This was identified as the main risk to raptors (Appendix E: Bird impact risk assessment) and would impact on the former two species. Collisions may also occur when individuals are travelling over the site, although this was considered to be a lower risk for raptors. Mortalities would impact the lifecycles of these species. These species occur at low density, being higher order predators, and therefore the loss of individuals is more significant than for more abundant species. Population level impacts would require regular mortalities over the long-term. Post-construction monitoring should be rigorously carried out to ensure turbines are shut down if ongoing collisions occur with these species. **Unlikely to generate a lifecycle impact.** Avoidance: Individuals may avoid the area, increasing the energetic cost of foraging and travelling between sites. This is unlikely to generate a lifecycle impact as there is better quality habitat to the north of the site (for the Square-tailed Kite and Powerful Owl) and to the west (Grass Owl). **Unlikely to generate a lifecycle impact.**
Woodland birds **Gang-gang Cockatoo** **Swift Parrot** **Superb Parrot** **Diamond Firetail** **Speckled Warbler** **Brown Treecreeper** **Regent Honeyeater**	These species may forage onsite or travel over the site when migrating or moving between ephemeral resources. Excluding the Brown Treecreeper, the remainder of these species are all known to occur in small to large groups, increasing the risk that collision poses to local populations. Although the woodland onsite is degraded in terms of habitat structure and composition (refer to Section 4: Flora and ecological communities) some individuals may also nest onsite. The site is located to the south of more extensive, better quality habitat and may therefore receive a 'source' of migrants.	Collision: There is a low risk of individuals colliding with turbines while foraging as these species prefer woodland to cleared areas and forage beneath the height of the turbines. The main risk of collision applies during migration or long-distance movements (Appendix E: Bird impact risk assessment). This risk is a non-mitigateable risk. The presence of the turbines may deter individuals from the immediate danger area. Furthermore, woodland exists to the immediate west (on the western slope of the site) that may provide a preferred movement corridor. However, a risk remains that mortalities will occur. For flocking species this may generate a population level impact more rapidly and monitoring will be required to ensure that mortality levels do not reach unacceptable levels without action being taken. **Unlikely to generate a lifecycle impact.** Avoidance: Individuals may avoid the area, increasing the energetic cost of foraging and travelling between sites. This is unlikely to generate a lifecycle impact as there is better quality habitat to the north of the site. **Unlikely to generate a lifecycle impact.**

b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

No populations have been listed for the local area under Part 2 of Schedule 1 of the TSC Act or Part 2 of Schedule 4 of the FM Act.

c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Endangered ecological community: Yellow Box, Blakely's Red Gum Woodland

Distribution and conservation

White Box, Yellow Box, Blakely's Red Gum Woodland is listed as an Endangered Ecological Community in NSW under the *Threatened Species Conservation Act 1995* and is covered by the national listing of Grassy White Box Woodland under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. Its listing reflects a high degree of destruction or modification by grazing, and in the ACT, loss of substantial areas to housing. This community probably formerly occupied much of the flats and lower slopes in the Goulburn district, from which it has mostly been completely cleared. Some remnants remain in a few areas, particularly on road verges, and remnant paddock trees indicate areas where the community previously occurred.

The Final Determination of the NSW Scientific Committee states that:

> "Some remnants of the community may consist only of an intact overstorey or an intact understorey, but may still have high conservation value due to the flora and fauna they support…..Disturbed remnants are still considered to form part of the community including remnants where the vegetation, either understorey, overstorey or both, would, under appropriate management, respond to assisted natural regeneration, such as where the natural soils and associated seed bank are still at least partially intact".

Occurrence onsite

There are small patches of predominantly native vegetation which could be regarded as belonging to this EEC scattered along the ridge on the Cullerin site, mostly towards the northern end (refer to Figure 4.1). They generally consist of a few remnant yellow box or Blakely's red gum and a groundcover which is dominated by native spear or wallaby grasses (*Austrostipa* and *Austrodanthonia* spp). These are scattered among areas which are vegetated almost exclusively with exotic pasture species or weeds. The trees are generally regrowth and too young to have formed the hollows which would make them an important resource for native fauna, and the groundcover is degraded, with a low native species diversity.

Most patches are located on areas of shallow, stony soil, and carry few weeds, the soil being too poor to support most of the weeds occurring in the vicinity. However, despite the low numbers of exotic species, these areas are of low conservation significance, due to their low native species diversity. It is reasonable to expect that following the breaking of the 2002-05 drought, most seed present in the seedbank would have germinated, so the recovery potential of these areas if grazing pressure were to be removed does not appear high. A typical area might include a sparse cover of *Austrostipa scabra ssp falcata*, Au*strodanthonia eriantha, A. carphoides* or *A. auriculata* and a few individuals of forbs *Goodenia hederacea, Crassula sieberiana, Oxalis perennans* and the small shrub *Hibbertia obtusifolia*.

Proposal impacts

The development could result in the destruction of some areas of EEC due to vehicle and machinery movements during the construction period. None are likely to be located on the proposed turbine sites, which are all in areas dominated by exotic groundcover species. Their loss would not be significant, given their low species diversity and the fact that they are located within grazed pasture, the condition of which is likely to continue to deteriorate under continued grazing. The substation site is located in another such area, including remnant yellow box and red gum trees, spear and wallaby grasses but virtually no native forbs other than the hardy and persistent *Crassula sieberiana* and *Rumex brownii.* It is also of very low conservation significance.

There are some patches of the EEC in slightly better condition. One is located within the eroded gully on the Eastern Slopes. This area is in only slightly better condition than the small patches found on the ridge top, but because of its larger size, does include a greater number of native species. Again, the least weedy areas are those of very poor, shallow soils, with only a sparse groundcover. The dominant remaining trees in this area are red stringybark and brittle gum, but there are occasional yellow box and red gum, so it also, arguably, belongs to the EEC. Groundcover is patchy, with some areas predominantly exotic, and some carrying native grasses including A*ustrodanthonia spp, Elymus scaber, Poa sieberiana* and *Microlaena stipoides*. In the sparsely vegetated area between two branches of the gully native forbs predominate over exotics, including *Gonocarpus tetragynus, Stylidium graminifolium, Goodenia hederacea, Drosera peltata* and *Triptilodiscus pygmaeus*. This area appears transitional between Yellow Box, Blakely's Red Gum Woodland and Widespread Tablelands Dry Shrub Tussock Grass Forest, and is in poor condition. Its loss would not be significant in terms of the EEC, but for the sake of retaining as much fauna habitat as possible this area should be avoided.

Another such patch of the better quality EEC is located at the northern extremity of the site, between the northern-most turbine site and the unsealed road. An area of about 1 hectare of steeper slope between the ridge top and the road carries Yellow Box, Blakely's Red Gum woodland in fair condition, with a greater variety of native tree and groundcover species and relatively few weeds. It would be preferable to avoid this area when considering access routes to the northern end of the site, although it would be possible to ascend this slope a little further to the east, where trees have already been cleared and the groundcover is largely exotic.

Yellow Box, Blakely's Red Gum Woodland EEC patches are scattered along the edges of Lerida Road North, which is outside the site, but could be impacted by road widening to gain access to the site. Since the access route(s) were unknown at the time of the survey it is not possible to determine what the impact on the EEC might be in this area, should widening be required.

In general, impacts on the Yellow Box, Blakely's Red Gum Woodland EEC will be minimal on the ridge top and substation site, due to the degraded state of remnants in these areas, and slightly more significant on the road access. The northern slope of the site is the best example of this EEC. Access routes should be developed with this limitation in mind. There is ample scope for avoiding these areas in planning the access routes and thereby avoiding a lifecycle impact on species occurring in this community.

If the designated areas of better quality EEC are avoided (marked on Figure 4.1) and care is taken in the positioning of access routes, the impact of the development would not have an adverse impact on the extent or composition of this community. The impacts would be localised, confined in general to already cleared and degraded areas. The development would not preclude the assisted regeneration of areas of this community in areas where there is potential to do so.

d) In relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

Endangered ecological community: Yellow Box, Blakely's Red Gum Woodland

The development would not have these effects, since the vegetation will remain much as before the development over most of the site. The better quality examples of this EEC (although of only low-moderate conservation significance) can be avoided.

Threatened flora species: Buttercup Doubletail (*Diuris aequalis*)

The development would not have these effects, since the vegetation will remain much as before the development over most of the site. The area that may provide potential habitat for this species can be avoided.

Threatened fauna

Key threatened fauna habitat features in the study area include mature woodland (rare onsite, confined to gullies), younger woodland and modified wetland habitats. The proposal would not result in the removal of a significant area of these potential threatened fauna habitat features.

Threatened bird and bat species with potential to utilise the site are dependent on remnant woodland habitat and riparian vegetation. Precise migration routes at the site are not known, but woodland species dependent on tree cover (such as the Diamond Firetail, Regent Honeyeater, Gang-gang Cockatoo and Superb Parrot) could be expected to use scattered trees and remnant patches as 'stepping stones'. The operation of the wind turbines has the potential to create a barrier between habitat areas, exacerbating existing levels of habitat fragmentation. If individuals avoid the ridge due to the presence of the turbines, the development could constitute a loss of threatened fauna habitat (although this habitat is considered marginal). Quantification of this potential impact is problematic due to the paucity of information on wind farm impacts and the site specific nature of these impacts. Given the distribution of surrounding vegetation and the potential movement corridors for birds (Figure 5.2), the development is not anticipated to additionally fragment available habitat to the extent that onsite use is compromised.

In general, the vegetation has been considered marginal for these threatened species. It is fragmented and heavily grazed. Most of the species considered are wide ranging, hence the site would constitute only a small proportion of their habitat, if present. Two small dams exist near the ridge. These were surveyed and found not to contain the Green and Golden Bell Frog however, if they are filled in to discourage water birds close to the turbines, potential habitat for this species may be lost. This species is known locally however, records are from lower landscape positions. The dams on the ridge are artificial and unlikely to provide habitat for this species.

e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No areas of declared critical habitat have been declared for the study area.

f) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan.

A draft recovery plan is available for the Green and Golden Bell Frog only. It states that:

> "the threatening processes thought to be operating at a distribution wide level include disease, predation on larvae by exotic fish and broad scale habitat alteration, isolation and loss…. Other threats include pesticides, agricultural chemicals, water quality issues, predator/prey interactions with cane toads and other stochastic and incremental impacts due to development pressures operating on specific populations".

Advocated recovery actions include:

> "increasing the security of key populations… the protection of these habitat areas, ensuring extant populations are managed to eliminate or attenuate the operation of factors that are known or discovered to be detrimentally affecting the species, … habitat management initiatives to establish self sustaining and representative colonies of 'at risk' captive populations … and through educational programs and involvement to increase the level of regional and local awareness of the conservation status of the (this species)."

The development would not exacerbate known risks or be detrimental to recovery actions.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The clearing of native vegetation is listed as a Key Threatening Process, as a major contributor to the loss of biodiversity. In the determination, the NSW Scientific Committee found that 'clearing of any area of native vegetation, including areas less than two hectares in extent, may have significant impacts on biological diversity'. Clearing can lead to direct habitat loss, habitat fragmentation and associated genetic impacts, habitat degradation and off-site impacts such as downstream sedimentation.

The placement of infrastructure can minimise the clearance of trees and be confined in large part to exotic pasture. The proposal would not contribute significantly to the operation of clearing as a threatening process at the local or regional level.

Clearing can also improve access for the European Red Fox into previously inaccessible areas, where the former vegetation is dense. This is not the case on this site, and no change to fox predation levels is likely from this development.

The invasion of native vegetation by exotic perennial grass is a further Key Threatening Process relevant to this proposal. The Yellow Box, Blakely's Red Gum Woodland EEC in particular is vulnerable to the introduction and spread of perennial grasses such as African Love Grass, Serrated Tussock, Couch, Kikuyu, Whisky Grass, Cocksfoot, Yorkshire Fog, Sweet Vernal Grass, Carpet Grass, Parramatta Grass and Paspalum. With the implementation of weed and sediment erosion control principles, the development is not expected to significantly increase the impact of this Key Threatening Process in the area.

The proposal would contribute positively to the Key Threatening Process Anthropogenic Climate Change, by providing an electricity supply which does not require the burning of fossil fuels.

Conclusion

An Endangered Ecological Community, potential habitat for one threatened flora species and potential habitat for fifteen threatened fauna species occur on or close to the subject site. For the Yellow Box, Blakely's Red Gum Woodland, Buttercup Doubletail and Green and Golden Bell Frog, this assessment concludes that unacceptable impact can be avoided through careful positioning of infrastructure and access routes and the adoption of standard weed and sediment erosion controls.

For the threatened microchiropteran bats, birds of prey and woodland birds considered, potential for population level impacts exists through collisions with turbines. Australian birds particularly are known for changing migration paths, based on ephemerally available resources therefore, although the site is not known to be located on a migration path, it may be ephemerally utilised by the subject species. Quantification of impact in advance of the development is speculative in the absence of verified species movements. Evidence from existing wind farms and species ecology suggests that the levels of collisions would not generate a population level impact however, uncertainty exists. Although this assessment does not anticipate a population level impact is recognises it as a risk that must be addressed. Rigorous and properly timed monitoring of collision impacts should be undertaken and protocols developed so that action can be taken if unacceptable levels of mortalities occur onsite.

D.2 *EPBC Act* Assessment of significance

The *Environmental Protection and Biodiversity Conservation Act* 1999 specifies specific factors to be taken into account in deciding whether a development is likely to significantly affect **Endangered Ecological Communities, threatened species and migratory species**, listed at this level. The following assessments characterise the significance of the likely impacts associated with the Cullerin Wind Farm proposal on Endangered Ecological Communities, threatened species and migratory species, separately.

Endangered ecological communities (EECs)

Parts of the site and areas which may provide access to it carry remnant native vegetation which falls within the description of the Endangered Ecological Community, **Grassy White Box Woodland** (referred to elsewhere in this document as White Box, Yellow Box, Blakely's Red Gum Woodland). The *Environmental Protection and Biodiversity Conservation Act* 1999 specifies seven factors to be taken into account in deciding whether a development is likely to significantly affect EECs. This assessment endeavours not to repeat information already discussed in the NSW Assessment of Significance (Appendix D.1). Knowledge of issues previously discussed in Section D.1 is assumed.

An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:

a) reduce the extent of a community,

The development would not have this effect, since the vegetation will remain much as before the development over most of the site. The better quality examples of this EEC identified by this report (although of only low-moderate conservation significance) can be avoided.

b) fragment or increase fragmentation of the community, for example by clearing vegetation for roads or transmission lines;

The pattern of clearing would not act to fragment this community. The better quality examples of this EEC identified by this report (although of only low-moderate conservation significance) can be avoided.

c) adversely affect habitat critical to the survival of an ecological community which consists of, or includes, fauna species;

The development would not have this effect, since the vegetation will remain much as before the development over most of the site. The better quality examples of this EEC identified by this report (although of only low-moderate conservation significance) can be avoided. The grazing history of the site will continue and vegetation dispersal vectors will not be affected. The site provides only marginal habitat for fauna and this would remain largely unaffected.

d) modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for the community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns;

The development would not have this effect. Soil and water impacts as a consequence of the development have been investigated within the Environmental Assessment Report for the proposal. Soil and water quality impacts can be mitigated with the adoption of sediment and erosion control measures, weed control and hazardous spill control procedures. The water table would not be impacted by works.

e) cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting;

The development would not have this effect, since the vegetation will remain much as before the development over most of the site. The better quality examples of this EEC identified by this report (although of only low-moderate conservation significance) can be avoided. Weed and sediment erosion controls would be implemented as part of the proposed development of the site. Aside from access trails and sites required for the installation of infrastructure, the existing grazing regime would be continued and no change to fire patterns or other factors which may affect species composition are anticipated to result.

f) cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: - assisting invasive species, that are harmful to the listed ecological community, to become established; and - causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community;

The development would not have this effect, since the vegetation will remain much as before the development over most of the site. Weed, hazardous spill and sediment erosion controls would be implemented as part of the proposed development of the site. The existing grazing regime would be continued with no change to fertilizer application, sediment mobilisation or other factors which may affect the integrity of the EEC being necessitated by the proposal.

The invasion of native vegetation by exotic perennial grass is relevant to this proposal. The subject EEC in particular is vulnerable to the introduction and spread of perennial grasses such as African Love Grass, Serrated Tussock, Couch, Kikuyu, Whisky Grass, Cocksfoot, Yorkshire Fog, Sweet Vernal Grass, Carpet Grass, Parramatta Grass and Paspalum. With the implementation of weed and sediment erosion control principles, the development is not expected to significantly increase this effect in the area.

g) interfere with the recovery of an ecological community.

The EEC onsite is degraded and not anticipated to improve under the existing regime which includes periods of heavy grazing. The proposal would not, of itself, interfere with the recovery of the EEC. No recovery plan has yet been prepared for this EEC.

Threatened flora and fauna species

Assessment of habitat requirements of threatened flora species indicated that because of the degree of prior disturbance over most of the site there are no threatened flora species for which the area could potentially be providing habitat. However, one species, the **Buttercup Doubletail (*Diuris aequalis*)** could occur on some sections of road verge near the northern end of the site, which could be affected if road widening is required during the construction phase. Five species of fauna have potential to either utilise the site or be impacted by the proposal when moving through the area. These species include three birds and two microchiropteran bat species (**Swift Parrot, Superb Parrot and Regent Honeyeater and Eastern Bent-wing Bat and Eastern Long-eared bat**).

The *Environmental Protection and Biodiversity Conservation Act* 1999 specifies eight factors to be taken into account in deciding whether a development is likely to significantly affect threatened species or their habitats. This assessment endeavours not to repeat information already discussed in the NSW Assessment of Significance (Appendix D.1). Knowledge of issues previously discussed in Section D.1 is assumed.

a) Will the action lead to a long-term decrease in the size of a population of a species?

Threatened flora: Buttercup Doubletail (*Diuris aequalis*)

Road widening in areas identified by this report has the potential to eliminate a population of this species, should it occur in the vicinity. These specific areas would be avoided during site development.

Threatened fauna

A reduction in the size of a local population could occur for all five subject species, as a result of ongoing fatal collisions with turbines and associated infrastructure.

Although there is a low amount of information available on bat migration routes, the site does not appear to be on a migration path. Mortalities would impact the local population size but would be unlikely to place a local population at risk of extinction due to the low numbers of collisions anticipated. Due to the speculation involved in the assessment, post-construction monitoring should be rigorously carried out to ensure turbines are shut down if large numbers of a threatened species are impacted.

There is a lower risk of the Swift Parrot, Superb Parrot and Regent Honeyeater colliding with turbines while foraging as these species prefer woodland to cleared areas and forage beneath the height of the turbines. The main risk of collision applies during migration or long-distance movements (Appendix E: Bird impact risk assessment). The presence of the turbines may deter individuals from the immediate danger area. Furthermore, woodland exists to the immediate west (on the western slope of the site) that may provide a preferred movement corridor. However, a risk remains that mortalities will occur, impacting on population size. For flocking species, such as the Regent Honey-eater this has potential to generate a population level impact. Monitoring will be required to ensure that mortality levels do not reach unacceptable levels without action being taken.

b) Will the action reduce the area of occupancy of the species?

Threatened flora species: Buttercup Doubletail (*Diuris aequalis*)

The vegetation will remain much as before the development over most of the site. The area that may provide potential habitat for this species can be avoided.

Threatened fauna

Key threatened fauna habitat features with reference to the subject species include mature woodland (rare onsite, confined to gullies) and younger woodland habitats. The proposal would not result in the removal of a significant area of these potential threatened fauna habitat features.

If subject species avoid the ridge as a result of the operational wind turbines, the development could constitute a loss of threatened fauna habitat (although this habitat is considered marginal). Quantification of this potential impact is problematic due to the paucity of information on wind farm impacts and the site specific nature of these impacts. Larger, less modified areas of woodland occur on the western and northern slopes of the site, which would be impacted least during site development.

c) Will the action fragment an existing population into two or more populations?

The threatened bird and bat species with potential to utilise the site are dependent on remnant woodland habitat. Precise migration routes at the site are not known, but woodland species dependent on tree cover (such as the Regent Honeyeater and Superb Parrot) could be expected to use scattered trees and remnant patches as 'stepping stones' during migratory or nomadic movements.

If subject species avoid the ridge as a result of the operational wind turbines, the development has the potential to create a barrier between habitat areas, exacerbating existing levels of habitat fragmentation in the area. The location of proximate resources suggests that the site is not located between important resources and that there is scope to travel around the development (such as over the wooded western slope of the site or to the east over wetlands). Theses species are wide ranging and so the development would not be expected to fragment an existing population into two or more populations.

d) Will the action adversely affect habitat critical to the survival of a species?

Onsite habitat is considered marginal with respect to the subject species; therefore the development would not have this impact.

e) Will the action disrupt the breeding cycle of a population?

None of the subject species are known to breed/reproduce onsite and given the marginal habitat available, this likelihood is considered to be low.

Potential impacts on the lifecycles of the subject species have been considered in D.1 a). There is potential to disrupt the life cycle of the Buttercup Doubletail, if it occurs. This risk can be mitigated by avoiding potential habitat. There is potential to impact the life cycle of bird and bat species via collision mortalities. Monitoring will be required to ensure that mortality levels do not reach unacceptable levels without action being taken.

f) Will the action modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

Onsite habitat is considered marginal with respect to the subject species. The development may constitute a barrier to some species due to the movement of the turbines, not habitat loss, however the site is not considered to be located between proximate areas of quality habitat for the species considered. The development would therefore, not have this effect.

g) Will the action result in invasive species that are harmful to a critically endangered or endangered/vulnerable species becoming established in the endangered or critically endangered species/vulnerable habitat?

Clearing can improve access for the European Red Fox into previously inaccessible areas, where the former vegetation is dense. This is not the case on this site, and no change to fox predation levels is likely from this development.

h) Will the action interfere with the recovery of the species?

Regent Honeyeater : A recovery plan is available for the Regent Honeyeater. It states that the main causes for concern regarding this species are:

- "specialised habitat requirements,
- significant reductions in extent of habitat,
- demonstrable reduction in habitat quality throughout its range,
- apparent reliance on a small number of favoured sites,
- clear reduction in range in recent decades,
- low population level
- low population densities over a large proportion of the range with aggregations occurring for breeding
- there are no obvious, straightforward or quick solutions to the postulated causes of the population decline. Only long-term changes to land management, on both public and private land, will lead to a significant improvement."

The development would not exacerbate known risks or be detrimental to recovery actions. Habitat suitable to the Regent Honeyeater would not be significantly altered by the development. The site is not known to be a favoured site. An increased risk of population impact is present during aggregations, which post-construction monitoring should address.

Swift Parrot: A recovery plan is available for the Swift Parrot. It states that limiting factors affecting the status of the species include:

- "The Tasmanian breeding range is largely restricted to the east coast within the range of the Tasmanian blue gum.
- The breeding season of the Swift Parrot coincides with the flowering of blue gum and the nectar of this eucalypt is the main source of food for the parrots during breeding.
- Woodlands and forests within the parrot's over-wintering range and its restricted breeding distribution have been fragmented and substantially reduced by land clearance for agriculture and urban and coastal development.
- Forestry operations and firewood collection have also altered the age structure of forests, resulting in the loss of older trees that provide a major food resource as well as hollows for nesting.

- The Swift Parrot also suffers from high mortality during the breeding season through collisions with man-made structures such as windows, wire mesh fences and vehicles."

Specific Recovery Plan objectives include:

- "To identify priority habitats and sites across the range of the Swift Parrot.
- To implement management strategies to protect and improve priority habitats and sites resulting in a sustained improvement in carrying capacity.
- To reduce the incidence of collisions with man-made structures.
- To determine population trends within the breeding range.
- To quantify improvements in carrying capacity by monitoring changes in extent and quality of habitat.
- To increase public awareness about the recovery program and to involve the community in the recovery."

The development would not exacerbate known risks or be detrimental to recovery actions. Habitat suitable to the Swift Parrot would not be significantly altered by the development. Although a collision risk is present, the recovery plan also cites man made structures including chain-link fences, windows and vehicles as presenting collision hazards. Monitoring is recommended by the recovery plan and would be implemented as a part of the proposal.

No other recovery plans for subject species have been drafted at this time.

Migratory species

The *Environmental Protection and Biodiversity Conservation Act* 1999 specifies three factors to be taken into account in deciding whether a development is likely to significantly affect threatened species or their habitats. The following Assessment of Significance assesses the significance of the likely impacts associated with the Cullerin Wind Farm proposal on the **Fork-tailed Swift** and **White-throated Needle-tail**, listed under the *Environmental Protection and Biodiversity Conservation Act* 1999 as a migratory species. These species were the only listed migratory species categorised as having greater than low potential to be impacted by the proposal (moderate and low-moderate potential, respectively).

Fork-tailed Swift

This species is a summer non-breeding migrant to the area, from August to mid April. It forages over open country, roosting in cliffs and tall tress and may spend nights on the wing (Pizzey and Knight 2003). Its flight can be erratic and occasional mass movements occur (Pizzey and Knight 2003). It is unlikely to roost onsite, given the lack of suitable roosting habitat but has potential to forage at turbine height as well as be susceptible to collision while migrating in groups at night. Potential habitat occurs in the area. The nearest record is approximately 50km from the site (NSW NPWS Wildlife Atlas, accessed 15 February 2006).

White-throated Needle-tail

This is a fast flying species, occurring in Australia in large numbers during the non-breeding season (October – August). It roosts in trees and forages on flying insects, commonly in thermals associated with storm fronts or bush fires (Australian Museum 2003) and often with other species, including the Fork-tailed Swift. The long distances travelled by this species and tendency to flock ("loose parties to large open flocks"; Pizzey and Knight 2003), put it at increased susceptibility for collision with wind turbines. Most records for this species in NSW are coastal however, several records occur around Canberra with Murrumbateman as the nearest local record.

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

a) substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat of the migratory species,

The vegetation onsite will remain much as before the development over most of the site; the grazing history of the site will continue, soil and water controls, weed controls and hazardous spill controls would be employed during construction, hence the site would not be substantially modified with respect to potential habitat for this species.

The installation of the turbines may act as a barrier to movement on a very local level however, considering the manoeuvrability of these two species, and the distances over which they range, this barrier (approximately 4km in linear length and discontinuous) would not be anticipated to impact the accessibility of important habitats.

These species do not breed in the area, thus the site does not represent breeding habitat. The site is considered only marginal roosting habitat, given the young age of remaining woodland onsite and the dominance of the site by aggressive avian species (Magpies, Ravens, White-winged Choughs). The ridge topography however, may facilitate foraging on insects using thermals.

The site is not considered to be important habitat for this species which was not seen onsite but may occasionally utilise the area.

b) result in invasive species that is harmful to the migratory species becoming established in an area of important habitat of the migratory species,

The development would not have this effect; vegetation will remain much as before the development over most of the site. Sediment erosion and weed controls would be implemented to ensure that weed species, which are already prolific onsite, are not encouraged further by the development. There is some scope to improve the floral composition of the site through off-set agreements with Department of Natural Resources.

c) seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of the species.

There is potential to impact the life cycle of this species via collision mortalities during migration. Both species are erratic flyers and can occur in large numbers, increasing the risk of the impact disrupting a significant proportion of a population of this species. The risk is lessened by limited time they could be expected to spend at the site and the capacity to habituate to humanised landscapes.

Local migration routes are not known. Monitoring will be required to ensure that mortality levels do not reach unacceptable levels without action being taken. With rigorous monitoring in place, this uncertainty can be addressed.

Conclusion

Based on the potential for impact as a consequence of the development of a wind farm on the Cullerin Range, an Assessment of Significance was completed for one Endangered Ecological Community, one threatened flora species, five threatened fauna species and two migratory species, all listed under the *EPBC Act*.

It is considered that significant impact can be avoided through the implementation of controls to address sediment and erosion, weeds and hazardous spills and monitoring of collision impacts. Rigorous and properly timed monitoring of collision impacts should be undertaken and protocols developed so that action can be taken if unacceptable levels of mortalities occur onsite.

APPENDIX E: BIRD IMPACT RISK ASSESSMENT

E.1 Risk assessment

The following risk assessment investigates the risk to birds from the proposed wind farm development on the Cullerin Range. Species considered include species listed as migratory birds under the *EPBC Act* as well as other species known from the area. This table excludes species listed as threatened at either the NSW or Commonwealth level – these species have been addressed in Appendix C: Threatened Species Evaluation. The approach of this table is qualitative, combining assessments of likelihood and consequence to produce a final risk category of low, moderate or high. The direct impact from collision as well as indirect impacts on habitat and habitat utilisation were considered.

Table E.0.1 Bird species risk assessment

Species and risk factors	Behaviour and ecology	Risk
Wedge-tailed Eagle *Aquila audax* Observed at site Forages in open country at blade height, male diving displays, prey source present at turbine sites. Low density and low reproductive rate.	Widely distributed in forest and plain habitats, sedentary. Constructs large stick nests in trees. Feeds on birds, rabbits, small mammals. Rabbits and lambs are local food sources. Observed singly soaring over 30m above the ground, to the west of the range (being harried by two ravens). Mortalities for the related Golden Eagle in US attributed to the presence of prey around turbines (Thelander *et al.* 2003). Turbines with lower blade reaches were most deadly to Golden Eagles. Summer and winter had highest mortality rates (Thelander *et al.* 2003). Wedge-tailed Eagles have collided with turbines in Tasmania and Victoria. Raptors continue to be present within 1 km of the Crookwell I turbines (URS 2004). At Toora (Vic.), Wedge-tailed eagles were regularly observed before and after operations began at this site. Eagles were observed to avoid the turbines by flying around or between them (Brett Lane and Associates 2005). During bird behaviour surveys at Codrington, Wedge-tailed eagles were observed to avoid turbines by flying horizontally around them (twice) and turning and not entering the turbine area (Biosis Research 2002). The species has also been observed flying safely between turbines at the Toora wind farm (Wonthaggi EES Panel 2003).	Mod.
White-bellied Sea-Eagle *Haliaeetus leucogaster* Known from the area Soars on air currents, hovers low over prey, makes angled power dives, travels large distances overland.	This species is known from the area and is thought to use terrestrial as well as riparian corridors to access inland areas (R. Falconer pers. comm. Dec 6 2005). While inland lakes and other large water bodies would be targeted for foraging and nests would be constructed near water, this species may move over the site. Riparian corridors and large lakes exist in the region that could attract this species however, the site is not located between large lakes (such as occur to the south – Lake Burrinjuck, Lake Bathurst, Lake George, Lake Sooley and Lake Pejar) and therefore risk of collision or of avoidance due to the proposal is considered to be low.	Low
Nankeen Kestrel *Falco cenchroides* Observed onsite Forages in open country at blade height, family parties manoeuvre in air currents.	Sedentary or nomadic. Soars around city buildings and spires (Pizzey 1985). Nests in tree hollows; few hollow-bearing trees are present onsite but some are located near the ridge in gullies and in remnant patches in the district.	Mod.

Species and risk factors	Behaviour and ecology	Risk
Brown Falcon *Falco berigora* Observed onsite Chases prey and dives at high speed Glides on air currents	Inhabits open woodland, forest clearings, farmlands and roadsides, among other habitat types. May renovate corvid nests or use tree hollows (Pizzey 1985). This species appears to be flexible in choice of nest site and diet (including lagomorphs, small ground prey, small birds, large birds or reptiles) allowing habitation of a broad range of environments, possibly through 'bet-hedging' (McDonald et al. 2003). A pair was recorded onsite in January 2006, swooping on the eastern slopes around scattered trees. Nesting habitat may be present onsite.	Mod.
Peregrine Falcon *Falco peregrinus* Known from the area Chases prey and dives at high speed Glides on air currents	Habitat most commonly gorges and timbered watercourses, generally near rivers and swamps. Nests on rock crevice, bare ledge, tree hollow or old corvid nest, also on spires and tall buildings (Pizzey 1985). This species appears able to adapt and habituate to human developments. Local records occur near Lake George and in reserves to the north-east and east. The site does not appear to be on a migration route, based on regional sightings.	Low
Brown Goshawk *Accipiter fasciatus* Known from the area Slips through trees and hedges to surprise prey Glides on air currents	Occurs in woodlands, open forests and scrublands. Builds nests in living trees 6-20m. Preys on small birds as well as small mammals. Habitat onsite is marginal; the open woodland patches are dominated by larger birds such as magpies, ravens and choughs and small mammals are at low density. Rabbits however are abundant and may attract individuals to the site seasonally.	Low
Australian Hobby Little Falcon *Falco longipennis* Known from the area Forages in open country at blade height Fast determined pursuit of flying birds and insects	Range of open habitats, typically woodland with large trees and timbered watercourses. Often seen over cities (Pizzey 1985). Builds stick nest in top of tall trees. Hunts small and medium sized birds (including ducks and herons) and flying insects. Appears able to adapt and habituate to developed environments. Few records exist in the local area.	Mod.
Swamp Harrier *Circus approximans* Known from the area Forages in open country at blade height	Migratory, breeding mostly in Tasmania, Victoria and South Australia. Inhabits swamps and wetlands, tall grasslands and grain crops (Pizzey and Knight 2003). Soars high and very low over open country. Constructs large stick nest in eucalypts. Sails low over crops and wetlands when foraging. More likely to be associated with flats than ridgetops.	Low
Barn Owl *Tyto alba* Known from the area **and other owl species** Night-flying Forages in open country	Inhabits open forests, woodlands and grasslands with stands of timber, including farmlands. Nests in tree hollows. Diet includes small mammals, birds, lizards. Small mammal populations on the turbine site are expected to be small, reflected in the survey trapping results. Barn owls are not expected to use the ridge for foraging on a regular or frequent basis. Forest owls are generally confined to areas with tree cover, although dispersing juveniles may fly over open country. This is expected to be a very rare event at the turbine sites.	Low

Species and risk factors	Behaviour and ecology	Risk
Tawny Frogmouth *Podargus strigoides* Known from the area Night-flying	Inhabits heavy forests to open woodlands, timber along watercourses in inland areas. Nests in flimsy stick platforms on branches 5-10m high. Sedentary (Pizzey 1985). Active at dusk, takes prey from sitting position from ground surfaces such as roads. Feeding activities are more likely of the site in timbered lowlands, and would generally occur below blade height.	Low
Painted Snipe *Rostratula benghalensis* Migratory Potential habitat adjacent to site	Little is known of the behaviour of this cryptic waterbird. Possibly nomadic; has been observed occupying ephemeral wetlands. Seeds and invertebrates are foraged for on the waters edge. Breeding is thought to occur in response to local conditions between September and December (Pringle 1987). Habitat may be present at Wet Lagoon, within 4 km of the site. There are no local records. This species does not appear to congregate in large numbers and spends most of its time foraging on the water's edge. Hence, the risk of population level impacts from collision or resource avoidance impacts would not be expected to be high for this species.	Low
Latham's Snipe Japanese Snipe *Gallinago hardwickii* Migratory Potential habitat adjacent to site	This species nests annually in northern Japan, where it congregates in large numbers on the shores of local lakes (Schodde and Tideman 1995). Favoured habitats during the non-breeding season include wet paddocks or shallow water with good covering of tussocks or other growth, seepage below dams, from sea level to 2000m (Pizzey 1985), where they probe for aquatic invertebrate and seed (Green and Osborne 1994). Habitat may be present at Wet Lagoon, within 4 km of the site. This species is recorded from south of Lake George and it may use riparian corridors to move across the landscape. It is not anticipated therefore, to move across the Cullerin Range, and be at risk of collision with wind turbines.	Low
White Ibis *Threskiornis molucca* Known from the area May fly in groups, can be nomadic or migratory Night-flying	Occurs singly or in large flocks, typically in pastures and swamps. Flies in lines or v formations with quick wing beats and glides. Nests over water in dense trees or swamp growth. Highly nomadic, migratory or dispersive (Pizzey 1985). A group was recorded from a nearby wetland during the survey. Australian White Ibises and other waterbird species demonstrate crepuscular peaks of abundance (Hamilton *et al.* 2004). In the Hunter Valley, the White Ibis was found to be one of the species most at risk of colliding with powerlines at night (Hunter Wetlands Research 1996 in URS 2004). In daytime bird behavioural studies at Codrington Wind Farm, where Straw-necked Ibises are abundant, 517 Ibises were observed. 476 birds adopted avoidance strategies of weaving between the turbines and 39 flew in a straight line through the site in a path that kept them well away from the turbines. There were no observed Ibis collisions and no Ibis carcasses have been found (Biosis Research 2002). Ibis and other waterbirds may travel large distances between local water bodies and those in Canberra. They probably use riparian corridors and would therefore avoid crossing into the path of turbines on Cullerin Range.	Low

Species and risk factors	Behaviour and ecology	Risk
Australian Wood Duck and other ducks *Checonetta jubata* Known from the area Swift flight, possibly with poor manoeuvrability	Typically in better-watered lightly timbered pastoral country with plentiful dams. Follows courses of creeks through timber. Nests in hollow of live tree (Pizzey 1985). Regionally abundant, recorded in valley dams near the turbine ridges. Unlikely to pass through the bladeswept area, but keep to riparian corridors.	Low
White-faced Heron *Ardea novaehollandiae* Known from the area May form winter flocks Tendency to perch on high trees or posts.	Common, sedentary and nomadic, found almost wherever there is shallow water, including dams. Builds stick nest in tree (5-12 m above ground), usually near water or some distance away. May perch on dead trees and telephone posts (Pizzey 1985). Possible flight paths are shown on Figure 5.1, following watercourses, drainage lines and low pastures between dams.	Low
Satin Flycatcher *Myiagra cyanoleuca* Migrant, breeding likely to occur within the area.	Typically a species of densely vegetative gullies in tall forests (Pizzey and Knight 2003) but the general absence of tree cover would make the site unlikely habitat. The foraging and nesting height of this species is likely to be low enough to avoid collision or avoidance impacts from the proposal, should the species occur onsite. This species migrates, arriving for the southern spring and summer to breed, then flying to tropical northern Australia, New Guinea, or the islands of South East Asia for the Southern winter. While most Australian species are classified as only partial migrants (Dingle 2005), accessing ephemerally available resources, this species is considered a full migrant. It is not a flocking species. The Satin Flycatcher favours heavily vegetated gullies in forests and taller woodlands when breeding (Pizzey 1985). This species may breed in the study area,	Low
Fork-tailed Swift *Apus pacificus* Migrant, habitat may occur within the area	Forages over open country and nests in cliffs and tall tress. Occasional mass movements occur and this species may spend nights on the wing (Pizzey and Knight 2003). It therefore has potential to forage at turbine height as well as be susceptible to collision while migrating in groups at night.	Mod.
White-throated Needle-tail *Hirundapus caudacutus* Migratory High-flying Vertical flight and diving displays May form large flocks	They are fast flyers, occurring in Australia in large numbers during the non-breeding season (October – August). They roost in trees and forage on flying insects, commonly in thermals associated with storm fronts or bush fires (Australian Museum 2003). Most records for this species in NSW are coastal however, several records occur around Canberra with Murrumbateman as the nearest local record. Although it is not known from the immediate area, the long distances travelled by this species and tendency to flock ("loose parties to large open flocks"; Pizzey and Knight 2003), put it at increased susceptibility for collision with wind turbines. The risk is lessened by limited time spent at the site and capacity to habituate to humanised landscapes. Local migration routes are not known.	Low-mod.

Species and risk factors	Behaviour and ecology	Risk
Rainbow Bee-eater *Merops ornatus* Migrant, suitable foraging habitat onsite.	A species of open woodlands and riverbanks. Foraging could occur in the area. Several records exist for the region. This species can form loose colonies when breeding, in northern Australia. As migrants usually follow established routes, it is unlikely that the site is on a migration pathway, given that the closest records are over 20km to the west of the site.	Low.
Great Egret *Ardea alba* and **Cattle Egret** *Ardea ibis* Migratory / dispersive, suitable habitat nearby.	These species primarily inhabit wetlands and also frequent paddocks and rubbish tips (Pizzey and Knight 2003). They are listed as dispersive and migratory, respectively. While foraging and nesting would be confined to offsite areas, potentially in the wetland corridor to the east of the site, movements to other foraging areas or during migration may result in collisions with turbines. It is unlikely that individuals would avoid areas of currently utilised habitat, as the proposal is approximately 4km from the nearest site (Wet Lagoon to the east). It is also likely that long-distance movements would follow wetland corridors and thereby avoid the site.	Low.

E.2 Conclusion

From the above assessment, no species was categorised as having high potential to be impacted by the proposal. Species categorised as having low-moderate or moderate potential to be impacted by the proposal are:

Wedge-tailed Eagle, Nankeen Kestrel, Brown Falcon, Australian Hobby, Fork-tailed Swift and **White-throated Needle-tail.**

For raptors, the risk was related primarily to foraging activity. There is potential to reduce this risk by managing the availability of prey on the site. For the Fork-tailed Swift and White-throated Needle-tail, the risk was related more to risk of collision during migration or long-distance movements. The latter risk is a non-mitigateable risk. The presence of the turbines may deter individuals from the immediate danger area. Furthermore, woodland exists to the immediate west (on the western slope of the site) that may provide a preferred movement corridor. However, a risk remains that mortalities will occur and monitoring is required to ensure that mortality levels do not reach unacceptable levels without action being taken.

APPENDIX F: PHOTOGRAPHS

F.1 Photographs of the site, by vegetation survey zone.

Ridge, R

Plates a, b, c and d show exotic pasture on the ridge.
Plate e shows more native species composition at the northern end of the ridge, qualifying as the EEC White Box, Yellow Box, Blakely's Red Gum Woodland EEC

Northern Slope, NS, accessed from Old Sydney Road

Plates f, g, h, i and j show better quality woodland occurring on the northern slope of the ridge, down to the Old Sydney Road at the north of the site. The vegetation qualifies as the EEC White Box, Yellow Box, Blakely's Red Gum Woodland EEC.

Southern Slope, SS

Plates k, l and m show scattered open woodland occurring on the southern slope of the ridge, down to the Hume Highway.

The vegetation is transitional between White Box, Yellow Box, Blakely's Red Gum Woodland EEC (low quality) and Widespread Tablelands Dry Shrub/ Tussock Grass Forest.

Western Slope, WS

Plates n and o show the fragmented Widespread Tablelands Dry Shrub/ Tussock Grass Forest on the western slopes.

Eroded gully, ES

(Note: Plates p, q and r have been purposely deleted).

Plates s and t show eroded gully and White Box, Yellow Box, Blakely's Red Gum Woodland EEC on the eastern slopes of the site.

Lerida Road North seen from the southern end of the ridge

Plate u shows southern end of the eastern slopes: modified Yellow Box, Blakely's Red Gum Woodland EEC.

Wet corridor to the east

Plate v shows the view of the wet corridor to the east, from the ridge onsite.

Plate w shows the view of the Cullerin Ridge from Wet Lagoon, approximately 4km to the east of the site.

APPENDIX G: ADDENDUM

G.1 Follow-up assessment of access routes

At the time of the original site assessment the proposed access routes to the ridgetop turbine sites had not been determined. This affected the ability of the biodiversity assessment to characterise the impact of the development on the White Box, Yellow Box, Blakely's Red Gum Woodland, listed as an Endangered Ecological Community in NSW under the *Threatened Species Conservation Act 1995* and the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999.* The biodiversity assessment stated:

> "as this remnant vegetation still fits within the definition of the EEC, additional surveying should be conducted once road access route options are pegged and the required road width is determined. The placement of access trails and installation of infrastructure in better quality areas could then be avoided. Target areas to survey would be the southern access point (the first 50m from Lerida Road North turnoff) as well as any works proposed on Lerida Road North and Old Sydney Road."

A second survey was made on 25 January 2006 to address this point. This addendum constitutes the assessment of these access routes.

The timing of this survey was less suitable than that undertaken in November 2005, as the groundcover, where it was composed largely of annual grasses, had died off and was no longer identifiable. This, combined with heavy grazing at the northern end of the site, made identification of the groundcover vegetation difficult. However, it was still possible to determine which areas are likely to fall under the definition of the White Box, Yellow Box, Blakely's Red Gum Woodland, listed as an Endangered Ecological Community in NSW under the *Threatened Species Conservation Act 1995*. It was assumed that any treeless area with a groundcover dominated by annual grasses and herbs was too degraded to be the EEC, but areas with appropriate tree species (either mature or regenerating) and at least partially native groundcover do constitute the EEC.

Lerida Road North

The road verges were assessed for potential impacts of widening the road to 6 metres, where it is currently less than this width. An additional potential impact is lopping overhanging tree branches. The location of all areas of road less than 6m wide, significant native vegetation and all overhanging trees were recorded, and are presented in Table G.1, below.

Table G.1: Location of significant features along Lerida Road North

Distance from southern-most grid	Width, if < 6m	Features present (grid reference in AGD66 when taken)	Presence of EEC
100m		Kangaroo grass starts at 100m on west verge only.	Yes, west side
300m		Mature and regrowth yellow box	Yes
400m		Northern end of same EEC patch with yellow box saplings overhanging road verge on western side opposite concrete structure.	Yes
500m		Kangaroo grass resumes on cutting, with a few eucalypt saplings, only on west verge	Yes, west side

Distance from southern-most grid	Width, if < 6m	Features present (grid reference in AGD66 when taken)	Presence of EEC
700m		Mature apple box, may need lopping, weedy annual grass understorey	No
900m		Mature yellow box on inner (west) side of slight bend, may need lopping (AGD 719927, 6144828). If road widening needed due to bend, take material off eastern verge.  **Figure G.1 Works on Lerida Road North road verge.**	Yes
1km		Four mature yellow box overhanging road, lopping may be required.	Yes
1.1km		Right hand bend, may need widening on east verge. First 1-2m from road edge is largely bare and could be removed without affecting significant vegetation. West verge is eroded but the vegetation is more intact.  **Figure G.2 Works on Lerida Road North road verge.**	Yes

Distance from southern-most grid	Width, if < 6m	Features present (grid reference in AGD66 when taken)	Presence of EEC
1.2km	4.5m	Culvert (719892 6145050), with yellow box saplings 1-3m from road edge on both sides and fair diversity, non-weedy groundcover on top of cutting on the west verge. The east verge is more degraded so if this area needs widening it should be on the east side, which could be done with the loss of only 1 yellow box sapling (1 of 8 in that location).  **Figure G.3 Works on Lerida Road North road verge.**	Yes
1.25km		Side road to telecommunications tower (AGD 719893, 6145078). If Lerida Road needs to be widened here to enable large vehicles to turn, the widening should be done on the east verge, which is dominated by weedy annuals out to 9m from the current road edge. A large yellow box overhangs the junction and may need lopping. If the side road needs widening it should be done on the southern verge, which is weedy. The northern verge has a groundcover in fair condition.	Yes
1.3km	4m	Grid and gate, the latter is wide enough to use without further road widening. Some overhanging yellow box branches just north of gate may require lopping.	Yes
1.35km		Red stringybark in poor condition overhanging.	No
1.4km	4m	Concrete causeway (6m) with road narrowing from causeway to crest slightly to north. Dense brittle gum saplings on cutting top and 1 mature broad-leaved peppermint overhanging. East verge consists of a 4m wide bare earth bank, which could be removed to widen the road.	No
1.6km	<5m	Culvert (AGD: 719850, 6145512), with eroded bare earth for 2-3m on both verges, but surroundings including yellow box and red stringybark. One mature yellow box overhanging 20m to north, saplings >3m from road edge both sides. Road could be widened to 6m without affecting these. Tree may require lopping.	Yes

Distance from southern-most grid	Width, if < 6m	Features present (grid reference in AGD66 when taken)	Presence of EEC
1.75km		Large overhanging yellow box on E side, abundant yellow box and Blakely's red gum saplings on both sides	Yes
1.8km	5.5m	Concrete causeway (AGD: 719872, 6145638), brittle gum saplings both sides, one red gum sapling on east verge.	Yes
1.85km		One yellow box and one red stringybark overhanging	Yes
1.9km		One broad-leaved peppermint slightly overhanging. The start of a quality section of EEC begins here (AGD: 719906, 6145770).	Yes
2.0km		Blakely's red gum on east verge slightly overhanging – lop branches rather than widening road, as the western verge has fair quality native groundcover.	Yes
2.25-2.3km		Culvert (AGD: 719934, 6146072). Several overhanging trees, more open grassy area north of these.	Yes
2.35km		Culvert, 6m width.	Yes
2.4km		Overhanging yellow box.	Yes
2.5km		Overhanging yellow box.	Yes
2.55km		Overhanging brittle gum.	Yes
2.6km		Overhanging red gum and yellow box.	Yes
2.65 km		Grid and gate (AGD: 720014, 6146430) into heavily grazed and more sparsely treed paddock. This marks the end of the quality section of EEC.	No
2.8km		Overhanging red gum, could be lopped, or widen road to avoid it.	No
2.9km		Overhanging brittle gum, could be lopped, or widen road to avoid it.	No
3.0km		Overhanging red gum, could be lopped, or widen road to avoid it (but road is in cutting so lopping would be easier)	No
3.15km		Overhanging red gum, could be lopped, or widen road to avoid it (but road is in depression so verges may be boggy)	No
3.2km	5m	Culvert (AGD: 719992, 6146928), boggy area, degraded vegetation.	No
3.4, 3.45		Culverts, 6m wide.	
3.7km		Culvert, 6m wide, overhanging yellow box on east side.	No
3.85km		Culvert, >6m wide.	No
3.95km		Culvert, >6m wide. Slightly overhanging yellow box on west verge, could be lopped or widen road to avoid it.	No

Distance from southern-most grid	Width, if < 6m	Features present (grid reference in AGD66 when taken)	Presence of EEC
4.05km		Grid and gate to heavily grazed mixed native and exotic pasture. Width >6m.	No
4.2km		Large overhanging yellow box on west side. Could lop or avoid by widening the east side.	No
4.5km		Grid onto Old Hume Highway, road wide enough to turn off Lerida Road without removing vegetation.	No

On Lerida Road North, the presence of the White Box, Yellow Box, Blakely's Red Gum Woodland EEC is restricted to the southern-most paddock (of the three paddocks through which the road passes). The northern and middle paddock are much more heavily grazed with no tree regeneration and more areas dominated by exotic pasture. Some remaining yellow box and Blakely's red gum in these paddocks indicate that the EEC also occurred here, but on the road verges it has been degraded, probably to the point of being non-recoverable. The remaining trees in these areas are still of conservation value as fauna habitat, and should not be disturbed other than by lopping if essential to allow tall vehicles to pass.

In the southern paddock, suggestions have been made in the table above as to which verge is the more degraded, in areas where it may be necessary to widen the road. In all cases, one or other verge has groundcover vegetation which is degraded, being either largely bare, or restricted to weedy annual grasses, and road widening impacts should be restricted to this verge. The loss of occasional saplings of yellow box and Blakely's red gum is not considered to be significant in terms of the total distribution of the EEC along Lerida Road North, as tree regeneration is abundant in the southern paddock. Better quality, predominantly native, groundcover, including occasional shrub presence, is a feature which is harder to replace than tree regeneration, and every effort should be made to minimise impacts on these areas. This would include taking care not to park any machinery used in road widening or tree lopping off the road within this paddock.

Old Sydney Road and gate to the northern access route

The potential habitat for the Buttercup Doubletail orchid (*Diuris aequalis*) was reassessed, and determined to extend from the junction with the Old Hume Highway to 300m up Old Sydney Road (AGD: 719292 6148424), at which point the groundcover becomes dominated by exotic species, although the same tree species are still present. Only the southern verge is likely to be potential habitat, as the northern verge also has a weedy understorey.

There are a few small trees overhanging the Old Sydney Road which may need minor lopping. The dominant vegetation is brittle gum, which suggests that this area is Widespread Tablelands Dry Shrub/Tussock Grass Forest rather than the EEC. However, around the gate that would be used for the northern access to the ridge, the dominant tree species is Blakely's red gum. On either side of the gate is quite dense regrowth of red gum and wattle (*Acacia ?deanei*), with grassy understorey dominated by the exotic annual quaking grass (**Briza maxima*), with a small component of native grasses (*Austrodanthonia* sp and *Poa sieberiana*) and no forbs. This would fall under the definition of the EEC, but it is in poor condition and of low conservation significance. The removal of wattles and lopping of red gums adjacent to the gate would not have a significant impact on the EEC in this area.

Northern access route

The proposed access route to the northern-most wind turbine site roughly follows an existing farm track up the least steeply sloping part of the ridge. For the most part this route passes through heavily grazed pasture, some of which may be dominated by native *Austrostipa* or *Austrodanthonia* species, but with no forbs at all detectable at the time of this survey. Extensive areas carry only annual pasture grasses, which were dead at the time of the survey, and seedlings of exotic annuals, including clovers (**Trifolium* spp).

The proposed route cuts across the western tip of a dense patch of brittle gum woodland, with virtually no understorey due to heavy grazing pressure. A few younger trees may need to be removed here (Figure G.4). The route then crosses a treeless saddle before passing into more open woodland with a mixture of red stringybark, brittle gum, Blakely's red gum and yellow box, and an understorey of annual grasses (Figure G.5). It would be difficult to call this area of woodland EEC, due to the exotic groundcover (despite the presence of both red gum and yellow box). The trees are probably sufficiently widely spaced for no tree removal to be required, but if trees do need to be removed, the preferred route is that which requires only red stringybarks in poor health to be removed. Removal of yellow box and red gum should be avoided.

Close to the ridge top there is an extensive rocky patch, 70-100m long and perpendicular to the proposed route, which still carries some native grasses and an occasional shrub (*Hibbertia obtusifolia*), particularly at the lower end (AGD 719108 6147492). Due to the amount of protruding vertically bedded rock, it is likely that the road will require more extensive earthworks through this area. It is marginally part of the EEC, although the nearest trees are brittle gum and red stringybark, with one small yellow box. The upper edge of the rocky patch has been invaded by annual grasses from the pasture above it, and is not part of the EEC. Given that the rocky patch extends some distance to the west and into an adjoining paddock which appears slightly less heavily grazed, the impact of putting the access road through one end of it would not be significant. It has very low native species diversity.

G.2 Conclusion

The access routes proposed would largely utilise existing roads and farm tracks. Where they are required to be modified to facilitate vehicle access, recommendations have been made in this addendum in order that the required lopping and grading can be undertaken in a manner that does not generate unacceptable impacts on the remnant native vegetation onsite and in immediately adjacent areas.

Figure G.4 Patch of brittle gum adjacent to saddle. A few younger trees may need to be removed.

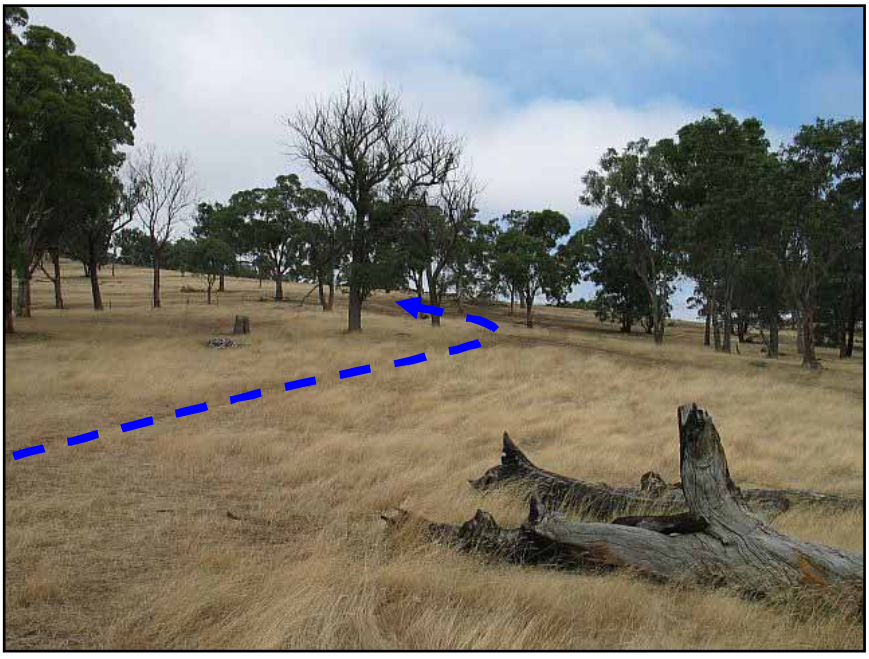

Figure G.5 Removal or lopping of red stringy bark is preferred to yellow box and red gum.