

3.3 Biodiversity assessment

Proposed development the Gullen Range wind farm, southern tablelands of New South Wales



Biodiversity Assessment

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1. INTRODUCTION

This Biodiversity Assessment has been prepared on behalf of Gullen Range Wind Farm Pty Ltd. It assesses the biodiversity values and impacts likely to be associated with the proposed development of the Gullen Range wind farm on the Southern Tablelands of New South Wales. The proposal is for up to 84 turbines and would generate up to 278MW of electricity. Infrastructure would be located along a north-south ridge system, clustered in four locations. Arranged from north to south these locations are named for nearby localities and include Kialla, Bannister, Pomeroy and Gurrundah (Figure 1-1 overview, Figures 2-1 – 2-4 individual locations). All locations are situated within the Upper Lachlan Local Government Area.

The proposal would involve excavation works and some removal of native vegetation to install and maintain up to 84 wind turbines. Inter-turbine connection (by underground cable), the connection of turbines to the electricity grid (by overhead cable) and the installation of an electrical substation and access tracks would also require excavation and vegetation modification.

This report characterises biodiversity attributes separately for each location and determines the likelihood and level of impact to flora and fauna that may arise during and following the proposed 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.

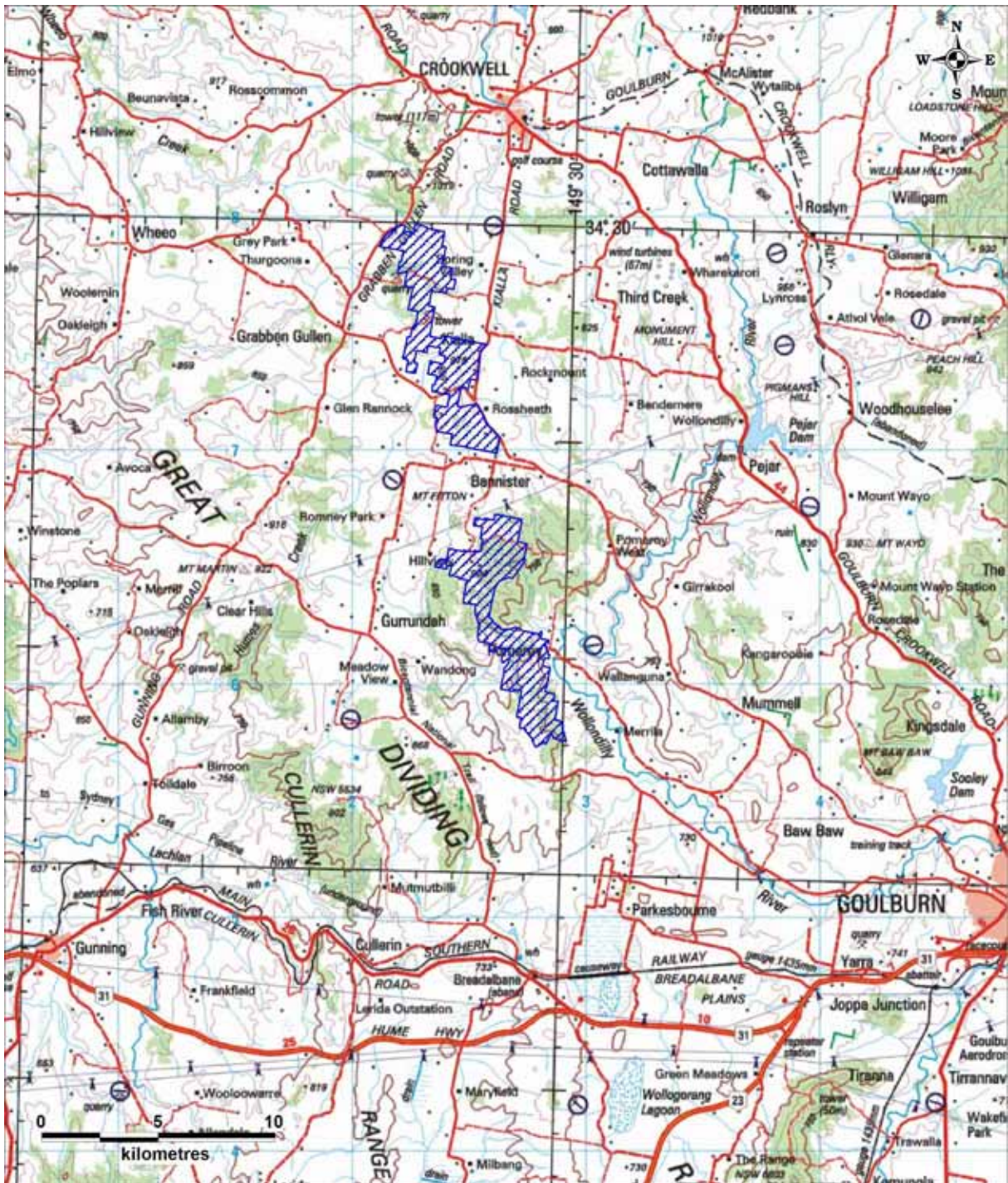


Figure 1-1 Location of the proposed Gullen Range wind farm

The indicative development envelopes are indicated in blue. Additionally, an electricity easement will connect the northern and southern envelopes.

2. THE PROPOSAL

2.1. Description of the locations

All four locations where infrastructure would be installed, Kialla, Bannister, Pomeroy and Gurrundah, are located on private property within and adjacent to agricultural areas used for sheep and cattle grazing. As well, residential dwellings and two commercial operations (chicken farms) are located nearby.

On average, the proposed development would occupy four kilometres of ridge line at each location. The ridge system over which the turbines would be installed runs in a north-south direction; the maximum distance between the northern-most location and southern-most location would be approximately 22km, refer to Figure 2-1.

In general, the locations can be characterised as grassland ridges and flats with woodland patches on slopes and in gullies. Factors affecting habitat value, such as soil type, elevation and landforms are described briefly in the figure captions below (Figures 2-2 to 2-5). Additional habitat features, such as the extent of rocky outcrops, maturity and connectivity of woodland patches, and the number and type of water bodies, are described in more detail in Section 5.2.1.

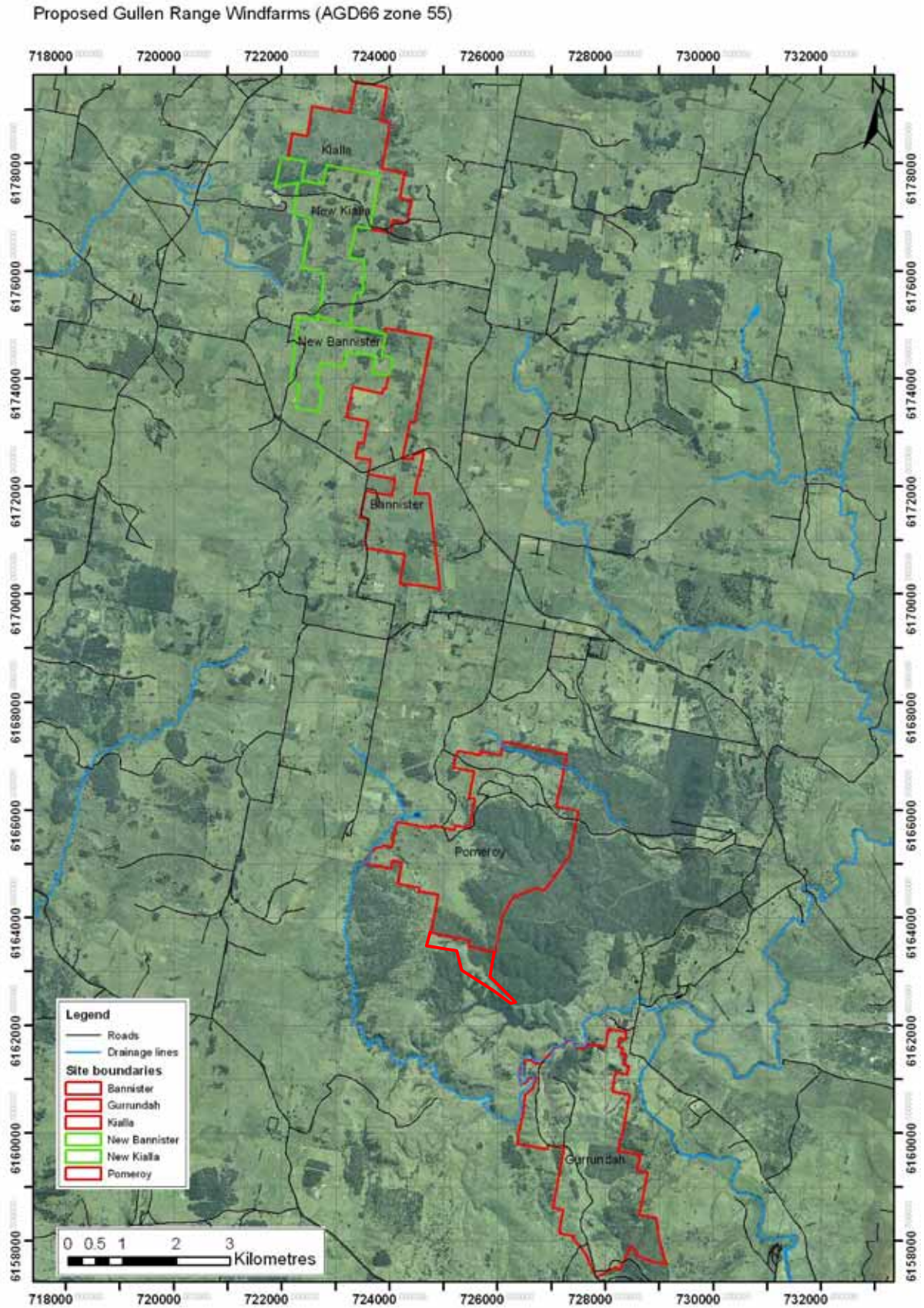


Figure 2-1 Site boundaries

The red area was assessed in the main survey session (autumn). Follow-up surveys (spring) addressed the new sites at Kialla and Bannister, shown in green, as well as selected parts of the original assessment area.

Proposed Gullen Range Windfarms (AGD66 zone 55)
 Kialla Site Boundaries

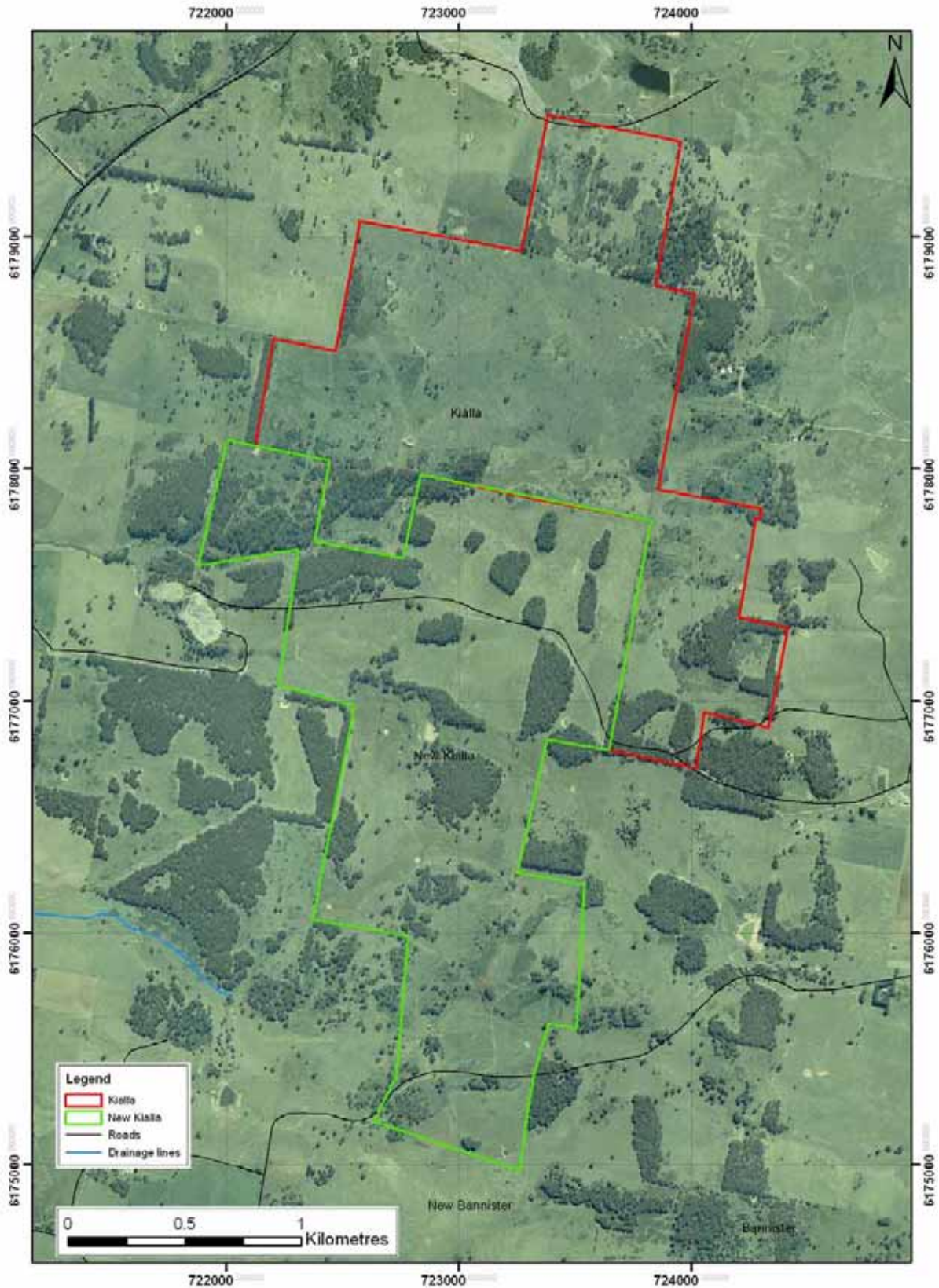


Figure 2-2 Kialla site boundaries (autumn survey red, spring survey green).

Kialla features Ordovician metasilstone derived soils. These soils are relatively infertile. Landforms are flat to moderately undulating with a mean elevation of approximately 970m ASL. Most of the site has been cleared of woodland and forest. Remnant patches remain along the site's southern boundary and offsite, to the east and south.

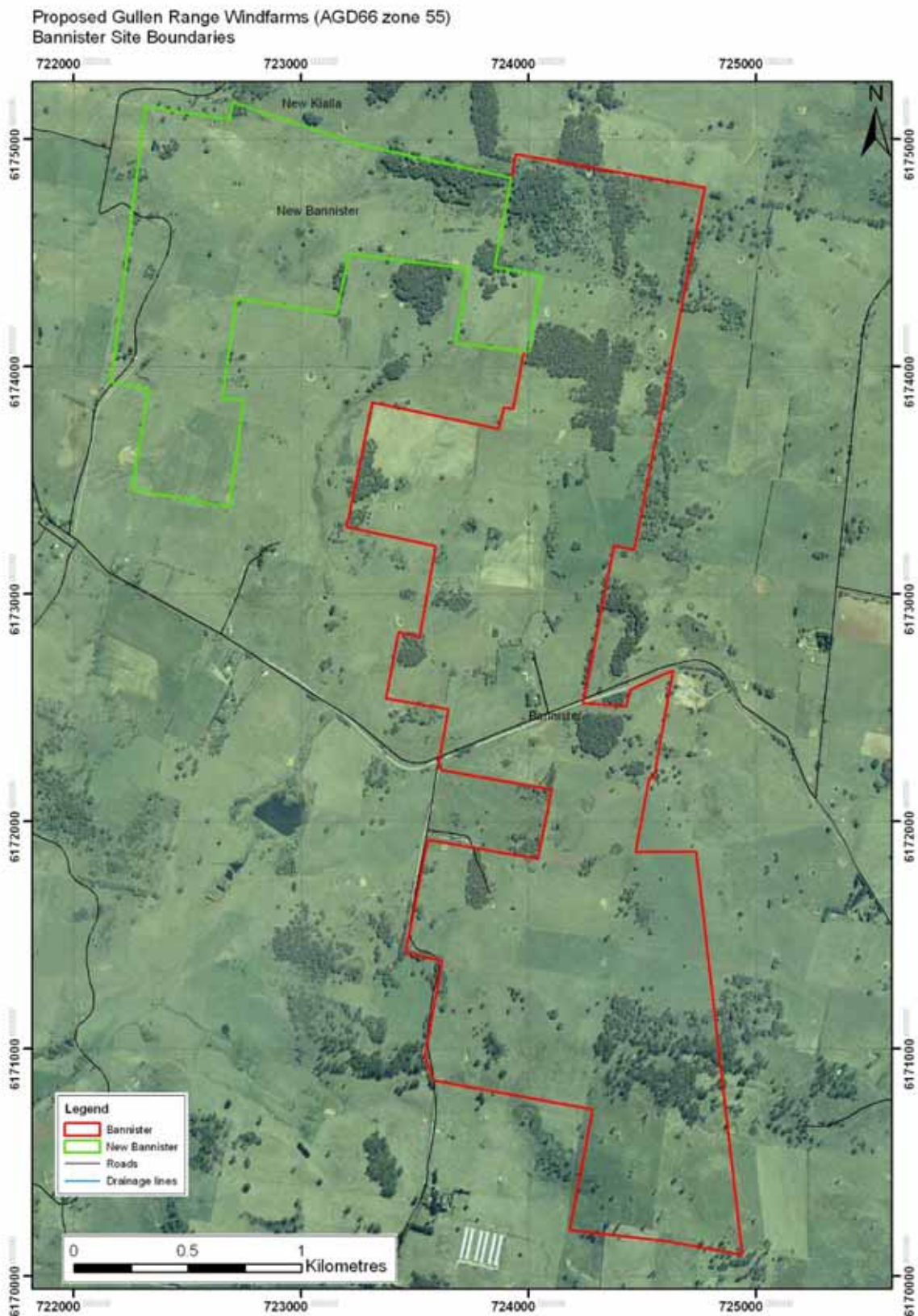


Figure 2-3 Bannister site boundaries: (autumn survey red, spring survey green).

This location features the relatively infertile Ordovician metasiltstone derived soils as well as basalt in higher areas. The latter soils contain more clay and are of higher fertility, depth and moisture-holding capacity. Landforms are flat to moderately undulating with a mean elevation of approximately 970m ASL. Most of the site has been cleared of woodland and forest. Remnant patches remain at the northern end of the site and in the south, with the latter more open and younger.

Proposed Gullen Range Windfarms (AGD66 zone 55)
Pomeroy Site Boundaries

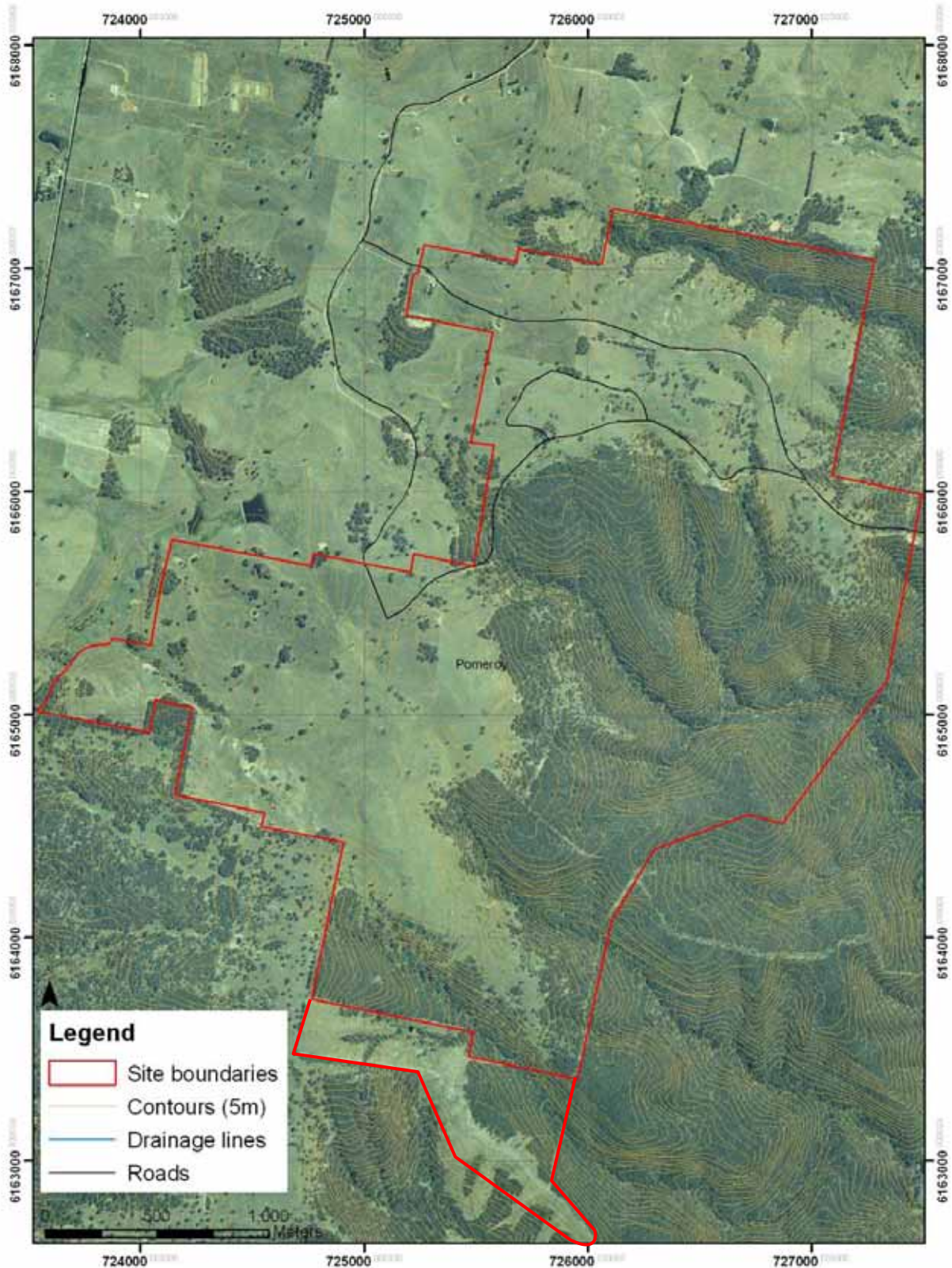


Figure 2-4 Pomeroy site boundaries

This location features the relatively infertile Ordovician metasiltstone derived soils as well as the more fertile basalt in higher areas. Landforms are flat to very steep with a mean elevation of approximately 860m ASL. Approximately half of the site has been cleared. Small woodland remnants remain in cleared paddocks. An extensive area of regrowth woodland which features several gully systems is present to the east. Approximately one fifth of this woodland occurs onsite.

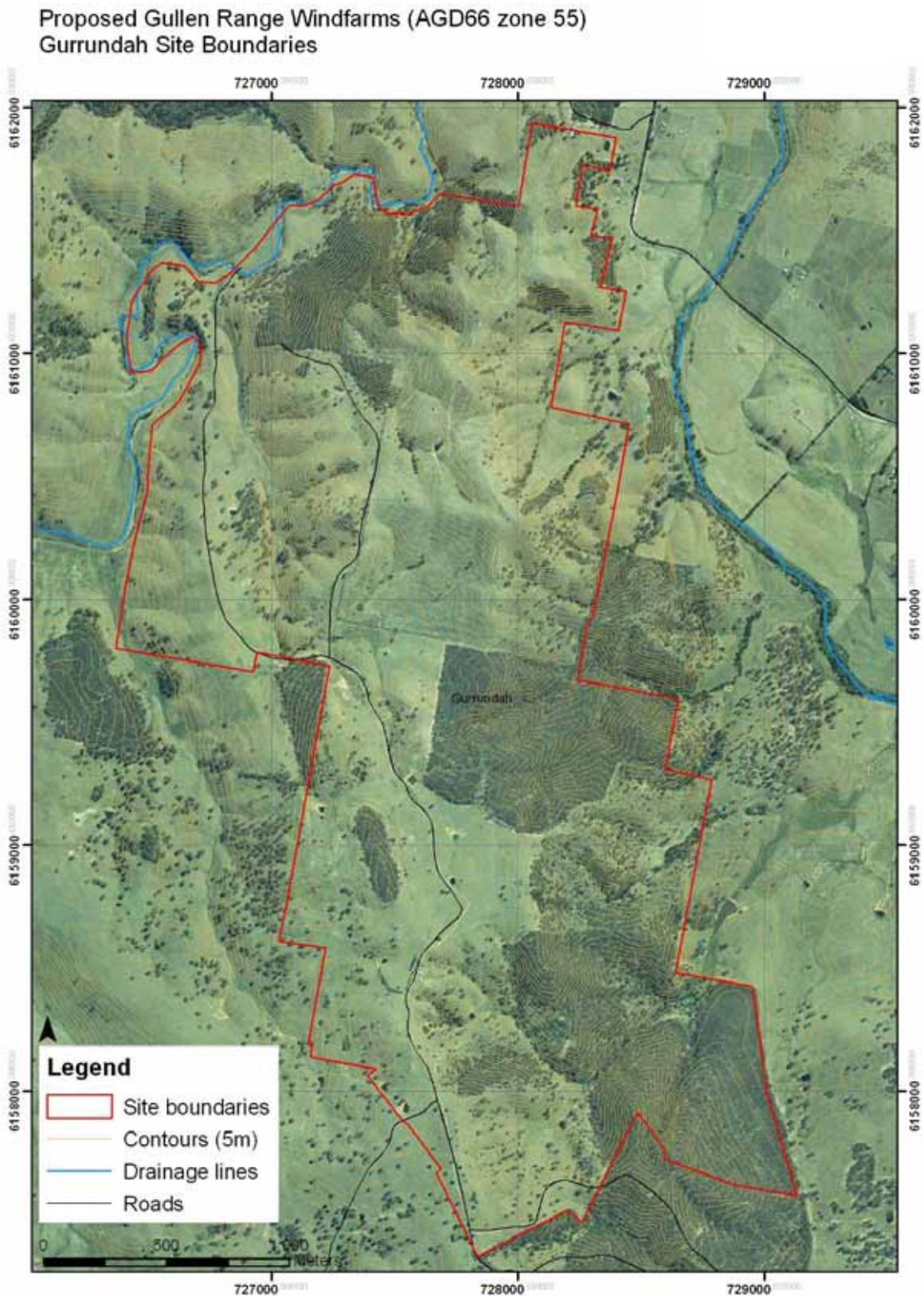


Figure 2-5 Gurrundah site boundaries

This location features the relatively infertile Ordovician metasiltstone derived soils. Landforms are undulating to very steep with a mean elevation of approximately 780m ASL. Approximately two thirds of the site has been cleared. Small woodland remnants remain in cleared paddocks. An extensive area of regrowth woodland is present on the south-eastern side of the site, which continues offsite to the south. A steep area of woodland is also present in the north-western corner of the site.

2.2. Proposed works and associated impacts

2.2.1. Proposed works

The proposal would involve the construction, operation, and eventual decommissioning after 25-30 years of:

- Up to 84 wind turbines, on a tubular steel tower up to 85m high;
- Electrical connections between wind turbines using underground cable;
- A substation and transmission connection linking the wind turbines to the existing TransGrid 330kV transmission system;
- The development or upgrade of internal access roads;
- Minor upgrades to offsite access;
- Onsite control rooms, equipment storage facilities and stockpile sites;
- Temporary concrete batching plant (s);
- Potentially, rock-breaking and blasting equipment during the construction phase.

2.2.2. Associated impacts

Environmental impacts would be associated with each stage of the proposal, including the installation, operation and decommissioning of the wind turbines and associated infrastructure, as discussed below.

Installation

Installation impacts would occur within a discrete time period of between 12-24 months. Direct impacts would be temporary. There is potential for indirect impacts to be ongoing, if these are not managed effectively. Potential installation impacts are outlined below.

- Vegetation clearing / branch lopping 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. It has been assumed that the existing availability of cleared areas onsite would mean further clearing to accommodate infrastructure would be minimal.
- Drainage line impacts. Increased sedimentation or nutrients that find their way to drainage lines can create ongoing offsite impacts. It has been assumed that large and heavy vehicles and turbine placement would not be required within close proximity to gullies and water bodies, with the exception of constructed dams located near proposed works. These may be filled.
- Road works. The works would require upgrades to roads onsite and potentially to public roads enroute to the locations. This would involve some clearing as well as cut and fill and the laying of road base.
- 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 buildings.
- 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.
- Indirect construction impacts. Noise, dust and vehicle emissions would be generated in carrying out the above mentioned activities.

Table 2-1 Development envelope

The development footprint is expected to create the following areas of disturbance. Some of these areas will be able to be rehabilitated after the construction phase.

	Quantity or length	Dimensions	Total area (hectares)	Description of existing land
Turbine footing	84 turbines	15 x 15m	1.89	Pasture
Access and crane stand*	84 turbines	40 x 22m	7.39	Pasture
Access and spur roads onsite#	45.0km	8m	36.00	Existing tracks and Pasture Woodland (potential EEC) 250m x 8m
External site access	4.6km	8m	3.68	Existing road / road easement, pasture
Underground powerline cabling onsite*	45.0km	2m	0.00	Predominantly located within access roads
Overhead powerline cabling / easement#	13.0km	20m	26.00	Existing tracks and pasture Woodland (potential EEC) 250m x 20m
Substation	1 substation	200 x 150m	3.00	Pasture
Control building	1 control room	25 x 15m	0.04	Pasture
Concrete batch plant#	2 concrete batch plants	100 x 75m	1.50	Pasture
Construction compound, staging and storage#	4 areas	3 ha	12.00	
			91.50	ha
Total site area	3400 ha		2.69	percent
Development envelope	1400 ha		6.54	percent

* Areas which can be rehabilitated after the infrastructure is installed (post construction phase).

Areas which can be rehabilitated after the life of the project (in excess of 25 years).

These totals include the total lengths of alternative power line and access tracks.

Access tracks onsite are largely existing farm tracks that would require upgrades.

Operation

Operational impacts would occur for the duration of the project.

- 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.

Decommissioning

Decommissioning impacts are difficult to accurately determine, given that over the next 25 years, construction techniques will progress. They are expected to include the following:

- Removal of all above ground infrastructure, including limited excavation (concrete slabs and underground cabling would remain insitu).
- Vegetation clearing / branch lopping may be required to facilitate the egress of large vehicles from the site and similarly to lay out turbine blades before their removal from the site. It has been assumed that the existing availability of cleared areas onsite would mean further clearing to accommodate infrastructure would be minimal.
- Indirect construction impacts. Noise, dust and vehicle emissions would be generated in carrying out the above mentioned activities.

Proposed Gullen Range Windfarms (AGD66 zone 55)

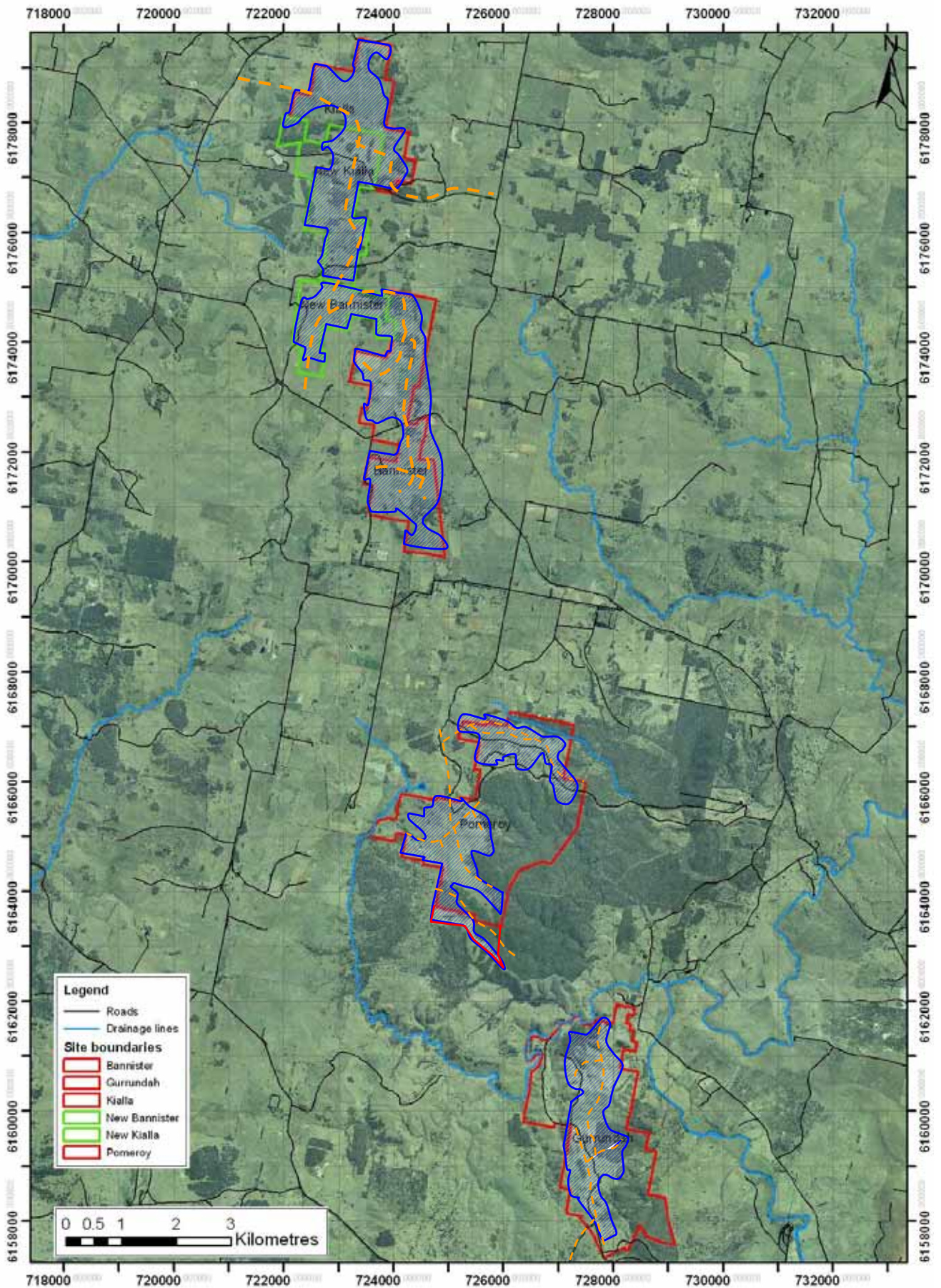


Figure 2-6 Location of the assessment area (development envelope).

The proposed turbine location envelopes are shaded in blue, electricity connections and access tracks are shown in orange.

3. REGIONAL CONTEXT

The installation and operation of wind farms have characteristics that make it necessary to examine a broad environmental context when assessing their impact:

- The turbines can be very tall and can therefore impact migration paths / movement corridors of birds and bats;
- The transmission easements required to connect the wind farms to the electricity grid can be very long, potentially fragmenting areas of habitat for species of flora and fauna, restricting the movement/dispersal of species;
- Upgrades to roads and access trails to facilitate the movement of large machinery onto the locations can disturb road-side vegetation remnants. In modified landscapes, these road side remnants often retain rare species, lost to adjacent more intensively utilised lands.

The area proposed for the development of the Gullen Wind Farm has unique biodiversity attributes. The NSW Southern Tablelands bioregion 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 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).

A regional review of habitats in the area was conducted with reference to aerial photography, topographic maps, by vehicle survey and using previous assessments conducted in the area.

3.1.1. *Bioregion and subcatchment overview*

About 14% of the bioregion is managed in conservation tenures. National parks and nature reserves occupy 596,638 hectares or 12.22 per cent of the bioregion. Three conservation reserves occur within 50km of the site; Tarlo River National Park, Morton National Park and Muddoonen Nature Reserve.

The four locations proposed for this development fall within the administrative jurisdiction of the Hawkesbury Nepean Catchment Management Authority, Upper Wollondilly River Subcatchment. The Upper Wollondilly River Subcatchment is the highest point in the catchment and is located adjacent to the westward flowing Lachlan River Subcatchment. There are two reservoirs and several weirs within the Subcatchment. The CMA note that there are no reserved lands in the Subcatchment, much of the land in the Subcatchment has been historically cleared of its riparian and floodplain vegetation for grazing and rural-residential development and that the lower reaches near Goulburn are more severely impacted than the upper reaches. There is also a willow and Serrated Tussock threat (Hawkesbury Nepean CMA 2006).

3.1.2. *Regional 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. A range of riparian and wetland habitats occur in the bioregion, including river oak forest, heathy swamps and sedgelands. These wetlands can be ephemeral, attracting large numbers of birds in wet

seasons. Lower elevation wetlands can be extensively depleted and degraded by draining, salinity, nutrient pollution, grazing, sedimentation and weeds.

There are 133 plant species listed in the *TSC Act* in the Hawkesbury Nepean catchment (DEC NPWS Wildlife Atlas 20 June, 2007).

3.1.3. *Regional fauna*

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).

Although showing much degradation, river corridors support species such as the Diamond Firetail (Wollondilly River, pers. obs. B. Marshall 2007). 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).

There are 98 fauna species listed in the *TSC Act* in the Hawkesbury Nepean catchment (DEC NPWS Wildlife Atlas 20 June, 2007). Large areas of well connected habitat are necessary for many of these threatened species. While many species can persist in smaller patches, these are often subject to disturbances which can impact on population viability (NSW NPWS 2003).

3.1.4. *Corridors*

Locally, much of the subcatchment has been cleared of woodland vegetation. Remaining remnants of substantial size can be seen on Figure 3-1 (and on the aerial photo, Figure 6-5). The pattern of remaining vegetation shows the most extensive areas to the west and east of the site. These may be preferred north-south movement corridors in the area. Although more fragmented, the western route follows the Lachlan River, increasing its value to wildlife. Between these two potential routes, the development envelope is located amongst more fragmented vegetation however, large patches are located near Pomeroy, and to the west along the Cullerin Range.

On a landscape scale, larger patches of remnant vegetation occur on the ridges, with flats cleared for more intensive land use. On a micro scale, road verges and creeks retain smaller areas of native vegetation that may be used by fauna. Creeks and rivers close to the sites include Kialla Creek, Ryans Creek, Humes Creek, Heffernans Creek, Waterhole Creek, Sheet of Water Creek, Gurrundah Creek and the Wollondilly River, most located near the two southernmost sites of Pomeroy and Gurrundah. Ephemeral wetlands occur, observed from roadsides, these appear extensively degraded by clearing and stock access.

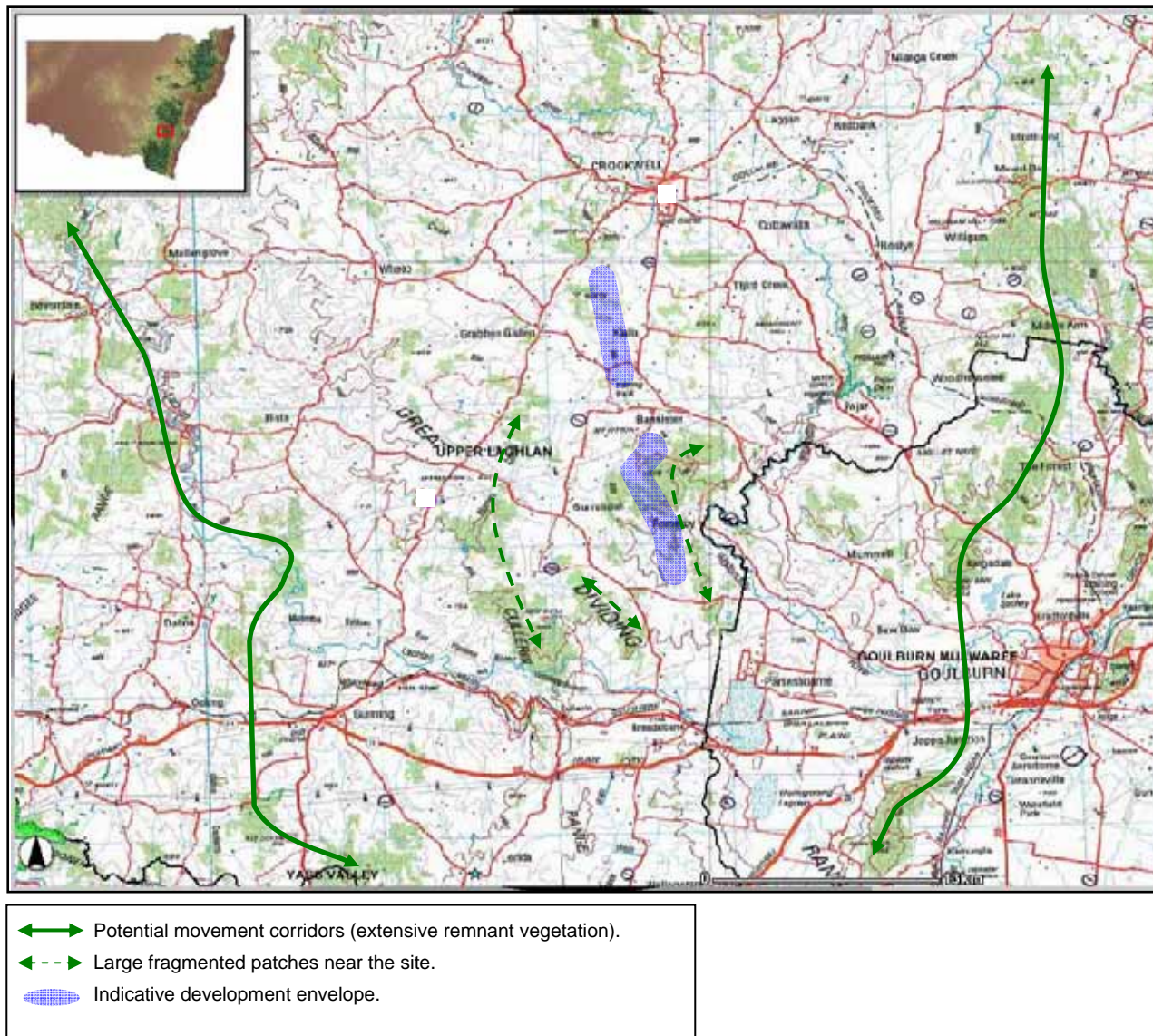


Figure 3-1 Potential regional corridors

Patterns in remnant vegetation are indicated with green arrows. The development envelope is indicated in blue.

3.1.5. Matters of national significance

Matters of national significance, listed under the *Environment Protection and Biodiversity Conservation Act 1999*, within a 50km buffer around the development envelope, were investigated using the EPBC reporting tool (accessed 20 June 2007, provided in full, Appendix F).

The following matters were returned by the search:

- Two threatened ecological communities: Natural Temperate Grassland of the Southern Tablelands of NSW and the Australian Capital Territory and White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.
- Eleven threatened flora species: Yass Daisy, River Swamp Wallaby-grass, Thick-lipped Spider-orchid, Buttercup Doubletail, *Tricolour Diuris*, Trailing Hop-bush, *Kunzea cambagei*, Basalt Pepper-cress, Hoary Sunray, Button Wrinklewort and Austral Toadflax.
- Fifteen threatened fauna species: Swift Parrot, Superb Parrot, Painted Snipe, Regent Honeyeater, Yellow-spotted Bell Frog, Littlejohn's Tree Frog, Golden Sun Moth, Large Pied Bat, Spot-tailed Quoll, Eastern Long-eared bat, Brush-tailed Rock Wallaby, Grey-headed Flying Fox, Pink-tailed Worm Lizard, Striped Legless Lizard and Broad-headed Snake.
- Thirteen migratory species: White-bellied Sea-Eagle, White-throated Needletail, Rainbow Bee-eater, Black-faced Monarch, Satin Flycatcher, Rufous Fantail, Regent Honeyeater, Great Egret, Cattle Egret, Double-banded Plover, Latham's Snipe, Painted Snipe and Fork-tailed Swift.
- One Ramsar site: Fivebough and Tuckerbil Swamps (located over 300km west of the study area).
- Two nationally important wetlands: Lake Bathurst and Lake George (located approximately 35 km south and south-east of the study area, respectively).

Where relevant, consideration was given to these matters in the assessment of threatened species and communities, Sections 4 and 5.

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. Survey effort and limitations

Timing of surveys

The main vegetation surveying was undertaken during the period 29 March - 5 April, 2007. The survey team included two botanists. The locations are large and survey timing was not optimal for all species. This survey was undertaken after a period of prolonged drought; some species which may be present in the soil seed bank were not apparent at the time of the survey. Rain had fallen about six weeks prior to the survey, producing some growth and germination of seed, but many plants were still in the seedling stage and few were in flower, so some identifications remain tentative. Many shrubs had been heavily browsed, making them more difficult to identify. Spring-flowering annuals are unlikely to have responded to the rainfall.

A follow-up survey was undertaken during 1 - 2 November, 2007 by one botanist, covering three additional properties in the Kialla - Bannister area. This additional survey effort addressed limitations of the earlier survey, since good rains had fallen in the area over winter and spring.

Area assessed and survey methods

At the time of the site assessment, a turbine layout had not been developed. Therefore, assessment of a 'development envelope' at each location was undertaken based on an analysis of topography via mapped contours. This method allowed the survey area to reflect the most likely location of the wind turbines, elevation (ASL) being used as a surrogate for potential wind speed. These were as follows:

1. Kialla, above the 980m contour;
2. Bannister, above the 960m contour;
3. Pomeroy, above 860m contour;
4. Gurrundah, above 780m in the northern part (Sugarloaf Trig), and above 800m in the southern half of the site.

Likely locations for access tracks and the substation were also assessed.

The survey methodology was the random meander method of Cropper (1993). No quadrat-based survey was done, but greater survey effort, equivalent to that required for quadrats, was applied to areas which were in better condition, or appeared likely to fall within the definition of the various Endangered Ecological Communities (EECs) which could occur in the vicinity.

The total survey effort on the first field survey was 5 full days by two botanists, with some additional time on the subsequent two days by a single botanist (total c. 11 person days). The second field survey (covering three additional properties, and briefly revisiting one of the earlier sites, Kialla) consisted of 1.5 person days.

Given that the exact location of the turbines was not finalised at the time of these surveys, it was not possible to exhaustively survey the sites most likely to be heavily impacted by the proposal. The flora survey concentrated rather on determining the vegetation types present and the general condition of the vegetation and likelihood of threatened species being present, within the broad areas likely to be affected by the proposal. It was assumed that no intact forest or woodland would be cleared, but that some isolated trees or small remnant patches of trees within pasture may need to be cleared. This approach was considered adequate to determine potential impact within the development envelope.

Surveys were undertaken in all areas of woody vegetation located within or adjacent to the relevant parts of the sites defined above. On the flatter sites (Kialla and Bannister) this amounted to all areas of native vegetation, while on the steeper Pomeroy and Gurrundah sites mainly the upper edges of vegetation on steeper parts of the site was assessed as the proposed infrastructure is predisposed to be located on ridgelines. However, some gullies and creek banks were also checked on Pomeroy. Checking within the extensive areas of pasture was more limited, but representative areas of native and exotic pasture were assessed.

Despite the survey limitations with regard to timing and intensity, it is considered unlikely that significant or threatened species would occur at sites likely to carry the wind turbines, largely because of the degree of disturbance of these areas. The survey effort is considered by the authors of this report to have been appropriate to the identification of biodiversity constraints.

It is considered that the site quality is not sufficiently high to justify spring searches for additional grassland species, or threatened species. Many grassland species are present, if less readily identifiable, in the cooler months, but the sites gave no indication of being likely to carry such species. The only significant omission is likely to have been orchids in the less disturbed areas. Given the size of the site, the grazing impact throughout and the relatively sparse nature of the proposed infrastructure, the probability that the proposal will affect any significant orchid population is very low.

4.2. Results

4.2.1. Vegetation types

In general, the locations carry a combination of pasture and woodland or forest. The ridges likely to carry the turbines on the four locations carry some remnant native vegetation in the form of scattered trees and small to medium sized (1-3 hectares) patches of remnant or regrowth woodland or forest, and some of the relevant paddocks consist of predominantly native pasture. Other areas consist of largely or entirely exotic (“improved”) pasture or weeds.

The surrounding slopes and gullies are unlikely to become turbine sites but could be affected if access routes for vehicles or powerlines were routed through them. In most cases the slopes and gullies carry substantially more native vegetation than the ridge tops. Representative areas of all vegetation types on the four locations within the marked development envelope were surveyed, including the forested slopes and the various types of pasture. Easements between the four sites were also surveyed (refer to Figure 6.5). Apart from past agricultural usage, two main factors govern vegetation types on the locations: geology and altitude. The pasture and six woodland vegetation types present in the study area are described below, summarised on Table 4-1 and illustrated on Figures 4-1 – 4-4. A list of all species detected during field work is provided in Appendix A.1. Supplementary lists from areas which could belong to EECs are also included, to provide more detail for these areas.

Pasture

At all locations, the groundcover over most of the ridge crests has been substantially altered by a long history of grazing and in many areas by ploughing and sowing of exotic pasture species, with variable success. On basalt soils, the conversion to exotic pasture has been more successful, with predominantly exotic pasture grasses such as phalaris and perennial ryegrass dominating in some areas on Bannister and the noxious weed serrated tussock dominant on the basalt areas of Pomeroy.

On soils derived from metasiltstone ploughing and pasture “improvement” has generally resulted in a predominantly native pasture dominated by wallaby grasses (*Austrodanthonia* species) and weeping grass (*Microlaena stipoides*), with a variable proportion of exotic legumes (clovers, *Trifolium* spp and medics, *Medicago* spp) and weeds such as sheep sorrel (**Acetosella vulgaris*) and flatweed (**Hypochaeris radicata*). In areas which have had tree removal but no ploughing, the native understorey grasses *Joycea pallida* and *Poa* spp still dominate, and some of these areas also include some native forbs, although in general these are uncommon in treeless areas, probably due to a long history of grazing.

Most of the native pasture in the elevated parts of the site appears to be derived from clearing of forest or woodland communities which are not listed as EECs; principally from communities 1, 2 or 5 described below.

One area of naturally treeless native grassland was found in the Kialla area, in the north-east corner of the Elliott property. This area consists of a broad flat upper drainage line containing two large relict swamp gums (*Eucalyptus ovata*) and predominantly native grasses dominated by the large tussock grass river tussock (*Poa labillardierei*). A slightly elevated area within the drainage line is dominated by kangaroo grass (*Themeda australis*). The topography and the presence of swamp gum, which favours sites with waterlogged soils, suggests that this area would have originally had a low density of trees. It could therefore fall within the definition of the Endangered Ecological Community, Natural Temperate Grassland of the Southern Tablelands of NSW and the Australian Capital Territory, listed as nationally endangered under the EPBC Act, but not listed under the NSW TSC Act.

The definition of this EEC states that it occurs between altitudes of 560 – 1200 metres in valleys influenced by cold air drainage and in broad plains. Although not explicitly stated, wet flats are likely to have been another location for this EEC. The community is distinguished by

the dominant cover of native tussock grasses including *Themeda australis* and *Poa* species. The description of the EEC states that about 70% of the species are forbs, comprising mostly daisies, lilies and native legumes growing in intertussock spaces. Shrubs and trees are sparse or absent.

The grassland on the Kialla site has been affected by a history of grazing and is therefore relatively low in native species diversity and includes a variable cover of weed species, primarily sweet vernal grass (**Anthoxanthum odoratum*), which is highly invasive in wet areas. The grassland quality is variable within the corner of the site where it occurs, with some patches being lower in weed cover and having a higher diversity of native species and some patches being dominated by sweet vernal grass. Prior to the survey work, long drought had resulted in the landowner at the northern part of Kialla de-stocking that portion of the site, allowing some re-growth of vegetation. The area dominated by kangaroo grass is less weedy than the wetter area dominated by river tussock. The description of the nationally listed EEC does not give any cut-off points below which the EEC could no longer be said to be present, so it would be safest to assume that the remnant in the drainage line at Kialla does belong to this EEC, although it is not a high quality remnant. Only five native grasses (*Poa labillardierei*, *Themeda australis*, *Microlaena stipoides*, *Austrodanthonia* sp and *Poa sieberiana* var. *cyanophylla*) and twelve forbs (*Asperula scoparia*, *Bulbine bulbosa*, *Carex inversa*, *Centella asiatica*, *Centipeda minima*, *Dichondra repens*, *Diuris sulphurea*, *Haloragis heterophylla*, *Luzula ovata*, *Rumex brownii*, *Scleranthus fasciculatus*, *Solenogyne gunnii*, some of them present only in low numbers) were detected, but the survey of this area was not extensive. The presence of the lily *Bulbine bulbosa* and the orchid *Diuris sulphurea* suggest that grazing pressure has not been heavy.

Some other areas of native pasture could be considered to belong to an EEC. The Final Determinations for White Box - Yellow Box - Blakely's Red Gum Woodland and Tableland Basalt Forest EECs both state that secondary grassland derived from clearing may still be considered to belong to the EEC. Areas of native pasture which appear to have been created by clearing of EECs (effectively, located near where EECs were found to occur on the site) could therefore be regarded as belonging to an EEC. Remnants of yellow box-apple box woodland within native pasture occur on basalt soils on Pomeroy, and native pasture adjacent to Tableland Basalt Forest remnants occurs on Bannister (both "old" and "new" sections). Native grasslands on Kialla and Gurrundah appear to be derived from clearing of one of the other forest or woodland types on the site (see below), so would not fall within the definitions of these EECs. On Gurrundah the dominant woodland community is scribbly gum-brittle gum-broad-leaf peppermint dry forest, and the largest area of native pasture, dominated by red-anther wallaby grass (*Joycea pallida*), is clearly derived from this community. The areas which carry occasional regrowth yellow box on Gurrundah are located on steeper slopes below the ridge crest and are unlikely to be affected by the proposal. On Kialla the dominant forest type is mountain gum – broad-leaf peppermint moist forest, which, while it includes one indicator species for Tableland Basalt Forest (mountain gum, *Eucalyptus dalrympleana*), is generally dominated by broad-leaf peppermint (*E. dives*) except in the drainage lines. The latter tree is not listed as a component of Tableland Basalt Forest. The presence of some remnant shrubs which are also not typical of this EEC (*Acacia gunnii*, *Hibbertia obtusifolia*, *Melichrus urceolatus*) in the least disturbed native pasture on Kialla suggests that the pasture on Kialla, while predominantly native, is not derived from clearing of an EEC, and is therefore not part of an EEC. There is no indication of this area having carried White Box Yellow Box Blakely's Red Gum Woodland in the past.

Woodland and forest

Vegetation at Kialla and Bannister tends toward moister forest types, reflecting, if not higher rainfall then possibly lower evaporation rates due to the slightly higher elevation.

There are two vegetation classification schemes available for the Goulburn area, the Southern CRA study (Thomas *et al.* 2000) and the SCIVI classification (Tozer *et al.* 2006). The latter

incorporates data from the former, and supersedes it. However, as earlier surveys for wind farm proposals in the region utilised the CRA classification, both schemes are used here to describe the native vegetation types found on the locations. Vegetation types seen in the area (excluding pasture, as discussed above) are as follows:

1. Scribbly gum-brittle gum-broad-leaf peppermint dry forest

Dry open forest dominated by scribbly gum (*Eucalyptus rossii*), brittle gum (*E. mannifera*), broad-leaf peppermint (*E. dives*) and broad-leaf hickory (*Acacia falciformis*) with sparse low shrubs (*Melichrus urceolatus*, *Brachyloma daphnoides*, *Monotoca scoparia*, *Hibbertia obtusifolia*, *Pultenaea subspicata*, *Dillwynia sericea*, *D. phyllicoides*, *Hovea heterophylla* and *Choretrum pauciflorum*) and a grassy groundcover dominated by red-anther wallaby grass (*Joycea pallida*) and *Lomandra filiformis ssp coriacea*, with a sparse scattering of forbs including *Patersonia sericea*, *Dianella revoluta*, *Stylidium graminifolium s. lat.* and *Goodenia hederacea*.

A large fenced and ungrazed remnant of this community occurs on the Gurrundah location on highly exposed upper slopes on Ordovician metasediments.

2. Broad-leaf peppermint-brittle gum dry forest

Dry open forest dominated by broad-leaf peppermint (*E. dives*) and brittle gum (*E. mannifera*) with a sub-canopy of broad-leaf hickory (*A. falciformis*) is widely distributed on Ordovician metasediments on Pomeroy.

It differs from the preceding vegetation type in the near absence of scribbly gum and of a few groundcover species indicative of poorer site quality such as *Patersonia sericea*. Otherwise many of the shrub and groundcover species and three of the dominant tree species are the same.

3. Apple box- yellow box grassy woodland

This community is regarded as belonging to the community White Box, Yellow Box, Blakely's Red Gum Woodland, listed as an Endangered Ecological Community (EEC) under the *Threatened Species Conservation Act 1995* and under the *Environment Protection and Biodiversity Conservation Act 1999*.

Woodland dominated by apple box (*E. bridgesiana*) and yellow box (*E. melliodora*) with occasional wattles (*Acacia dealbata*, *A. deanei*, *A. falciformis*, *A. melanoxylon*), few shrubs (*Melichrus urceolatus*, *Hibbertia obtusifolia*, *Bossiaea buxifolia*, *Cassinia* spp) and a relatively diverse grassy groundcover occurs on basalt at Pomeroy. The groundcover includes grasses *Joycea pallida*, *Poa sieberiana*, *Elymus scaber*, *Microlaena stipoides*, *Austrodanthonia* spp and occasional *Themeda australis*, *Lomandra* spp and forbs such as *Hydrocotyle laxiflora*, *Dichondra repens*, *Geranium solanderi*, *Scleranthus fasciculatus*, *Hypericum gramineum* and the small fern *Cheilanthes austrotenuifolia*.

This association tends to occur in a band at mid-slope, below the dry brittle gum-broad-leaf peppermint forest and above a moister forest type found in gullies. There are remnant yellow box trees at this mid-slope position in paddocks at Gurrundah, which although they are on metasediments rather than basalt, may represent the same vegetation community, somewhat more degraded by grazing. Some of the remnants on Pomeroy are fenced off from stock and apparently infrequently grazed and so are in moderately good condition.

4. Blakely's red gum- yellow box grassy woodland

Another community which is part of the above-mentioned EEC is dominated by Blakely's red gum (*E. blakelyi*) and yellow box, with a grassy understorey. It does not occur on any of the four locations, but was observed to be present along Range Road and Pomeroy Road, closer to Goulburn. The understorey of this community was not investigated as it was not found on any of the locations, but as access roads to the locations pass through it, it may be affected to a slight extent by lopping of branches overhanging the road.

5. Mountain gum – broad-leaf peppermint moist forest

A taller moist forest type dominated by mountain gum (*E. dalrympleana*) and broad-leaf peppermint with blackwood (*Acacia melanoxylon*) as a sparse sub-canopy layer and a grassy groundcover occurs on higher elevation sites. It is widespread on Bannister and Kialla, tending to occur on Ordovician metasiltstone substrates, and to be replaced by narrow-leaf peppermint (*E. radiata*) on basalt (see Type 7. below).

A grassy community dominated by mountain gum, broad-leaf peppermint and apple box also occurs around gully edges on basalt on Pomeroy. Broad-leaf peppermint tends to dominate on flats and mountain gum in drainage lines on Kialla. In these drainage line situations the groundcover composition is similar to that listed in the Final Determination for the EEC Tableland Basalt Forest in the Sydney Basin and south East Highlands Bioregion, and as mountain gum is included in the list of indicator species, remnants in drainage lines could be considered to be included within the EEC. As broad-leaf peppermint is not listed as a component of the EEC, the bulk of the forest remnants on Kialla which are dominated by this species and have very little mountain gum would not be considered to be part of this EEC. On Pomeroy, although the community is grassy, and located on basalt, only one of the three dominant tree species is listed as a component of Tableland Basalt Forest, so these stands would therefore not be considered to fall within this EEC.

6. Snow gum or ribbon gum moist forest

Snow gum (*E. pauciflora*) and ribbon gum (*E. viminalis*) are the dominant trees of a few remnants scattered on basalt on Bannister and Pomeroy. Occasional black sallee (*E. stellulata*) also occur in this grassy forest type, which has been largely cleared but probably formerly occupied the colder parts of the site, around drainage depressions on the high ridges and plateaux. The large river tussock *Poa labillardierei* is a typical understorey component of this community.

The largest patch of this community occurs on a steep south-facing slope on the eastern side of the southern part of Bannister. This community could be regarded as belonging to the EEC Tableland Basalt Forest, and as derived grasslands are also included in this EEC (NSW Scientific Committee, 2007), surrounding pasture, if predominantly native, could also be considered to be part of the EEC. However, most pasture on basalt is exotic.

7. Narrow-leaf peppermint moist forest

Narrow-leaf peppermint is the dominant or sole canopy species in one area of Bannister on basalt derived soils, one patch in the north-west corner of the Banfield property and one a linear east-west running remnant on a ridge crest on the eastern side of the Leonard property. These two remnants are contiguous. This community has occasional blackwood (*Acacia melanoxylon*) in the understorey but otherwise lacks a shrub layer and in its least disturbed form has a mixed grass/herb groundcover of moderate diversity including bracken (*Pteridium esculentum*) and shade tolerant grasses and herbs such as *Microlaena stipoides*, *Austrodanthonia* spp., *Elymus scaber*, *Acaena*

novae zelandiae, *Asperula conferta* and *Viola betonicifolia*. Stands dominated by narrow-leaf peppermint are the most typical form of the community described as the EEC Basalt Tableland Forest and these two remnants would belong to this EEC. In light of the inclusion of derived grasslands in this EEC, adjacent areas of pasture, if predominantly native, could also belong to the EEC.

The following table (overleaf) summarises the occurrence of these eight native vegetation types (including natural grasslands, discussed under Pasture, above) at the locations and on potential access routes in the surrounding area.

4.2.2. Disturbance and weeds

Most of the ridge top areas likely to host the turbines are highly disturbed, a result of clearing, ploughing, sowing introduced pasture grasses / legumes, grazing and subsequent weed invasion. The degree of replacement of native with exotic pasture species varies with geology (greater on basalt soils than on soils derived from metasilstone) and past management features, including how recently the location has been cleared. Parts of Kialla and Pomeroy appear to have been cleared relatively recently and are still dominated by the large native tussock grass *Joycea pallida*. This grass also dominates pasture on the edges of the large remnant on Gurrundah, where proximity to trees has probably limited the extent to which exotic pasture species could be established.

Patches of trees within the cleared areas on ridge tops are all accessible to livestock and consequently have little or no shrub layer. The level of replacement with exotic groundcover grasses and forbs varies with the size of the remnant. Small remnants have a predominantly exotic groundcover, while larger ones, such as some of those on Bannister, have a halo of exotic species round the margins but are largely native in the remnant interior.

Larger remnant native vegetation patches around the steeper edges of the locations are often in better condition than small patches on the ridge tops, due to lower levels of use by livestock. In some cases these areas are fenced off from stock, as on Gurrundah and the central area of Pomeroy, and in others they are unfenced but probably unattractive to livestock because of steep slopes and a lack of edible plants in the understorey. Some parts of these areas have very few exotic plant species, but there are some parts, such as creek banks, which are highly weed infested, mostly with blackberry (**Rubus fruticosus sp. agg.*). On Pomeroy, the serrated tussock infestation also extends into the edges of remnant forest.

Several weed species declared noxious in Goulburn-Mulwaree and Upper Lachlan Local Government Areas are abundant on parts of the locations. Blackberry is mostly confined to the gullies and as such is outside the likely impact zone of the proposed development. Nodding thistle (**Carduus nutans*) is common in pasture on Bannister and Scotch thistle (**Onopordum acanthium*) is less common. Serrated tussock (**Nassella trichotoma*) is widespread and abundant on Pomeroy, and a few plants were detected in the southern part of the Bannister location. Sweet briar (**Rosa rubiginosa*) is scattered sparsely on Pomeroy and Bannister. All of these weeds are listed as noxious in category 4 (must be controlled according to measures specified in a local management plan published by the LGA).

Table 4-1 Vegetation types and their determinants onsite and on potential access routes.

Grey shading indicates the vegetation communities that fall within the definition of EECs, including the EEC Basalt White Box, Yellow Box, Blakely's Red Gum Woodland.

Locations	Kialla	Bannister	Pomeroy	Gurrundah	On access routes
Elevation	~980m ASL	~980m ASL	~860m ASL	~780m ASL	
Geology					
Basalt	No	Yes - Produces a heavy soil, located predominantly on flats. Converted to exotic pasture more frequently than other soils with a greater tendency to weed infestation.	Yes - Produces a heavy soil, located predominantly on flats. Converted to exotic pasture more frequently than other soils with a greater tendency to weed infestation.	No	
Ordovician metasilstone	Yes – Produces relatively infertile soils.	Yes – Produces relatively infertile soils.	Yes – Produces skeletal and relatively infertile soils. Predominantly located on steeper ridges with rock outcrops.	Yes – Produces skeletal and relatively infertile soils. Predominantly located on steeper ridges with rock outcrops.	
Vegetation type					
1. Scribbly gum-brittle gum-broad-leaf peppermint dry forest SCRA classification: Forest Ecosystem 113, North-East Tablelands Dry Shrub/ Grass. SCVI classification: DSF p9, Tableland Low Woodland or DSF p14 Western Tablelands Dry Forest.	No	No	No	Dominant on upper slopes with a large retained patch on east-facing side.	

Locations	Kialla	Bannister	Pomeroy	Gurrundah	On access routes
2. Broad-leaf peppermint-brittle gum dry forest SCRA classification: Forest Ecosystem 109 Widespread Tablelands Dry Shrub/ Tussock Grass Forest. SCIVI classification: GW p23 Tableland Hills Grassy Woodland.	No	No	Dominant on upper slopes on east-facing side, mostly young (<30 yrs) regrowth.	No	Common on verges of approach roads.
3. Apple box- yellow box grassy woodland SCRA classification: Forest Ecosystem 90 Northern Tablelands Acacia Herb/ Dry Grass Forest. SCIVI classification: GW p24, Tableland Grassy Box-Gum Woodland. Potential EEC: White Box, Yellow Box, Blakely's Red Gum Woodland	No The patch at the front gate of Kialla does not contain yellow box and is heavily sheep trampled. It does not qualify as EEC. This EEC does not occur within the Kialla boundary.	No	Some patches retained in fair condition east from the stockyards in southern half of site, around upper edges of some gullies and remnant trees with exotic groundcover in eastern part of northern half of site.	Scattered yellow box indicate the presence of a mid-slope band of this woodland type, now largely cleared. The remnants are likely to be below the development envelope.	
4. Blakely's red gum- yellow box grassy woodland SCRA classification: Forest Ecosystem 160 Northern Slopes Dry Grass Woodland. SCIVI classification: GW p24, Tablelands Grassy Box-Gum Woodland. Potential EEC: White Box, Yellow Box, Blakely's Red Gum Woodland	No	No	No	No	Present in one or two patches of roadside remnant on Range Rd and Pomeroy Rd.
5. Mountain gum – broad-leaf peppermint moist forest SCRA classification: Forest Ecosystem 111, Central Northern Tablelands Dry Shrub/Grass Forest. SCIVI classification: Part of a broader group, GW p20, Tableland Basalt Forest. Potential EEC: Tableland Basalt Forest (partial only).	The only woodland community present on this location, with numerous remnant patches. Only patches in drainage lines where mountain gum is dominant could be considered as part of the EEC.	One large patch north on Banfield property, small patches on Leonard property. Where broad-leaf peppermint is dominant, the EEC is not present.	Yes	No	

Locations	Kialla	Bannister	Pomeroy	Gurrundah	On access routes
<p>6. Snow gum or ribbon gum moist forest</p> <p>SCRA classification: Part of a broader group, Forest Ecosystem 89, Eastern Tablelands Acacia/Herb/Grass Forest. SCIVI classification: Part of the broader group WSF p73, Cool Montane Wet Forest.</p> <p>Potential EEC: Tableland Basalt Forest</p>	No	<p>Eastern boundary of this location in mid-northern section (near old buildings) and mid-southern section on steep slope above and around dam.</p>	Yes	No	
<p>7. Narrow-leaf peppermint moist forest</p> <p>SCRA classification: FE56, Tableland and Escarpment Moist Herb/Fern Forest - <i>E radiata</i>/<i>E. viminalis</i>/<i>Viola</i> spp. SCIVI classification: WSF p73 Cool Montane Wet Forest.</p> <p>Potential EEC: Tableland Basalt Forest</p>	No	<p>North-west corner of Banfield property, in good condition.</p> <p>Narrow east-west belt on eastern side of Leonard property in poor condition.</p> <p>Potential for some associated native pasture, if present, to be EEC.</p>	No	No	No
<p>8. Natural Temperate (wet) Grassland</p> <p>SCRA classification: FE147, Tablelands Moist Sedge/Herb/Grassland. SCIVI classification: FOW p54, Tableland Swamp Woodland.</p> <p>Potential EEC: Natural temperate grasslands of the southern tablelands</p>	<p>One area in an upper drainage line in the north-east corner of Elliott property, dominated by <i>Poa labillardierei</i>.</p>	No	No	No	No

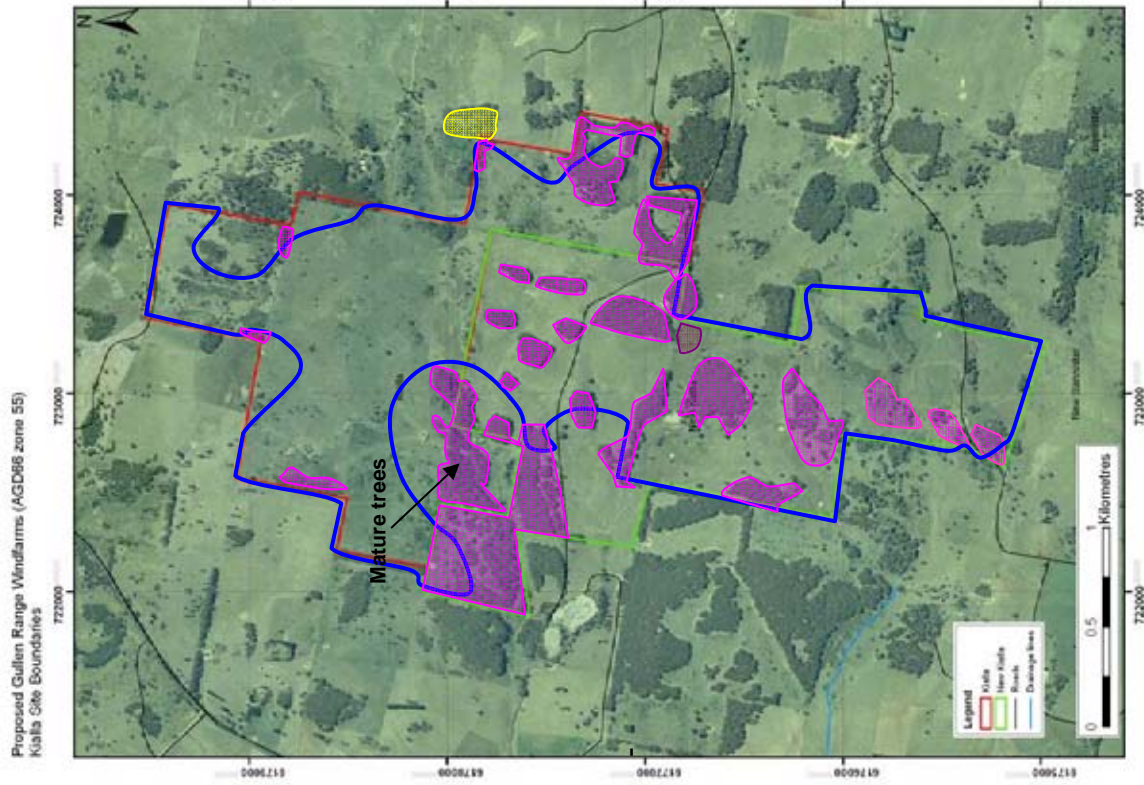


Figure 4-1 Kialla: Vegetation types.

Native vegetation within the proposed development envelope is mapped in one of five vegetation types. Remaining pasture within the development envelope appears to be predominantly native, but is not derived from an EEC and therefore does not represent a biodiversity constraint.

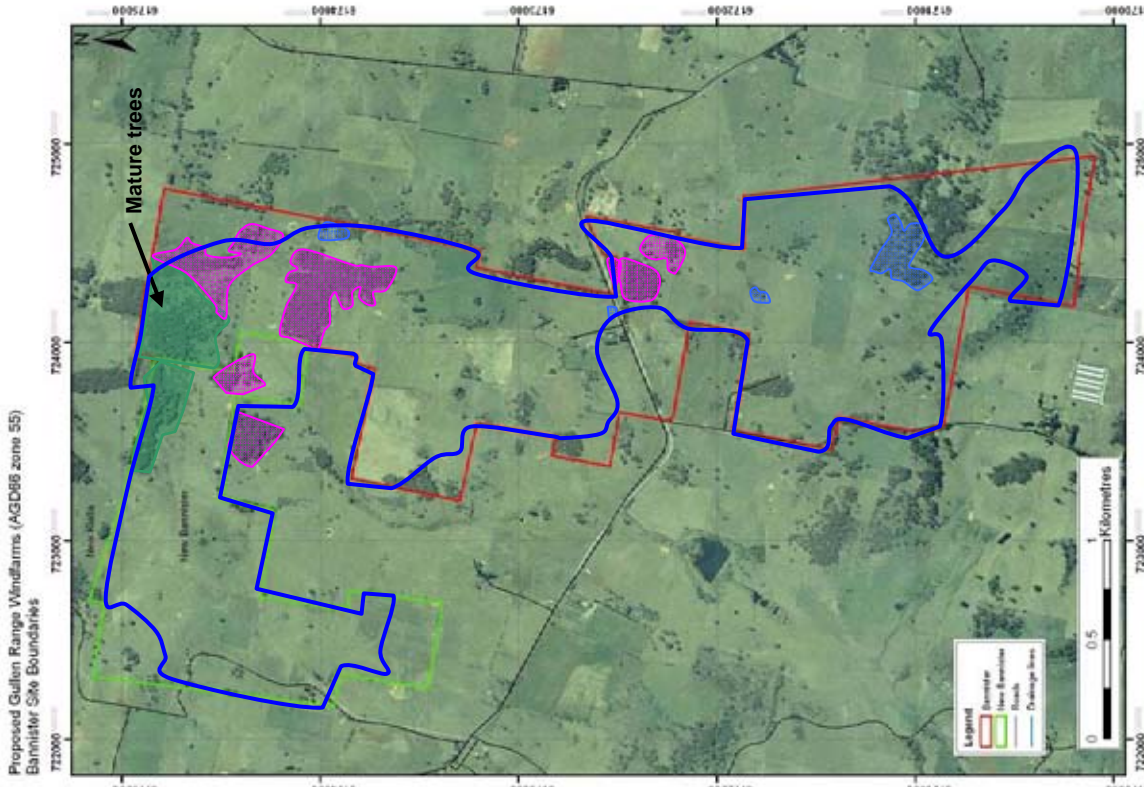


Figure 4-2 Bannister: Vegetation types.

Native vegetation types:

	3. Apple box- yellow box grassy woodland (EEC)
	5. Mountain gum - broad-leaf peppermint moist forest
	6. Snow gum or ribbon gum moist forest
	7. Narrow-leaf peppermint moist forest
	8. Natural Temperate (wet) Grassland
	Development envelope

Proposed Gullen Range Windfarms (AGD66 zone 55)
Pomeroy Site Boundaries

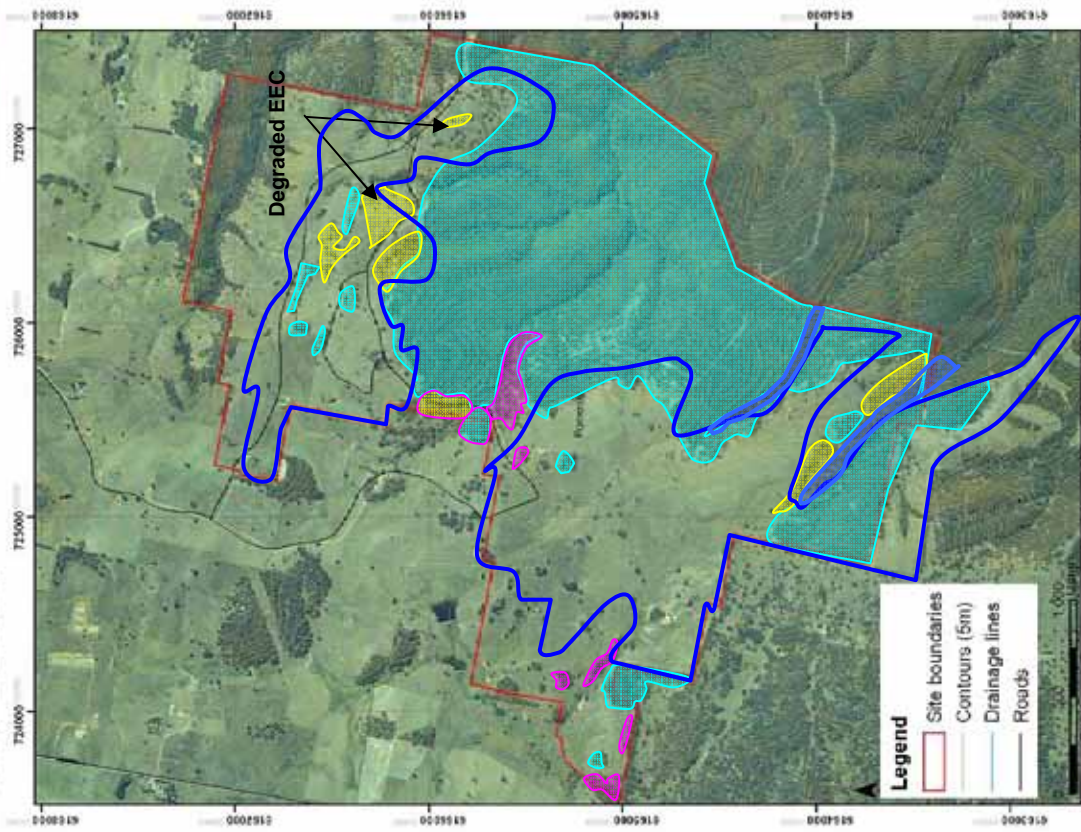


Figure 4-3 Pomeroy: Vegetation types.

Native vegetation within the proposed development envelope is mapped in one of seven vegetation types. Remaining pasture within the development envelope is predominantly exotic and does not represent a biodiversity constraint.

Proposed Gullen Range Windfarms (AGD66 zone 55)
Gurrundah Site Boundaries

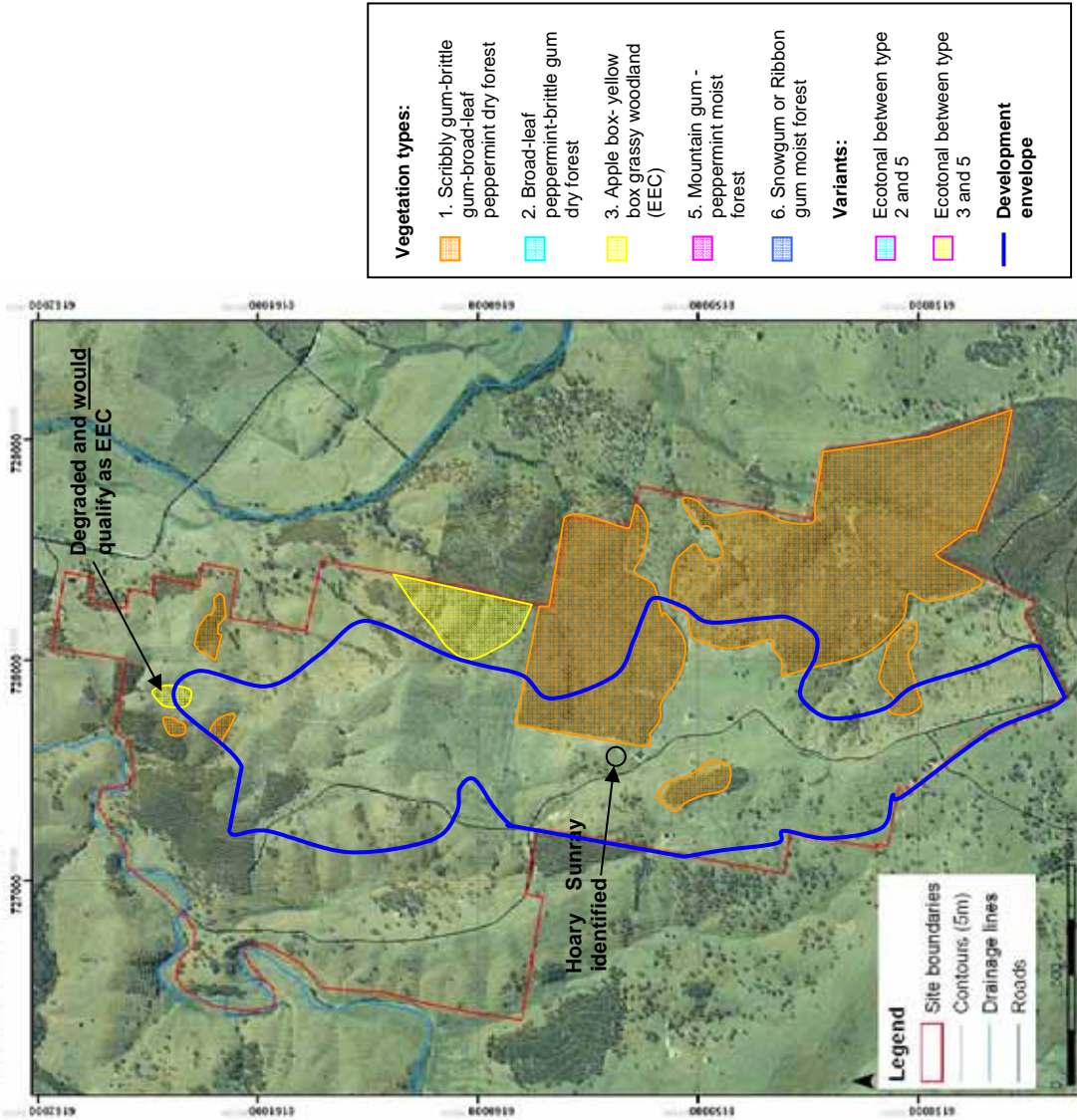


Figure 4-4 Gurrundah: Vegetation types.

4.2.3. Plant 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 locations. One species listed nationally under the *Environment Protection and Biodiversity Conservation Act 1999* was identified from a single non-flowering plant in pasture on Gurrundah, the Hoary Sunray (located on Figure 4-4).

An on-line search of the DEC Wildlife Atlas database for the Goulburn 1:100,000 map sheet produced only six threatened plant species which had been recorded in the region, mostly from the eastern part of the region. Consequently the search area was enlarged to include the surrounding Crookwell, Taralga, Gunning, Braidwood and Canberra map sheets and some additional species of grassy woodlands or grasslands on the Southern Tablelands were added, producing a total of 27 threatened species for the wider region. These 27 species were evaluated for their potential to occur within the areas that would be impacted by the proposal, based on local records and known habitat preferences (presented in full, Appendix C). Twenty-six species rated nil or low likelihood for impact and were not evaluated further. Only the Hoary Sunray was identified as having greater than low potential for impact as a consequence of the proposal.

The Hoary Sunray (*Leucochrysum albicans* ssp *albicans* var. *tricolor*), listed as nationally vulnerable under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* was detected on road verges in the area (on Range Road), and a single plant was identified on Gurrundah. This is a conspicuous species with white “paper daisy” flowers, pink buds and silver foliage. It grows in grasslands and grassy woodlands and may be locally common on the Southern Tablelands, on road verges or in sites with a history of light or infrequent grazing, such as Travelling Stock Reserves. It appears to require disturbance, or bare ground, in order to reproduce, but does not persist under long-term grazing (J. Miles, pers. obs.). Only one non-flowering plant was found on Gurrundah. There is a yellow-flowered taxon, *Leucochrysum albicans* ssp *albicans* var. *albicans*, which has similar foliage and is not listed as threatened. It occurs around Braidwood, so the plant found on Gurrundah might also belong to this taxon, although the presence of definite white-flowered plants on the verges of Range Road indicates that it is more likely threatened var. *tricolor* which is present on Gurrundah.

An assessment of significance was carried out, pursuant to the EPBC Act, for this species. The poor quality of habitat in which this species was observed and low likelihood of a viable local population being present, were the key determinants in this assessment. A significant impact is not anticipated as a consequence of the proposal.

Some sections of remnant forest and woodland around the edges of the Gurrundah location and parts of Pomeroy could provide suitable habitat for a few additional threatened species; the shrubs *Bossiaea oligosperma*, *Dillwynia glaucula*, *Pultenaea pedunculata* and spring-flowering orchids *Caladenia tessellata* and *Diuris aequalis*. However, the probability of them occurring in areas likely to be affected by the proposal is very low, so further survey for these orchid species may not be warranted unless proposed access routes pass through suitable habitat. The same applies to the three shrub species, which occur in dry forest or woodland which it is assumed would not be directly affected by the proposal.

4.2.4. Vegetation communities of conservation significance

White Box, Yellow Box, Blakely’s Red Gum Woodland

Two vegetation types were identified during the site assessment which fall within the definition of the Endangered Ecological Community: **White Box, Yellow Box, Blakely’s Red Gum Woodland**. These were 3. Apple box- yellow box grassy woodland (identified onsite at Pomeroy and Gurrundah and at the site boundary at Kialla) and 4. Blakely’s red gum- yellow

box grassy woodland (only identified offsite, on the potential access roads of Range Road and Pomeroy Road, closer to Goulburn,). The former is mapped on Figures 4-2, 4-4 and 4-5.

The Endangered Ecological Community, White Box, Yellow Box, Blakely's Red Gum Woodland, is listed as an Endangered Ecological Community in NSW under the *NSW 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, particularly on road verges where the groundcover may be relatively intact, and as remnant paddock trees.

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 Box-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. Treeless areas of secondary grassland from which trees have been cleared may be regarded as part of the EEC.

Under the liberal interpretation of the EEC provided by NSW NPWS, 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, even where the groundcover is substantially altered, if it might be considered that the soil seedbank still includes many native species. The Box-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 (*Eucalyptus bridgesiana*) and brittle gum (*E. mannifera*). Broad-leaved peppermint (*E. dives*) and scribbly gum (*E. rossii*) are not mentioned, but might be assumed, since they are common associates of brittle gum. Brittle gum, scribbly gum and broad-leaved peppermint are present in association with yellow box on Gurrundah and apple box and yellow box are co-dominant with occasional brittle gum and broad-leaved peppermint on Pomeroy. Brittle gum, scribbly gum and broad-leaved peppermint are typical of a drier, shrubby plant community (Widespread Tablelands Dry Shrub/ Tussock Grass Forest, Forest Ecosystem 109 of Thomas *et al.* 2000). This community is still relatively intact in the less developed parts of the Goulburn region, and occurs on Gurrundah and Pomeroy. Areas of overlap occur between this community and the Box-Gum Woodland EEC, where the vegetation includes 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.

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 rainfall which fell prior to the survey provided some opportunity to assess the state of the seedbank, since numerous seedlings were observed in pasture. The bulk of the seedlings appeared to be exotics, mostly legumes and grasses, so the seedbank in these areas could be assumed to have little or no regeneration potential. However, in areas with shallow, rocky soils and among yellow box remnant trees, there are patches where native grasses are dominant. Despite a relatively low species diversity, these areas must be regarded as being part of the Box-Gum Woodland EEC under the NPWS guidelines.

A different and much more stringent set of guidelines for identifying the Box-Gum Woodland EEC as listed under the *EPBC Act* is provided on the Department of Environment and Water website (www.deh.gov.au/epbc.index.html). This definition requires:

That patches be of at least 0.1 ha (50 x 20 metres) in size, have a groundcover layer comprising at least 50% cover of native species (as assessed in autumn when high numbers of spring flowering annuals are not present) and include 12 or more native understorey species (excluding grasses), of which at least one must be from a group of species listed as being important in that community, in a list of numerous species potentially occurring within the EEC provided by DEH. The latter requirement may be waived if the patch is greater than 2 hectares in size, with 20 or more mature trees per hectare or natural tree regeneration present.

Most of the areas where yellow box is present on Pomeroy would fall easily into the EEC definition, as they appear to have been little disturbed by pasture "improvement" activities though they do receive some grazing pressure. These occurrences of the EEC are located off the ridge tops, around mid-slope level and in gully heads. There is one extensive occurrence of yellow box trees within the flatter partially cleared area which might be affected by the proposal. This is in the northern section of the Pomeroy site. The groundcover in this area is more than 50% exotic, with a heavy infestation of serrated tussock, although native grasses (*Austrodanthonia* spp and *Microlaena stipoides*) are still abundant in spots. This area would qualify as a degraded remnant of the EEC under the NSW NPWS definition, although it appears that there would be very little chance of it responding to assisted natural regeneration as the soil seedbank probably now consists largely of exotic species. It would not qualify as EEC under the more stringent DEH definition as the understorey is more than 50% exotic. Refer to Figure 4-5 for the location of this remnant.

The degraded remnant surveyed on Gurrundah would fall within the EEC definition even under this more stringent set of DEH guidelines. It is about 1 ha in size, has 14 mature yellow box trees, and 17 non-grass understorey plants (shrubs and forbs which have been recorded as occurring in the EEC according to the list provided by DEH) were recorded around the trees. The remnant has surprisingly few weeds, probably because most of the topsoil has been blown away in this very exposed location, so the species composition is over 90% native. Despite this, the remnant is not in good condition, as there is no tree regeneration due to grazing pressure, and the understorey diversity is low, with many plants being present only in very low numbers. Refer to Figure 4-4 for the location of this remnant.

Areas of pasture near these remnants, if predominantly native, could be regarded as belonging to this EEC. In general, native pasture not occurring among trees is of low species diversity, but an assessment of whether areas of pasture to be directly impacted by the proposal could fall within the EEC definition will have to await more detailed information about proposed turbine locations. Avoidance of woodland and treed areas would mitigate against this potential constraint.

Tableland Basalt Forest

As discussed in Section 4.2.1, two vegetation types may fall within the definition of the assessed but not yet listed EEC **Tableland Basalt Forest**. These are 6. Snow gum – ribbon gum moist forest and 7. Narrow-leaf peppermint moist forest. A third vegetation type, 5. Mountain gum – broad-leaf peppermint moist forest, may fall partially within this EEC, in situations where mountain gum is the dominant species and the groundcover is grassy. Such situations are typically not on basalt-derived soils, but occur in drainage lines where soil depth and fertility is enhanced by colluvial and alluvial deposition.

On Bannister, a remnant dominated by narrow leaf-peppermint occurs in the north-west corner of the Banfield property. In this location it is in good condition (it has diverse groundcover and few weeds). Another remnant occurs to the west on the Leonard property, being a linear remnant on a ridge crest. This remnant appears to have been subjected to a much greater grazing pressure, being considerably weedier, and having fewer native species in the groundcover. Both remnants would qualify as belonging to the EEC Tableland Basalt Forest, although that on the Leonard property is more degraded. Its groundcover may be more than 50% exotic in some areas. Another large remnant immediately south of Range Road includes largely native areas in the western part of the remnant patch, with more degraded smaller remnants on the Range Road verge and in paddocks on the eastern edge of this site (adjacent to the access track to the southern half of the Bannister site). The Final Determination to list this EEC does not provide any guidelines on how degraded a remnant needs to be before it no longer satisfies the definition of the EEC, so it would be simplest to regard all these narrow-leaf peppermint forest patches as belonging to the EEC.

On the section of Bannister south of Range Road there are wooded remnants dominated by ribbon gum (*E. viminalis*) or snow gum (*E. pauciflora*) on basalt which would also fall within the EEC definition, since the Final Determination lists *E. radiata*, *dalrympleana*, *viminalis* and *pauciflora* as potential canopy dominants, either alone or in various combinations. The groundcover in the less disturbed larger wooded remnants on steeper slopes on the eastern edge of Bannister is predominantly native, whereas smaller patches isolated within grazed paddocks, such as the one immediately south of the monitoring tower, have a predominantly exotic groundcover. These might be regarded as degraded remnants of this EEC. If clearing of any of these wooded remnant patches is proposed, then further assessment of their EEC status may be required, although in general, all isolated small remnant tree patches in the southern part of Bannister have a predominantly exotic groundcover, and would therefore be regarded as EEC in “low” condition under the *Native Vegetation Conservation Act*. It may be possible to clear such remnants, with consideration of project offsets.

Vegetation in some of the larger gullies on Pomeroy which is dominated by ribbon gum may also fall within the definition of Tableland Basalt Forest, but these areas are all likely to be outside the impact zone due to their steepness. An area may be affected by the electricity transmission connecting the Pomeroy site to the Gurrundah site. In this area, thinning has occurred previously such that it is possible to largely or entirely avoid mature trees in the routing of this easement (20m wide).

The Final Determination for Tableland Basalt Forest also states that native grasslands of this community derived from clearing may also fall within the EEC definition if they contain the characteristic non-woody species listed in the EEC definition. This poses some difficulty in deciding whether pasture on basalt on Bannister falls within the definition of this EEC or not. Theoretically, areas of native pasture could do so. However, on site the native pasture generally appears to be confined to soils derived from metasediments, with pasture on basalt being more thoroughly converted to exotic species. Therefore it is safe to assume that, land management of the more fertile pasture on basalt has resulted in it being modified to an extent that it does not belong to the Tableland Basalt Forest EEC.

Assessments of Significance

Assessments of Significance, as specified under the TSC Act and the EPBC Act were completed to properly characterise the threat to the White box- Yellow Box – Blakely's Red Gum Grassy Woodland EEC. These assessments concluded that, as infrastructure placement would largely avoid the mid slope position where the relatively intact stands of this community occur, the potential for direct impact would be low. The remnants of this community onsite are already substantially degraded and are unlikely to suffer a negative impact from the proposal. Nonetheless, where possible, this community should be avoided.

An Assessment of Significance was carried out for Tableland Basalt Forest, and concluded that as long as none of the larger forested areas on basalt were cleared, there would be no significant impact on this EEC. No probable access routes pass through any of the better quality remnants of this community (Banfield property north-west corner, immediately south of Range Road, western side, and south of Range Road, eastern edge). So long as forest remnants are not cleared and an adequate buffer zone is left undisturbed around remnants, the impact on this community should not be significant. Smaller degraded remnants would be of lesser significance, such as the one through which the track south from Range Road passes on the Banfield property, and various small isolated remnants south from Range Road. A 250m long easement (20m wide) would be required through this community at the south of the Pomeroy site. In this location, mature trees are located only in the gully, which would be avoided. It is considered that the easement could be routed through an area previously thinned and thereby minimise fragmentation and the risk of impact on community integrity.

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. Survey effort and limitations

Assessed area

As discussed for flora surveys, at the time of the site assessment, a turbine layout had not been developed and assessment areas at each location were selected based on mapped contours. Assessment areas were as follows:

- Kialla, above the 980m contour;
- Bannister, above the 960m contour;
- Pomeroy, above 860m contour;
- Gurrundah, above 780m in the northern part (Sugarloaf Trig), and above 800m in the southern half of the site.

Likely locations for access tracks, powerlines and the substation were also assessed.

Survey timing and conditions

The main survey work was carried out for nocturnal and diurnal terrestrial vertebrates between March 29 and April 5, 2007. The survey team consisted of three members focussed on fauna. The late autumn timing, tending cool in the evenings and without rainfall, was not optimal for recording frogs, reptiles and microchiropteran bats, requiring a cautionary treatment of potential to occur. The weather was variable during the surveying, ranging from very warm to cold days and nights. Wind speeds were also variable for the duration of the surveys (refer to Table 5-1).

A follow-up survey, conducted on 1 - 2 November 2007, was required to consider three additional properties between Kialla and Bannister. This survey work consisted of habitat evaluations. Refinement of reptile habitat mapping and reptile searches were also undertaken at several locations within the original survey areas to better map areas of constraint. The weather at this time was optimal for searching for reptiles and thereby addressed to some extent the limitations of the earlier survey. . The survey effort is considered by the authors of this report to have been appropriate to the identification of biodiversity constraints.

Table 5-1 Weather conditions during surveys

Summarised information from the Goulburn Airport Bureau of Meteorology weather station is provided below.

	Temperature min, max	Max wind gust	Precipitation
March 29, 2007	12.7, 21.6°C	NW 61 km/hr	0 mm
March 30, 2007	8.6, 15.4°C	W 65 km/hr	0 mm
March 31, 2007	2.5, 20.3°C	W 39 km/hr	0 mm
April 1, 2007	3.5, 20.9°C	E 28 km/hr	0 mm
April 2, 2007	5.0, 24.0°C	WNW 41 km/hr	0 mm
April 3, 2007	3.0, 25.5°C	E 41 km/hr	0 mm
April 4, 2007	12.3, 22.2°C	NE 35 km/hr	0 mm
April 5, 2007	3.3, 22.7°C	WSW 43 km/hr	0 mm
November 1, 2007	5.7, 23.9	ENE 37 km/hr	0 mm
November 2, 2007	13.9, 26.5	SE 44 km/hr	1.6 mm

Survey methodologies and effort

Survey effort was distributed among habitat types (woodland, pasture, wetlands) and landscape positions (ridges, flats, gullies), being most intensive in the areas with the greatest habitat resources, in order to maximise the list of species recorded.

Mammals, reptiles, birds and amphibians were targeted. Trapping was undertaken at Pomeroy and Gurrundah, where the more extensive areas of vegetation are located. The survey effort was biased to the larger and more structurally complex locations (Pomeroy and Gurrundah) however, all locations were covered sufficiently to gain an understanding of their differing biodiversity values.

Standardised survey methods undertaken included:

- Elliot trap transects: 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. Traps were baited with a mixture of peanut butter, honey, cat food and rolled oats.
- Cage trap transects: Each transect consisted of five traps (all cage traps). Traps were spaced 20-40m apart in microhabitats suitable for catching medium-sized mammals. Traps were baited with a mixture of peanut butter, honey, cat food, sardines and rolled oats.

Trapping was only undertaken at The Pomeroy and Gurrundah sites. The basis of the survey program and the biodiversity assessment was to evaluate the risk to threatened species. Habitat evaluation was considered sufficient to rule out the presence of threatened ground mammals at Kialla and Bannister. Elliot and cage trapping at these locations could not be justified and was not undertaken.

- Bird censuses: 30-60 minutes duration, recording the height and number of each species observed.
- Reptile searches: 30-60 minutes duration, targeting representative herpetofauna habitat types. Sheets of metal, rocks, fallen timber, leaf litter, hollow logs and tussocks were actively searched.
 - Threatened reptile habitat assessment: Guided by the ecological characteristics of the target species. Parameters included:
 - Grazing: whether the site was lightly, moderately or heavily grazed (cover and presence of scat)
 - Ground cover composition: % rock, % bare ground, %vegetation (both native and exotic), % litter,
 - Fallen timber presence
 - Aspect
 - Exposed geological features
 - Number of rocks with ants (relevant to *Aprasia parapulchella*)
 - Presence of predators (large centipedes)

Sites were then assessed qualitatively on the above factors and evaluated for their potential for occurrence of each threatened reptile species. These criteria then formed the basis for selecting areas of habitat which had a low, moderate or high potential of occurrence. This approach was chosen to determine areas of the development envelope to avoid, and where avoidance was not possible, mitigate. The methodology for habitat assessment is biased toward habitat attributes specific to reptile fauna adapted from Sass (2003, 2007), Daly 2004, and Fischer *et al.* 2004.

- Frog searches: A selection of water-bodies were visited and calls identified by comparison to pre-identified calls.
- Vocalisations of the threatened Powerful Owl, Masked Owl, Barking 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 two persons for 15 minutes in duration. The length of vehicle-based transects was determined by length of track suitable for spotlighting.
- Anabat recordings: 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.

This report acknowledges that the survey timing was deficient for some species, specifically spring flowering annuals, frogs, and microchiropteran bats. As an alternative to additional survey effort, threatened species in these categories were either evaluated for their potential to occur (based on habitat available, known ecological characteristic of the species and known records) or were assumed to occur. This is a precautionary approach to impact evaluation and the development of mitigation measures, as even extensive surveying at optimal periods can fail to detect species. Where assumed to occur, areas of potential habitat were identified as constraints to be avoided (for example, woodland).

Table 5-2 Fauna survey effort summary

Site	Survey type	Number of surveys per site
<i>Kialla</i>	Anabat	1
	Bird survey	7
	Call playback	1
	Habitat evaluation	21
	Reptile search	3
	Spotlight transect	2
<i>Bannister</i>	Anabat	2
	Bird survey	6
	Call playback	1
	Habitat evaluation	14
	Reptile search	6
	Frog search / callback	2
<i>Pomeroy</i>	Spotlight transect	3
	Anabat	2
	Bird survey	5
	Habitat evaluation	10
	Reptile search	6
	Frog search / callback	2 x 2 ¹
<i>Gurrundah</i>	Spotlight transect	4
	Trapping transect	6
	Anabat	2
	Bird survey	5
	Call playback	3
	Habitat evaluation	9
<i>Gurrundah</i>	Reptile search	6
	Frog search / callback	2
	Spotlight transect	3
	Trapping transect	4

¹ Two sites surveyed twice

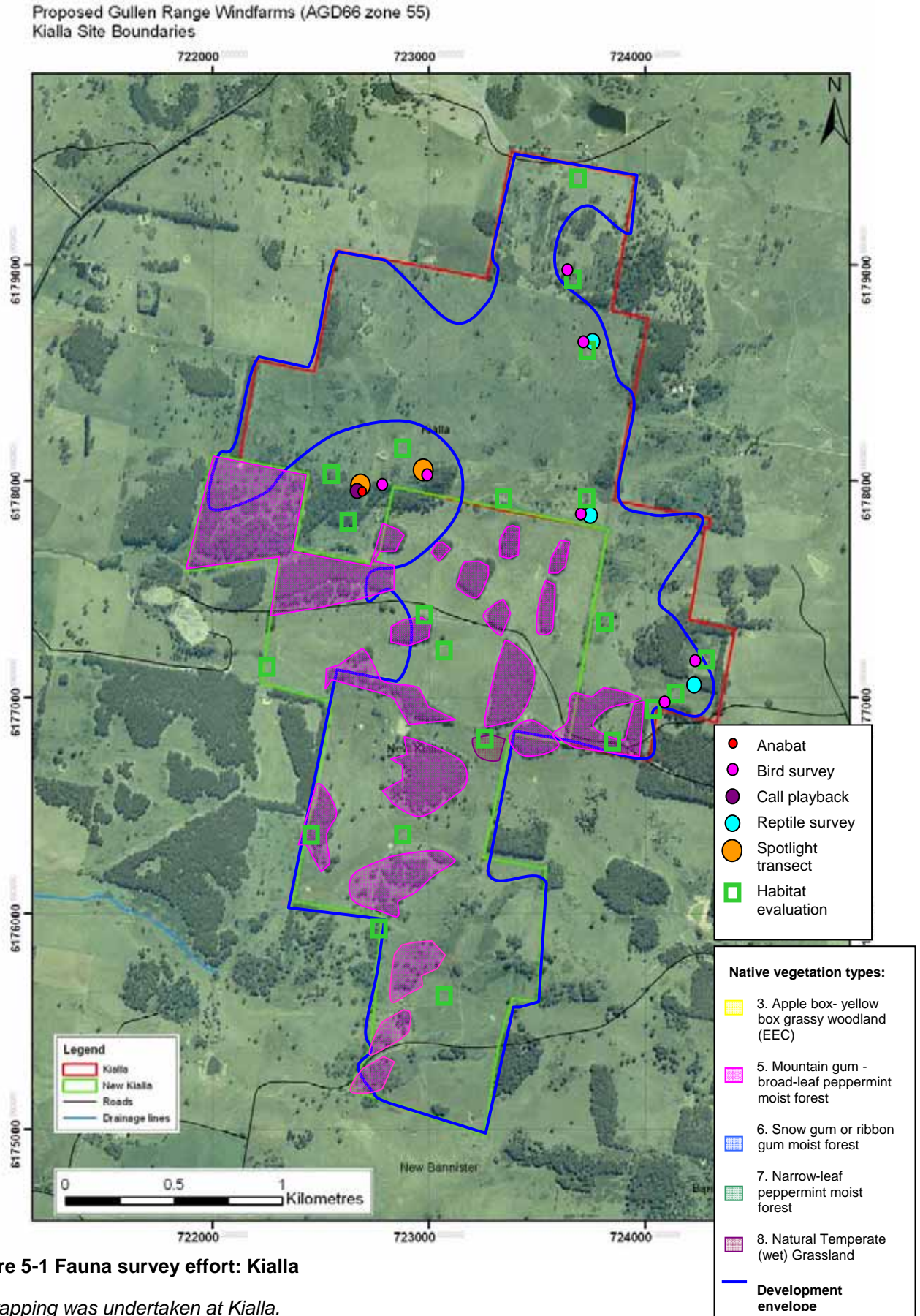


Figure 5-1 Fauna survey effort: Kialla

No trapping was undertaken at Kialla.

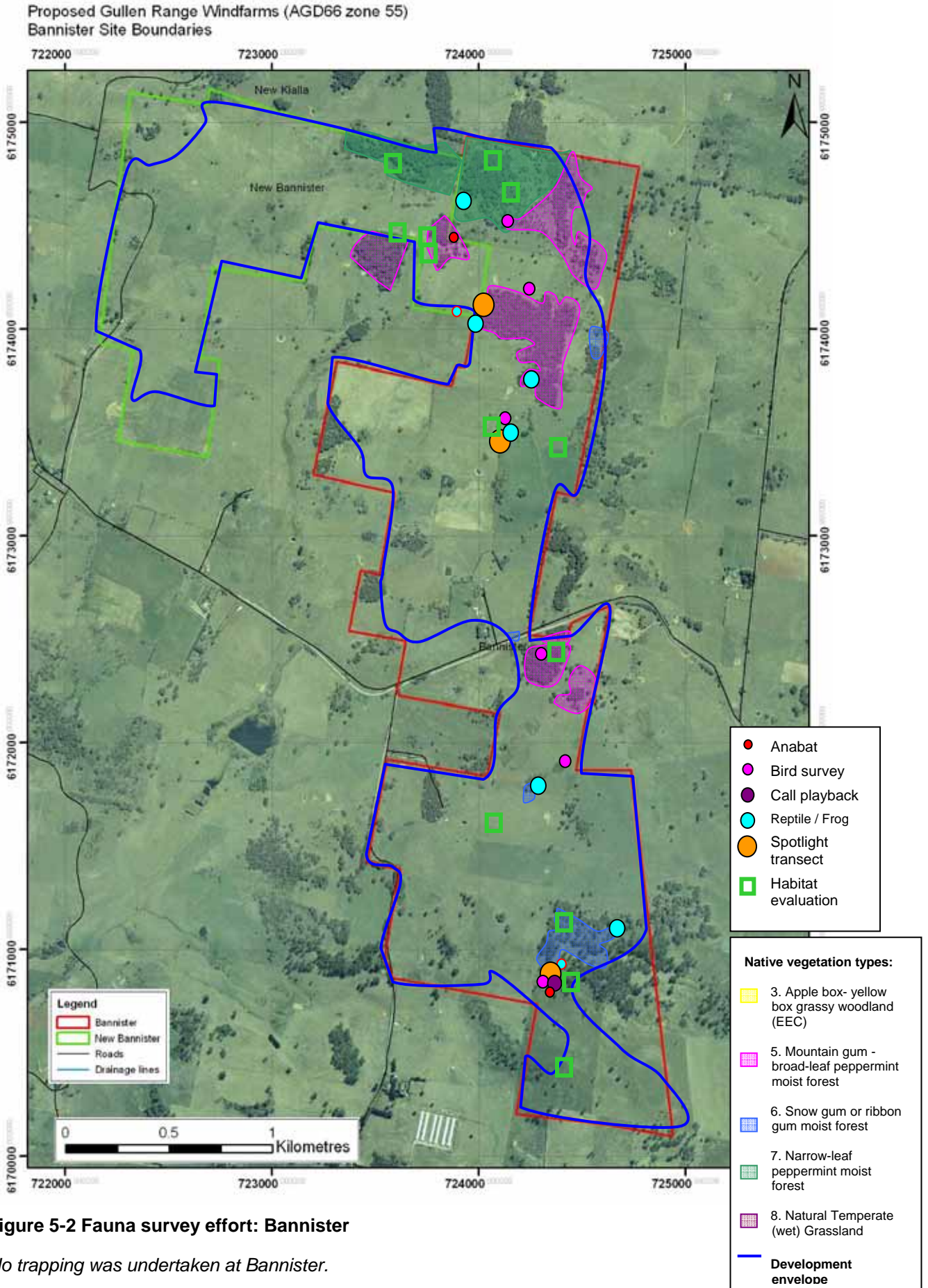


Figure 5-2 Fauna survey effort: Bannister

No trapping was undertaken at Bannister.

Proposed Gullen Range Windfarms (AGD66 zone 55)
Pomeroy Site Boundaries

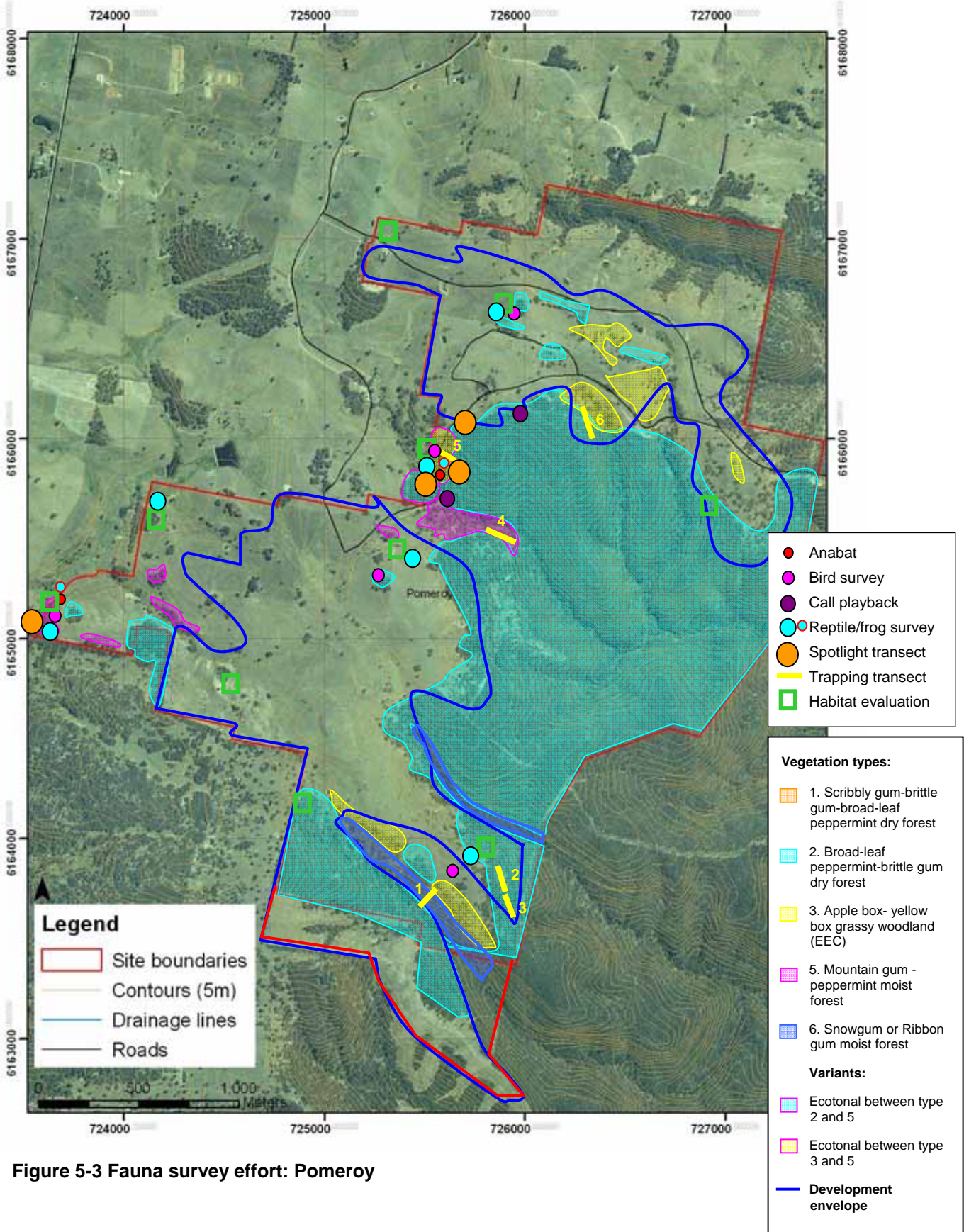


Figure 5-3 Fauna survey effort: Pomeroy

**Proposed Gullen Range Windfarms (AGD66 zone 55)
 Gurrundah Site Boundaries**

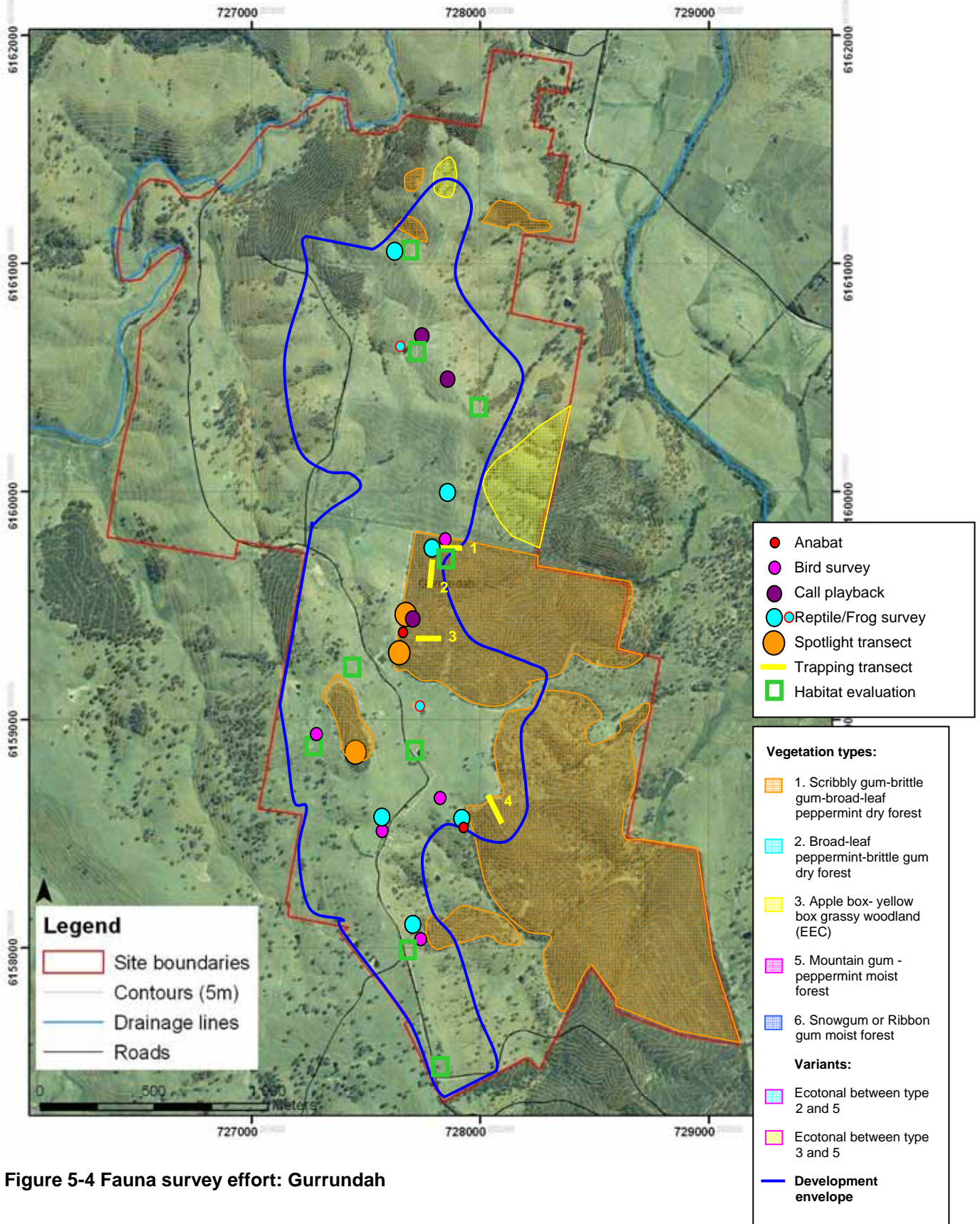


Figure 5-4 Fauna survey effort: Gurrundah

5.2. Survey results

5.2.1. Fauna habitat in the study area

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

- Pasture, often containing isolated paddock trees;
- Woodland, predominantly occurring as patches of native tree regeneration;
- Wetlands, predominantly small dams but also including nearby creeks and rivers.

A summary of the habitat evaluations for each site follows (refer also to habitat summary table, Table 5-3 and photographs of each site, Appendix G):

Kialla

The general matrix at this location was described as pasture with small remnant patches of woodland. On average, the diameter at breast height (DBH) of trees was 48cm, indicating most vegetation was not mature, although hollow-bearing trees were present at ten of the 21 sites selected for habitat evaluation. Ground refuge consisted mostly of bracken and fallen timber, rocks and tussocks formed additional although sparse refuge. Six sites featured dams or drainage lines, most being dry at the time of the site assessment.

Bannister

The general matrix at this location comprised pasture with small remnant patches of woodland as well as pasture with scattered trees. On average, the diameter at breast height (DBH) of trees was 78cm, indicating mature hollow-bearing vegetation to be present. Eleven of the 14 sites selected for evaluation retained hollow-bearing trees. Ground refuge consisted mostly of rock piles (cleared from paddocks) and fallen timber (predominantly piled and likely to be burned) although natural outcrops remain. Five dams are present, two being dry at the time of the site assessment.

Pomeroy

The general matrix at this location comprised pasture with scattered trees but small patches of regenerating woodland occur and large areas of contiguous forest are located nearby. On average, the diameter at breast height (DBH) of trees in the survey areas was 49cm, masking a skewed distribution; mature trees were predominantly in gullies or isolated in paddocks, much younger regeneration occurred as patches in pasture. Seven of the 11 sites selected for evaluation retained hollow-bearing trees. Ground refuge was minimal. Seven water sources occurred, including dams, drainage lines and creeks.

Gurrundah

The general matrix at this location comprised pasture with woodland located in gullies and on slopes. On average, the diameter at breast height (DBH) of trees was 52cm, indicating some mature vegetation was present. Five of the nine sites selected for evaluation retained hollow-bearing trees. Ground refuge was present at most sites, comprised of fallen timber, poa tussocks and rocks. Six water sources occurred, including dams, gullies and a river.

Table 5-3 Habitat evaluation summary table

Site	Habitat evaluation sites	Average DBH (cm)	Rocky outcrops	Ground refuge	Water source	Hollows
Kialla	Pasture			Y (fallen timber)		
	Pasture (native)			Y (bracken)		
	Pasture with isolated trees	70	Y	Y (sparse fallen timber)		Y (few small hollows)
	Pasture with isolated trees	40		Y (bracken)		
	Pasture with isolated trees	40		Y (fallen timber)		
	Pasture with isolated trees					
	Pasture (native) with isolated trees	100		Y (tussocks, fallen timber)	Y (depression, dam nearby)	Y (large spout)
	Pasture with scattered trees	90	Y	Y (rocks)		Y (small – large, includes stags)
	Woodland	20			Y (dam dry)	
	Woodland	70		Y (fallen timber)	Y (dam dry)	Y (small - large abundant, includes spouts)
Woodland				Y (large dam to north)		
Woodland	20					
Woodland	30					
Woodland	30	Y	Y (fallen timber)		Y	
Woodland	40		Y (fallen timber)		Y (medium)	
Woodland	40		Y (fallen timber)		Y (small - medium abundant)	
Woodland				Y (drainage line)		Y (small abundant)
Woodland				Y (fallen timber)	Y (drainage line)	
Woodland		20		Y (fallen timber)		Y (few small hollows)
Woodland		50		Y (fallen timber)		Y (small in woodland fragment, larger is nearby paddock tree)
Woodland		70		Y (sparse fallen timber)		
Woodland		40		Y (fallen timber, bracken)		
Summary		48.1	4 out of 21	16 out of 21	6 out of 21	10 out of 21
Bannister	Pasture with isolated trees	170				Y (sparse medium)
	Pasture with isolated trees	90	Y (rock piles)		Y (dam nearby)	
	Pasture with isolated trees		Y		Y (2 dams nearby, 1 dry)	Y several visible in nearby woodland
	Pasture with isolated trees		Y			Likely

Site	Habitat evaluation sites	Average DBH (cm)	Rocky outcrops	Ground refuge	Water source	Hollows
	Dam adjacent to woodland	100			Y (2 dams nearby, 1 dry)	
	Woodland	40		Y (branches)		Y (predominantly small)
	Woodland	80		Y (fallen timber, bracken patches in adjacent pasture)	Y (small dam)	Y (small abundant, potential for large)
	Woodland	100	Y (poor refuge)	Y (fallen timber, bracken)		Y (small abundant)
	Woodland			Y (fallen timber)		Y (small)
	Woodland	70				Y (small - medium)
	Woodland		Y (small rock pile)	Y (some fallen timber)		
	Woodland	30		Y (fallen timber piles)	Y (dam nearby)	Y (few small)
	Woodland	20				Y (medium to large in nearby woodland)
	Woodland	80				Y (few medium)
	Summary	78.0	5 out of 14	6 out of 14	5 out of 14	11 out of 14
Pomeroy	Pasture	50			Ephemeral in gully	Y (sparse stags in paddock, abundant hollows in mature gully trees)
	Woodland	20		Y (fallen timber)		
	Wet pasture	20			Y (2 dams)	
	Pasture	50		Y (blackberry infestation)	Y (creek)	Y (small - large abundant)
	Pasture	Isolated trees: 100, regen: 30			Ephemeral in gully	Y (few in isolated paddock trees)
	Pasture	50			Y (creek and 2 dams)	Y (few small)
	Pasture with isolated trees	80		Grass tussocks		Y (small abundant)
	Woodland	20	Y (rocky gully)		Y (permanent shallow pools)	Y (small)
	Pasture	20				
	Pasture	100			Y (dam nearly empty)	Y (small)
	Summary	49	1 out of 10	2 out of 10	7 out of 10	7 out of 10
Gurrundah	Woodland	40		Y (fallen timber)		Y (small - medium abundant)

Site	Habitat evaluation sites	Average DBH (cm)	Rocky outcrops	Ground refuge	Water source	Hollows
	Pasture with isolated trees	70		Y (limited fallen timber)		
	Woodland	60		Y (fallen timber)	Ephemeral in gully	Y (small)
	Pasture			Y (dam)		
	Woodland	35 (few larger ~90)		Y (fallen timber)	Y (dam nearby)	Y (small - large abundant)
	Pasture	15	Y	Y (grass tussocks)	Y (river and several dams adjacent)	Y (small)
	Dam			Y (grass tussocks around dam)	Y (dam and nearby gully)	
	Dam				Y (dam)	
	Rocky outcrop		Y	Y (rocks and fallen timber)	Y (river nearby)	Y (small - large nearby)
	Summary	51.6	2 out of 9	8 out of 9	6 out of 9	5 out of 9

Key habitat features – all locations

Important fauna habitat features at the locations include hollow-bearing trees, linking woodland remnants, wetlands, rocky outcrops and native pasture. While these features are largely located outside areas that would be directly impacted by the development of the wind farm (which would be predominantly located in cleared ridges and flats), they play an important role in sustaining native fauna populations at the sites and potentially, in the locality. The potential for indirect as well as direct impacts of the proposal on these features should be considered.

Hollow-bearing trees

Hollow-bearing trees are present both in isolated paddock trees and within more mature woodland remnants. The former can provide linking habitat for mobile fauna and have been shown to be valuable habitat for microbats in modified landscapes (Lumsden and Bennett 2004). They are at greater risk when installing access tracks and other wind farm infrastructure, being located within the cleared ridge-top paddocks. Hollow-bearing trees within more mature woodland remnants can support a more diverse ecosystem, providing refuge, breeding habitat and greater foraging resources. These are contained within remnant woodland patches and more extensive woodland that would not be directly impacted by the works.

Woodland patches

Remnant woodland patches can provide refuges for mobile fauna such as migrating birds and bats and, dependant on size and structure, can provide more permanent habitat for birds, reptiles and mammals. Most remnants are small and dominated by 'edge specialist' species, such as magpies, whose territorial behaviour precludes high bird diversity in these patches. However, some larger, more structured (ie. including mid and understorey vegetation) remnants occur at the sites. As stated previously, these areas would not be directly affected by the works.

Wetlands

Wetlands at Kialla and Bannister are limited to dams and drainage lines, most dry at the time of assessment. Offsite, immediately north of Kialla, a large dam provides water bird habitat. Pomeroy and Gurrundah have a larger number of deeper dams and are also within close proximity to creeks (Pomeroy) and rivers (Gurrundah). Dams had little surrounding vegetation, reducing their value as fauna habitat. Creeks and rivers however, not only had greater surrounding vegetation but can also provide valuable connectivity in modified landscapes. The connectivity allows greater resistance to population level threats by providing fauna with access to other habitats.

Rocky outcrops and native pasture

Rocky outcrops, rock piles and rocky stream beds were present at the locations. These can provide reptiles with a moderated microhabitat and some protection from the trampling impacts of grazing. Reptile habitat assessments concluded that the four sites had varying levels of habitat quality determined by past or current disturbance regimes. Most sites had been modified by the sowing of exotic pasture grasses or substantial weed infestation however, where native pasture remains and is not heavily grazed, it provides refuge and foraging habitat for reptiles and ground mammals. The best examples occur at Kialla and Pomeroy.

5.2.2. Species recorded onsite

A diverse faunal assemblage was recorded across all habitat types and it is anticipated that more cryptic species are also present, going undetected due to the limited duration of surveying. In total, 47 species were identified at Kialla, 55 at Bannister, 83 at Pomeroy and 61 at Gurrundah. Highest overall species richness was found at Pomeroy, particularly with respect to birds and mammals, as seen in Table 5-4. Refer to Appendix B the full fauna lists for each location.

Table 5-4 Species richness across all locations

Location	Frogs	Birds	Mammals	Reptiles	Total species richness
Kialla	0	31	7	8	47
Bannister	2	38	10	3	55
Pomeroy	5	53	17	6	83
Gurrundah	5	41	8	6	61

Amphibians

All species recorded at Bannister, Pomeroy and Gurrundah, with the possible exception of the Smooth Toadlet and Lesueur's Frog, are common species with an apparent tolerance to some disturbance or low water quality, as would be expected from the condition of aquatic habitats observed over the majority of the sites. The Smooth Toadlet and Lesueur's Frog were identified in less modified areas with good native vegetation cover at Pomeroy and Gurrundah. Lack of deep water sources at Kialla was likely responsible for no species being recorded at this location; constructed dams were shallow and empty and no drainage lines appeared sufficient to carry water in average conditions. It is likely that a greater diversity of frogs would have been recorded during warmer weather after rainfall.

Birds

The three general habitat types carried differing bird species including (but not limited to):

- Woodland birds: bronze-wings, **fantails**, forest owls, pardalotes, robins, thornbills, thrushes and **treecreepers**;
- On woodland edges and in pasture: birds of prey, choughs, currawongs, **magpies**, **parrots**, pipits, ravens, starlings and thornbills; and
- Waterbirds: **ducks**, grebes, teals and herons (the latter offsite).

Rather than finding a high diversity during individual survey transects, surveying indicated that certain species (indicated in **bold**, above) dominated their preferred habitats. For example, in many woodland sites the Grey Fantail aggressively defended drainage lines. In scattered trees and small remnants, the Crimson Rosella and Australian Magpie were far more abundant than any other species.

Sixteen species were observed at (estimated) heights above 30m, and therefore have potential to collide with moving turbines blades. These included the Australian Magpie, Australian

Raven, Brown Falcon, Common Starling*², Crimson Rosella, Galah, Grey Fantail, Laughing Kookaburra, Little Eagle, Rainbow Bee-eater (listed as migratory under the EPBC Act), Striated Pardalote, the threatened Powerful Owl (listed under the NSW TSC Act, not observed but known to fly above 30m), Nankeen Kestrel, Silvereye, Sulphur-crested Cockatoo, Wedge-tailed Eagle, White-faced Heron and White-winged Chough.

Of these, species observed to flock in numbers greater than four, and therefore be at increased multiple collision risk (and therefore with greater potential to affect a local population) were the Australian Raven, Common Starling*, Crimson Rosella, Galah, Rainbow Bee-eater, Striated Pardalote, Silvereye, Sulphur-crested Cockatoo and White-winged Chough. Also at risk are species at low density in the landscape such as the Brown Falcon, Nankeen Kestrel and Wedge-tailed Eagle. Night migrating birds such as the Silvereye are also considered to be at increased risk.

Mammals

Trapping was only undertaken at the Pomeroy and Gurrundah sites, limiting the species list at Kialla and Bannister. However, the lesser degree of woodland and increased fragmentation of remnants on these sites was assumed to result in fewer ground dwelling mammals at these locations (anabat, spotlighting and call play-back were undertaken at all four locations: Kialla, Bannister, Pomeroy and Gurrundah).

More than one species of macropod were present at each site. Arboreal mammals (gliders and possums) were present at each location, including the threatened Squirrel Glider at Gurrundah. The Ringtail Possum and/or Sugar Glider (prey species of the Powerful Owl) were recorded at all locations.

Microbats were abundant at all sites, identified foraging in woodland, over dams and around isolated paddock trees. Several threatened species were identified (refer to Section 5.2.3).

Mature woodland remnants with some degree of connectivity offered the key mammal habitat. The low amount of ground cover at all sites, likely to be a consequence of extended drought and heavy grazing by stock and native fauna, reduced the quality of habitat available for ground dwelling species. This is also likely to have consequences for larger fauna who prey on these species such as forest owls, foxes and potentially quolls, if locally present. The Brown Antechinus was trapped at Pomeroy and Gurrundah, the Yellow-footed Antechinus (declining) was trapped at Gurrundah.

Exotic species including the black rat, deer, fox, goat, hare and pig were recorded during surveys. Foxes, rabbits and hares are likely to be established at all sites. Goats are likely to be established at Pomeroy and deer at Kialla, Bannister and Pomeroy. Deer are farmed on the Elliot property.

Reptiles

The timing of the first survey session (autumn) was not optimal for reptiles. However, experienced personnel using hand searches revealed a total of 13 reptile species including snakes, skinks and dragons. Furthermore, an assessment of available reptile habitat was undertaken to evaluate potential habitat across the four sites, with a focus on threatened species.

Three main habitat types suitable for threatened reptile fauna were present across the study sites:

² * indicates introduced species.

1. Rock outcropping (Striped Legless Lizard, Pink-Tailed Worm-Lizard)
2. Native grassland (Grassland Earless Dragon, Striped Legless Lizard)
3. Woodland and forest (Little Whip Snake)

At all four sites, some locations revealed a high likelihood of occurrence for at least one of these species (refer to threatened species evaluations, Appendix C). Key areas with high likelihood of threatened reptile occurrence were identified as:

- Kialla*
- Forested patch in far south-west corner
 - Large patch of native grassland in the central portion of site
- Bannister*
- Rocky knoll south of the monitoring tower
- Pomeroy*
- Forested patch on the eastern portion of site
 - In the central portion of site, around the monitoring tower on the northern aspect
- Gurrundah*
- Large native grassland area between Sugarloaf Trig and woodland remnant
 - Rock outcropping east of the sheds
 - Woodland remnant on the eastern portion of the site

Follow-up surveying was undertaken in Spring 2007. At this time the weather was more conducive to carrying out additional reptile searches. Also, with the indicative turbine layouts available, the areas of potential threatened reptile habitat which overlapped turbine locations or access tracks could be evaluated and mapped with more precision. The follow-up survey is documented in Appendix C. Revised areas of constraint for threatened reptiles are mapped in Appendix C.

5.2.3. Threatened species

Five threatened fauna species were recorded during the field work:

Site	Species	Comments
<i>Kialla</i>	Common Bent-wing Bat (possible*)	Located in a woodland fragment containing several stags and mature trees bearing hollows, near a dam (almost dry).
	Large-footed Myotis (probable*)	
<i>Bannister</i>	Common Bent-wing Bat (possible*)	Both species located on the edge of a woodland fragment containing mature trees bearing hollows, near a dam and adjacent to a cleared paddock with scattered trees.
	Large-footed Myotis (probable*)	
<i>Pomeroy</i>	Common Bent-wing Bat (possible*)	The Common Bent-wing Bat was detected in a riparian woodland strip containing mature hollow-bearing trees, adjacent to cleared paddock. All three species were detected near a drainage line within extensive woodland remnant containing mature hollow-bearing trees.
	Eastern False Pipistrelle (possible*)	
	Powerful Owl	
<i>Gurrundah</i>	Common Bent-wing Bat (probable*)	The Common Bent-wing Bat was detected adjacent to scattered paddock trees near a dam.
	Squirrel Glider	The Common Bent Wing Bat and Squirrel Glider were both detected within and extensive woodland fragment containing small hollows and at least one mine shaft.
	Grassland Earless Dragon habitat**	
		The potential Grassland Earless Dragon habitat was located

Site	Species	Comments
		north of this woodland fragment, in native pasture.

* Confidence levels of possible and probable were obtained from microbat call analysis. Refer to Appendix B.2 for more detail.

** An area of quality potential habitat for the Grassland Earless Dragon (listed as endangered at both the state and national level) was identified at the northern end of the Gurrundah site. Due to the difficulties in ruling out the presence of this cryptic species, it has been assumed to be present, as a precautionary measure. Refer to Appendix C for more detail.

All of these species are listed as Vulnerable under the NSW *Threatened Species Conservation Act 1995*. The Common Bent-wing Bat is listed as Conservation Dependant under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999*.

An evaluation of other threatened species listed under the NSW *Threatened Species Conservation Act 1995* by the Department of Environment and Climate Change (DECC NPWS Wildlife Atlas, accessed 27 March 2007 – Goulburn, Crookwell and Gunning 1:100,000 map sheets) and the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* ('Matters of National Significance' reporting tool, accessed 20 June 2007 – 50km buffer from the development envelope) was also undertaken (provided in full, Appendix C.2, and discussed below).

The risk of wind farm development to fauna is more complex than for flora and therefore, a risk assessment was carried out using five categories rather than the three (low, medium and high) used for flora. The fauna impact rating below assumes no mitigation measures are adopted and was assigned based on five equally weighted factors:

1. The species is known to occur locally,
2. The species could breed onsite,
3. The species could forage onsite,
4. The species could occur in the path of turbines or infrastructure,
5. Given 4, the species is a flocking or colonial species (individuals cluster in groups).

Four amphibians, 30 birds (including species listed as migratory), 12 mammals and three reptiles were assigned a rating. The evaluation is presented in full in Appendix C.2 and summarised below in Table 5-5.

Table 5-5 Threatened species unmitigated impact rating

Impact rating score assumes no mitigation measures are adopted. The higher potential impact scores (3-5) are shaded in grey.

Impact rating score	Impact classification	Species
0	Nil potential impact	Double-banded Plover. Broad-headed Snake.
1 – 2	Low potential impact	Booroolong Frog, Littlejohn's Tree Frog, Yellow-spotted Bell-frog. Magpie Goose, Freckled Duck, Australian Painted Snipe, Australasian Bittern, Black-necked Stork, Hooded Robin, Grass Owl, Painted Snipe, White-bellied Sea-Eagle, Black-faced Monarch. Golden Sun Moth. Brush-tailed Rock-wallaby, Tiger or Spotted-tailed Quoll, Yellow-bellied Glider, Eastern Long-eared bat.

Impact rating score	Impact classification	Species
3 – 4	Moderate potential impact	Green and Golden Bell Frog. Glossy Black Cockatoo, Blue-billed Duck, Square-tailed Kite, Brown Treecreeper, Regent Honeyeater, Powerful Owl, Speckled Warbler, Swift Parrot, Fork-tailed Swift, White-throated Needletail, Rainbow Bee-eater, Satin Flycatcher, Rufous Fantail, Great Egret, Cattle Egret, Latham's Snipe. Eastern Pygmy Possum, Squirrel Glider, Koala, Eastern False Pipistrelle, Large-eared Pied Bat, Eastern Freetail Bat, Grey-headed Flying Fox. Striped Legless Lizard, Pink-tailed Worm Lizard, Little Whip Snake, Grassland Earless Dragon.
5	High potential impact	Gang-gang Cockatoo, Diamond Firetail, Superb Parrot. Common bent-wing bat.

Thirty-two species were found to have an impact rating score between 3 and 5 before the application of mitigation measures and are therefore considered to have potential for a moderate to high level of impact. Some of these impacts are readily avoided or mitigated while other impacts may pose a significant threat to the species considered, as discussed below.

The Green and Golden Bell Frog, whilst having declined rapidly in the last two decades, is known to be able to tolerate disturbed habitats and low water quality. There is low potential for it to occur in constructed dams in elevated landscape positions however, local records occur (date of records: 1975, 1985) and if present onsite, this species could theoretically breed and constitute part of a local population. The risk to this species can be mitigated by avoiding all areas of potential habitat (water bodies with some riparian vegetation). No suitable areas were observed in areas where turbines or infrastructure may be located.

The threatened reptiles Striped Legless Lizard, Pink-tailed Worm Lizard, Little Whip Snake, and Grassland Earless Dragon have potential to utilise habitat that would be directly impacted by the proposal. That is, as the turbine locations were not locked in before the site assessment, it cannot be ruled out that potential habitat would be lost or individuals removed during the installation of turbines and access tracks. This potential impact can be mitigated by avoiding the better areas of potential habitat identified for these species onsite (located on Figures 6-1 to 6-4). Additional spring surveys and micro-mapping were carried out to establish with greater confidence, the presence or absence of these species and the boundaries and quality of potential habitat (refer to Appendix C for more detail).

The arboreal mammals Eastern Pygmy Possum, Squirrel Glider and Koala are potentially able to forage and breed in the larger woodland remnants onsite. As the development is proposed largely outside these areas, the threat can be mitigated by confining works to the cleared areas and creating a buffer to protect woodland remnants; that is, reducing traffic through and indirect impacts upon woodland remnants.

The proposed infrastructure would be located outside of the more extensive woodland remnants where threatened birds identified in Table 5-5 could forage and nest. Therefore, the key threat to these species centres on the risk of collision; woodland habitat onsite is fragmented and the risk of collision with turbine blades is present for species moving between fragments or over the site. For flocking species, there is a risk that a single collision event may act to reduce the local population of an already declining species by a significant amount. For species at low density in the landscape, such as birds of prey, the loss of a single bird may also have a significant effect.

Microchiropteran bats, also foraging and breeding predominantly in the larger woodland remnants onsite, are vulnerable to collision risks while foraging around water sources in open

paddocks (dams on ridges), isolated paddock trees near turbines and when moving between remnants or migrating over the site. The Common bent-wing bat, being a colonially roosting species, known from the area, is likely to be at greatest risk due to the potential for many individuals to be at risk of turbine collision during migrating or dispersing seasons.

To properly characterise the impact of the proposal on threatened fauna, pursuant to the *NSW Environmental Planning and Assessment Act* and the *Commonwealth Environmental Protection and Biodiversity Conservation Act*, an 'Assessment of Significance' was conducted (refer to Appendix E) for species for whom effective mitigation strategies would be more difficult:

Birds Glossy Black Cockatoo, Blue-billed Duck, Square-tailed Kite, Brown Treecreeper, Regent Honeyeater, Powerful Owl, Speckled Warbler, Fork-tailed Swift, White-throated Needletail, Rainbow Bee-eater, Satin Flycatcher, Rufous Fantail, Great Egret, Cattle Egret, Latham's Snipe, Gang-gang Cockatoo, Diamond Firetail, Swift Parrot and Superb Parrot.

Bats Eastern False Pipistrelle, Large-eared Pied Bat, Eastern Freetail Bat, Grey-headed Flying Fox and Common bent-wing bat.

Reptiles Grassland Earless Dragon*.

* *As the initial wind farm site plan showed turbines and tracks within the area of potential Grassland Earless Dragon habitat identified at Gurrundah, this species was also included in the 'Assessment of Significance'.*

Based on these assessments (Appendix E), mitigation measures were identified that would ensure the level of potential impact on these species is minimised or, where possible, avoided. On the basis of effective implementation of these mitigation measures, significant impact is not anticipated for these species. Mitigation measures include:

- Careful positioning of infrastructure and access routes to avoid woodland areas.
- The adoption of standard weed and sediment erosion controls to confine impacts.
- The development and implementation of a bird and bat monitoring program.

Available evidence suggests that the risk of population level impacts through avoidance and collision impacts is low however, as uncertainty remains, a monitoring program with adaptive management mechanisms to address collision impacts would be required. Protocols of the program should ensure that relevant species are targeted, timing is appropriate to target species and mechanisms are in place to ensure that evasive action is taken in time to avoid population level impacts on target species. The proposal should include a commitment to undertake changes to the operation of the wind farm (such as temporary shutdown of turbines and modification of onsite fauna resources) should monitoring data suggest unacceptably high collision or avoidance impacts.

- Avoidance of identified areas of potential threatened reptile habitat.

Presence was assumed for all threatened reptiles where areas of potential habitat were identified. Habitat assessment was conducted over two seasons to gain a temporal understanding of this potential. Where development was excluded from these areas (eliminating potential for impact), no Assessment of Significance was undertaken.

However, if the **Grassland Earless Dragon** is present in the location identified at Gurrundah north, a viable population of this species could be placed at risk of extinction by the development of a track and turbine through this habitat. The core area of potential habitat should be avoided by works. Impacts to the periphery, as indicated on revised site layout plans, will avoid fragmentation of habitat and are considered by this report to be acceptable. Grazing at current levels of intensity is recommended in this area to preserve the existing habitat qualities.

6. CONSTRAINTS SUMMARY

In summary, the key biodiversity constraints associated with each location are summarised below and illustrated on Figures 6-1 to 6-5.

6.1.1. *Kialla*

This location contains several woodland fragments. In this extensively modified landscape, even small remnants can provide important fauna habitat. A degraded EEC remnant (White Box, Yellow Box, Blakely's Red Gum Woodland) is located on the eastern edge of the site, outside the site boundary, which would be avoided. While most vegetation is relatively young, more mature vegetation containing hollows occurs at the south-east corner of the location. This area has the greatest potential to harbour hollow-dependent threatened species including owls, gliders and bats. Some vegetation associated with drainage lines around the edges of the "old" Kialla area could fall within Tableland Basalt Forest EEC, and some remnant patches on "new" Kialla also fall within this EEC.

While much of the pasture in the cleared paddocks appears to be dominated by native grasses, there are very few native forbs and most pasture has not been derived from clearing of an EEC, so does not represent a development constraint. There may be some areas on "new" Kialla where pasture does represent a marginal EEC. Away from wooded areas, this is in such low condition so as to represent a limited constraint. One less heavily grazed native pasture paddock (the more recently cleared area located in the north-eastern part of the development envelope on "old" Kialla), has potential to provide habitat to threatened reptiles, although none were recorded.

An area in the head of a drainage line in the "new" Kialla area is part of the EEC Natural Temperate Grassland.

6.1.2. *Bannister*

The more mature vegetation in this area also belongs to the EEC Tableland Basalt Forest, although regrowth patches to the south and east do not. Some remnants in the southern part of Bannister also belong to the EEC Tableland Basalt Forest, including some small, isolated, degraded remnants which may fall within the development envelope.

This location contains several woodland fragments with a degree of connectivity remaining. Woodland or forest in the northern-most part of the site is the most mature and therefore has highest potential to provide habitat for threatened species such as owls and gliders, although none were recorded. This area also has some potential to provide habitat for threatened reptiles.

The basalt outcropping on the southern part of the site has been considered to provide marginal habitat for the Striped Legless Lizard and Pink-Tailed Worm-Lizard. The better areas of potential habitat have been mapped and should be avoided by the proposal.

6.1.3. *Pomeroy*

Some sections of remnant forest and woodland around parts of Pomeroy could provide suitable habitat for threatened plants (*Bossiaea oligosperma*, *Dillwynia glaucula*, *Pultenaea pedunculata* and the spring-flowering orchids *Caladenia tessellata* and *Diuris aequalis*). However, the probability of these occurring in areas likely to be affected by the proposal is very low. Further survey for these species may not be warranted unless proposed access routes pass through suitable dry woodland habitat. Several areas of EEC vegetation (White Box, Yellow Box, Blakely's Red Gum Woodland) are identified.

Pomeroy has the largest proportion of reasonably connected woodland of any site as well as extensive woodland offsite to the east. Although younger trees predominate, it also contains mature trees (predominantly in gullies) and, considering the size of this woodland and the presence of drainage lines and dams, the habitat provided is suitable for several threatened species, including mammals, birds and reptiles. The threatened Powerful Owl was recorded in this area. An access road currently winds through the northern section of this woodland (development of this access way would not be considered appropriate to minimising impact on the woodland habitats). The woodland also contains rocky outcrops that may contain cave roosts for bats. Colonial roosting threatened species would constitute the greatest collision risk. One such species (*Miniopterus schreibersii*) was recorded on and near Pomeroy.

Potential habitat for the Pink-tailed Worm-lizard occurs near the sheds at Pomeroy. The species was not found despite extensive searches and the potential for this species to occur is considered low despite suitable habitat being present. However, the species cannot be said with confidence to be absent, due to its cryptic nature. The better quality Pink-Tailed Worm-Lizard habitat has been mapped and should be avoided.

The substation area was assessed and has no biodiversity constraints to development. The most viable area for its location appears to be the crest near the easement. This will require some minor cut and fill. The vegetation is weedy and exotic. Alternatively, the area closer to the shed could be used.

6.1.4. Gurrundah

Some sections of remnant forest and woodland around the edges of the Gurrundah location could provide suitable habitat for threatened plants (the shrubs *Bossiaea oligosperma*, *Dillwynia glauca*, *Pultenaea pedunculata* and the spring-flowering orchids *Caladenia tessellata* and *Diuris aequalis*). However, the probability of these occurring in areas likely to be affected by the proposal is very low. Further survey for these species may not be warranted unless proposed access routes pass through suitable dry woodland habitat. Two areas of EEC vegetation (White Box, Yellow Box, Blakely's Red Gum Woodland) are identified.

An extensive woodland remnant is present in the southern half of this location, on the eastern side. An access track currently winds through this area at the north, to access Sugarloaf Trig. Squirrel Gliders, listed as a threatened, are present in this woodland (development of this access way would not be appropriate and clearing or other impacts within this woodland, similarly would not be appropriate). The woodland also contains mine shafts that may contain cave roosts for bats. Colonial roosting threatened species would represent the greatest collision risk. One such species (*Miniopterus schreibersii*) was recorded on Gurrundah. Due to the more fragmented nature of other woodland onsite, high habitat value for mammals is not expected in these fragmented areas.

Woodland onsite and the rocky outcropping and grassland just south of Sugarloaf Trig provides potential habitat for threatened reptiles. Follow-up surveying was conducted to clarify the constraints on this site (spring survey and micro-mapping, November 2007, refer to Appendix C). Areas of constraint have been mapped and should be avoided to avoid the potential for significant impact (which would require referral to state and federal agencies).

Several dams are located along the ridge. A common mitigation for wind farm developments is to locate alternative watering points for stock and remove the dams on ridges, so as to avoid attracting birds into the 'collision zone'.

The steep rocky soils and heavy grazing have left the soils highly susceptible to wind erosion. Excavation works will have to employ rigorous sediment and erosion controls to minimise impacts to landform stability, soils and drainage lines during works.

Habitat features considered important at each site for maintaining native fauna onsite are indicated in the following figures which incorporate both flora and fauna constraints.

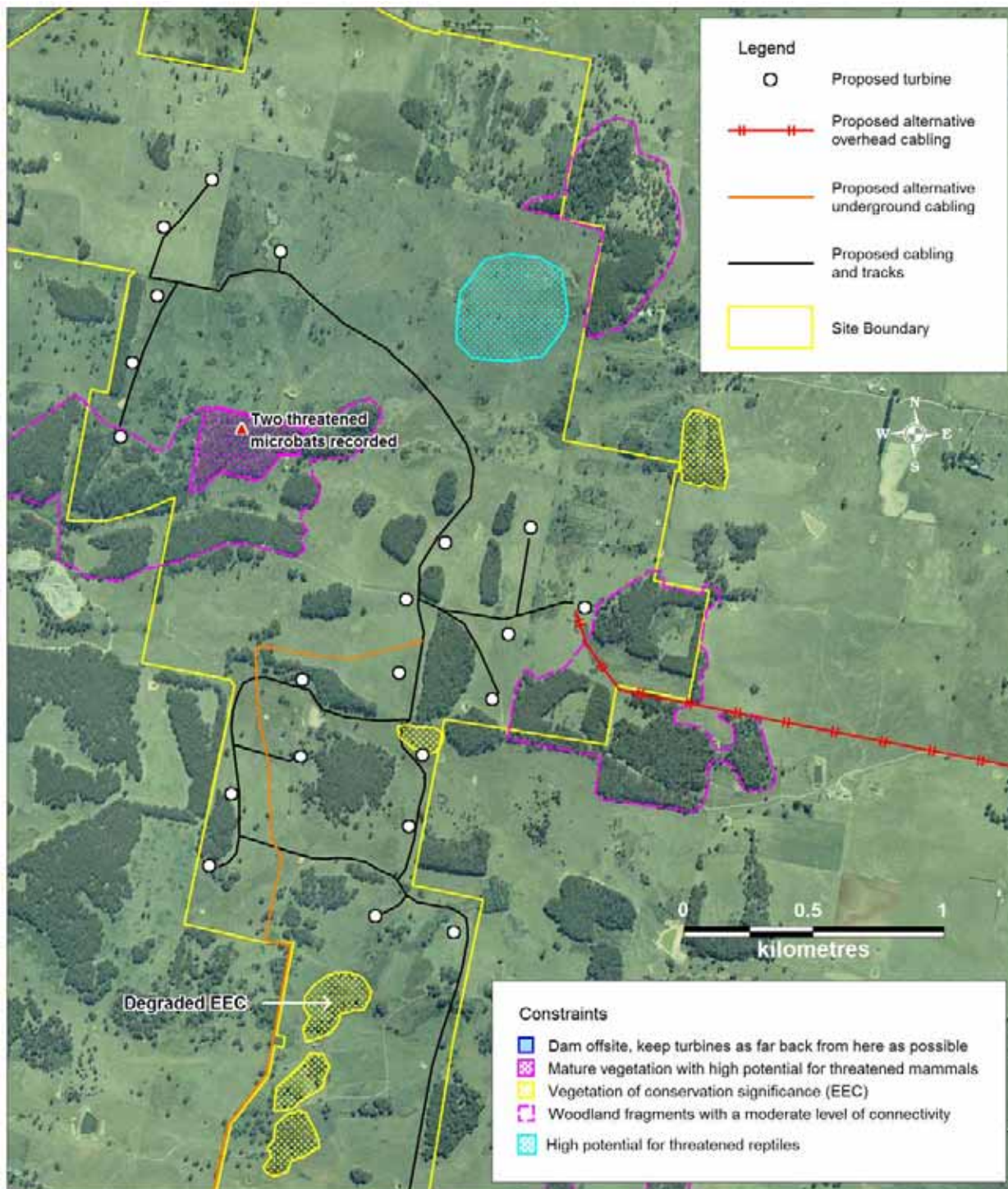


Figure 6-1 Kialla key biodiversity constraints.

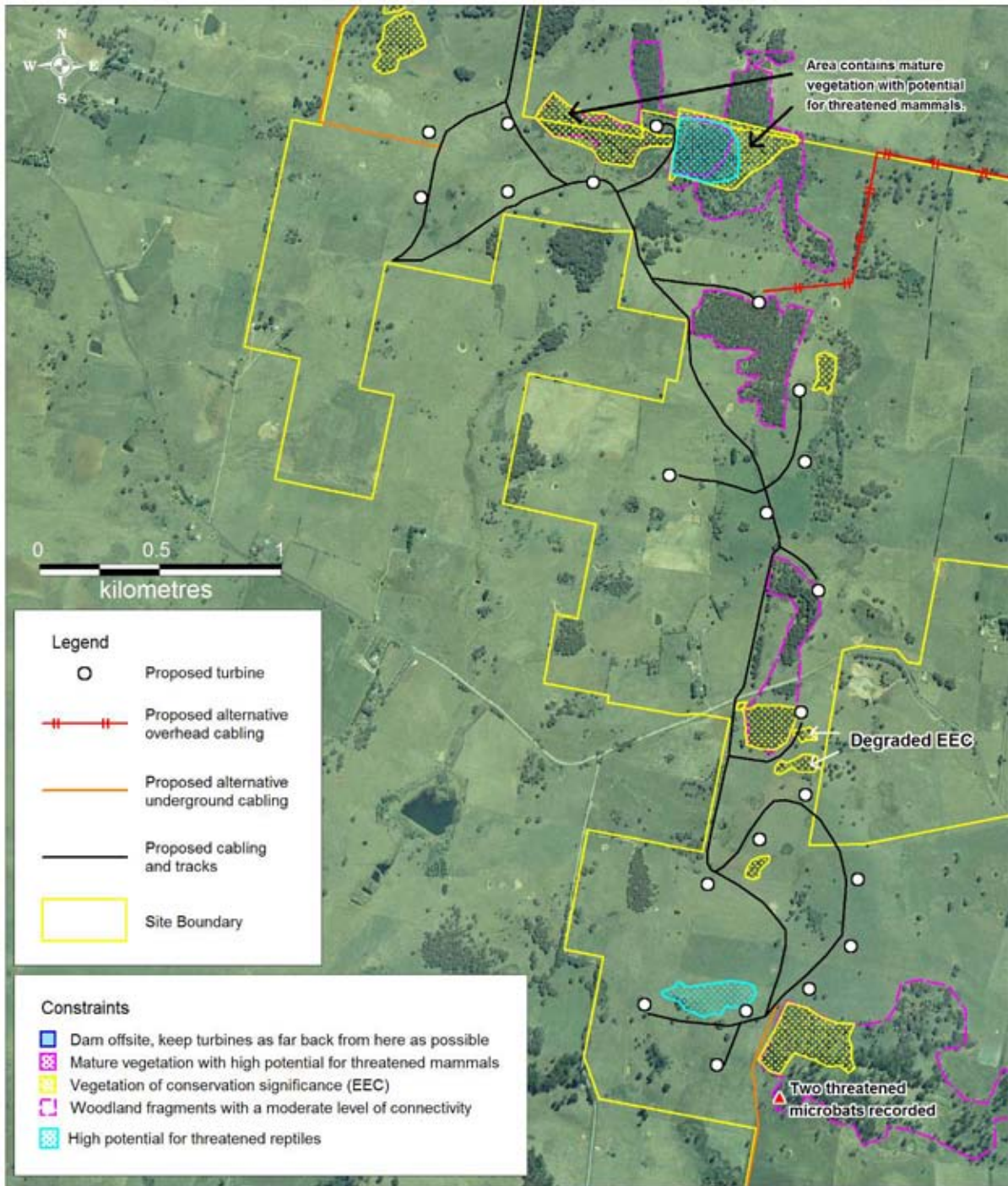


Figure 6-2 Bannister key biodiversity constraints.

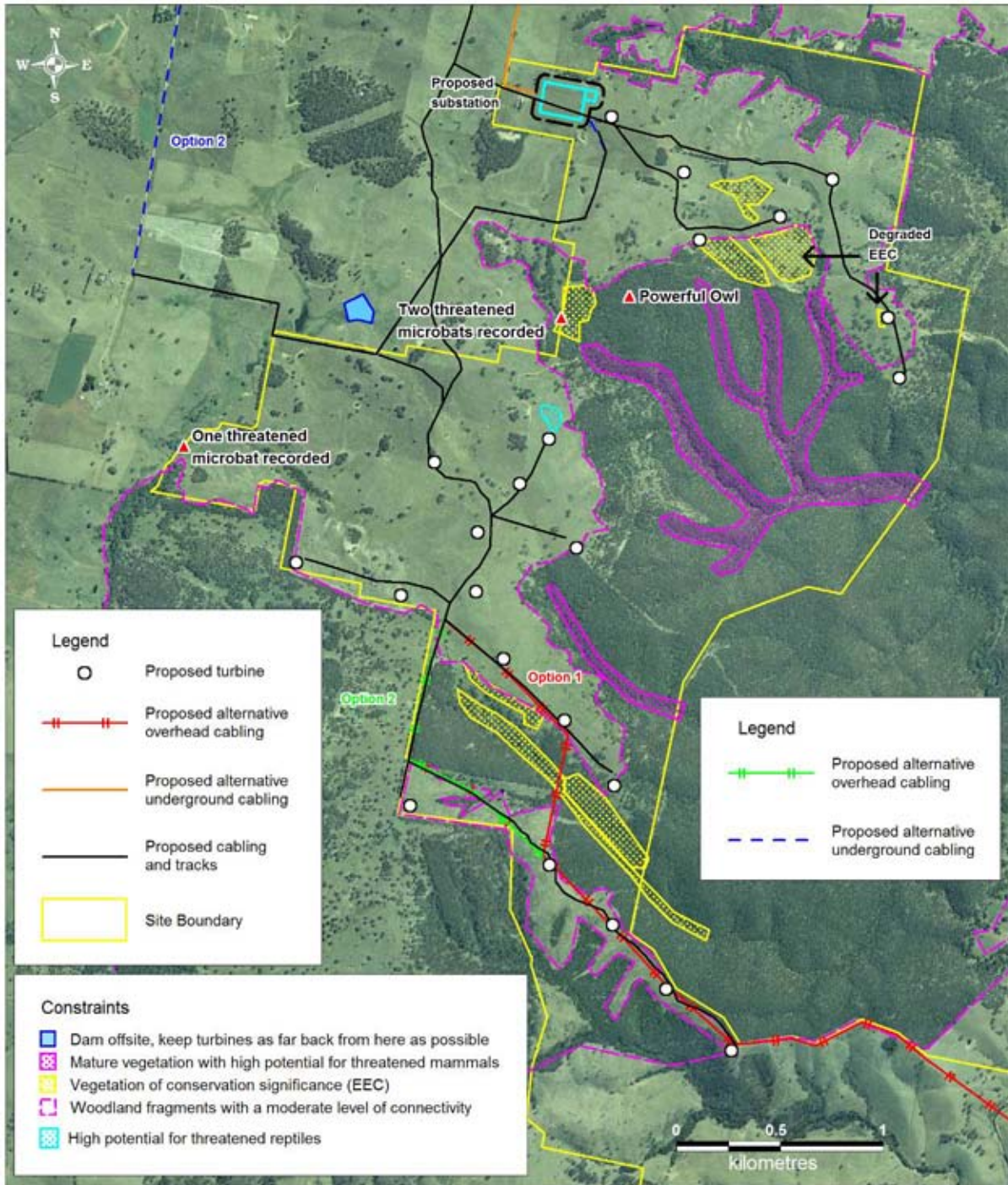


Figure 6-3 Pomeroy key biodiversity constraints.

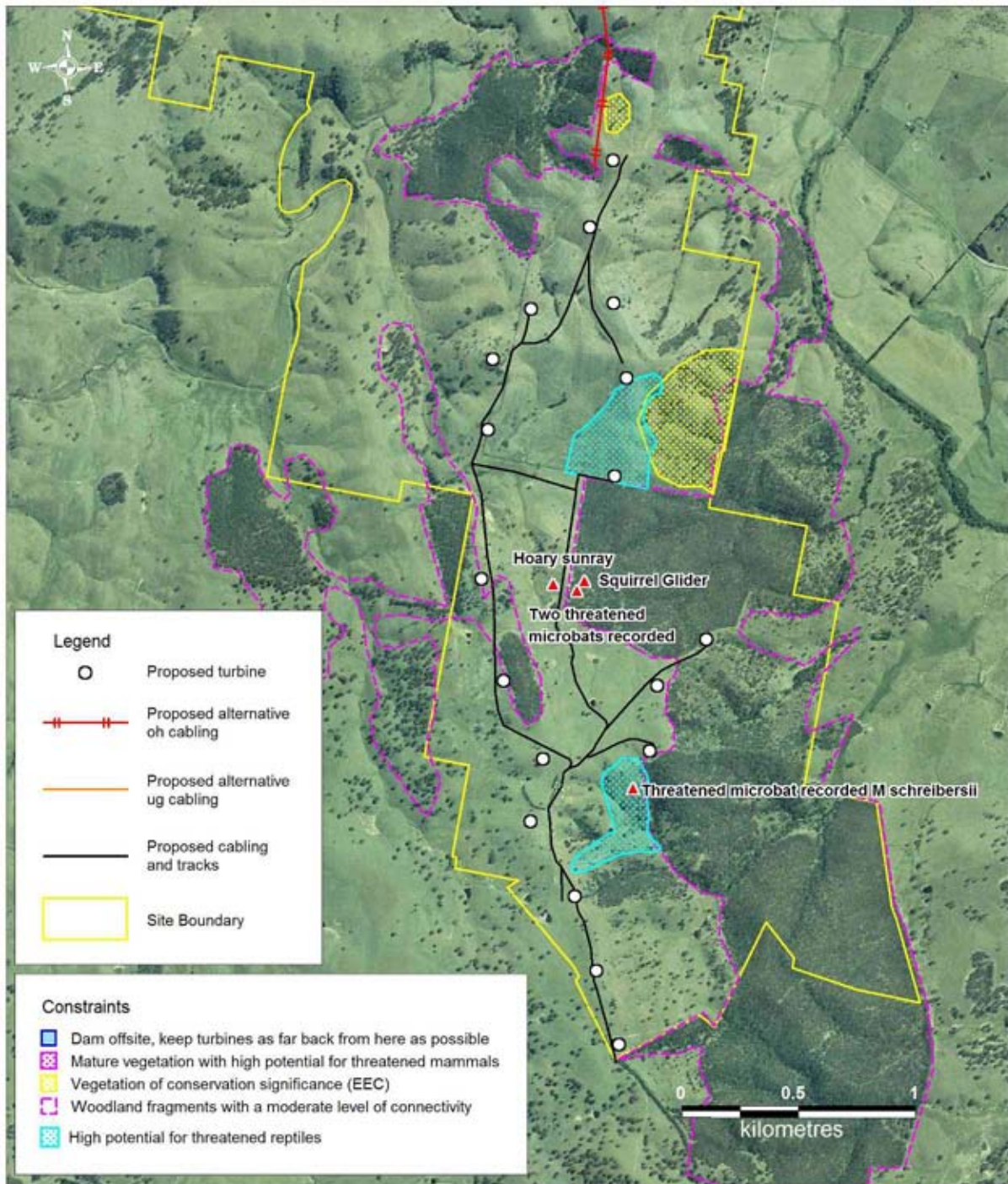


Figure 6-4 Gurrundah key biodiversity constraints.

6.1.5. Access and electricity easements route assessment

Although access and electricity easement routes had not been clearly identified at the time of the biodiversity assessment, several options were investigated and an annotated map produced to guide route selection (Figure 6-5). Constraints are discussed below.

Kialla

The narrow road into the Kialla site, Stephenson's Lane, contains a row of trees that may be difficult to avoid when bringing in large vehicles during the construction phase (Waypoint 1, Figure 6-7). The adjacent paddock may be a preferable option. It could easily be reseeded with pasture grasses after the construction phase, to stabilise the area.

Kialla Road contains some overhanging trees that may require minor lopping to obtain access for large vehicles during the construction phase (Waypoints 2 and 3).

Range Road, which may be used as a general access route to all sites for vehicles coming from Goulburn, contains some roadside remnants that would qualify as White Box, Yellow Box, Blakely's Red Gum Woodland, listed as an Endangered Ecological Community (EEC) under the *Threatened Species Conservation Act 1995* and under the *Environment Protection and Biodiversity Conservation Act 1999*. Some branches overhanging this road may require lopping to allow large vehicles to pass, however this is expected to be limited. Two areas are indicated where this community occurs (Waypoints 7 and 8, Figure 6-5). In general this road is wide enough to accommodate large vehicles and presents limited constraints.

Bannister

Closer to the Bannister site on Kialla Road, overhanging trees that may require lopping to obtain access for large vehicles during the construction phase occur (Waypoints 5 and 6).

The proposed electricity easement veers west along a 'paper road' to the north of the Bannister site (Waypoint 4). The area indicated on Figure 6-7 is a woodland remnant containing many mature trees. A sign declares it is also a wildlife refuge. The vegetation includes *Eucalyptus pauciflora* and *E. viminalis* and this could be considered to fall within the Tableland Basalt Forest EEC. The mature age of the trees is also of significance in this landscape. To avoid impact to this area, the easement may be better located south in the cleared paddock. There appears to be potential to weave around existing trees on this alternative route.

Pomeroy

Access roads between Pomeroy and Bannister are narrow, with sharp turns and generally the road corridors provide the most intact native vegetation remnants. Adjacent paddocks are largely cleared. Easements would more appropriately be located in these cleared paddocks to avoid the removal of trees and excessive road widening around corners. Limited branch lopping of mature hollow bearing trees may be required in several areas, to allow large vehicle access (such as Walkoms Lane, Waypoints 11, 12 and 13).

Storriers Lane contains some narrow sections with trees close to the road on both road verges, some of which contain hollows. Bannister Lane, Learys Lane and Prices Lane also contain trees with hollows and planted wind breaks which would best be avoided.

Gurrundah

The electricity easement between Pomeroy and Gurrundah would largely follow an existing clearing. This vegetation type is not of conservation significance. An existing cleared strip is evident on Figure 6-5 and this would be the preferred route to reduce additional clearing.

The entry to the Gurrundah location contains several large trees that will require some branch lopping to allow vehicles to pass. One of these is a yellow box which leans across the road. It is an isolated tree although technically may fall within the definition of the as White Box, Yellow Box, Blakely's Red Gum Woodland EEC. The impact is not considered to be significant but should be avoided if possible.

Several water bodies are indicated on the 1:50,000 Dalton topographic map for Bannister Lane. In general, these were assessed to provide poor water bird habitat and the passage of heavy vehicles during the construction phase would not be expected to generate adverse impacts.

Proposed Gullen Range Windfarms (AGD66 zone 55)

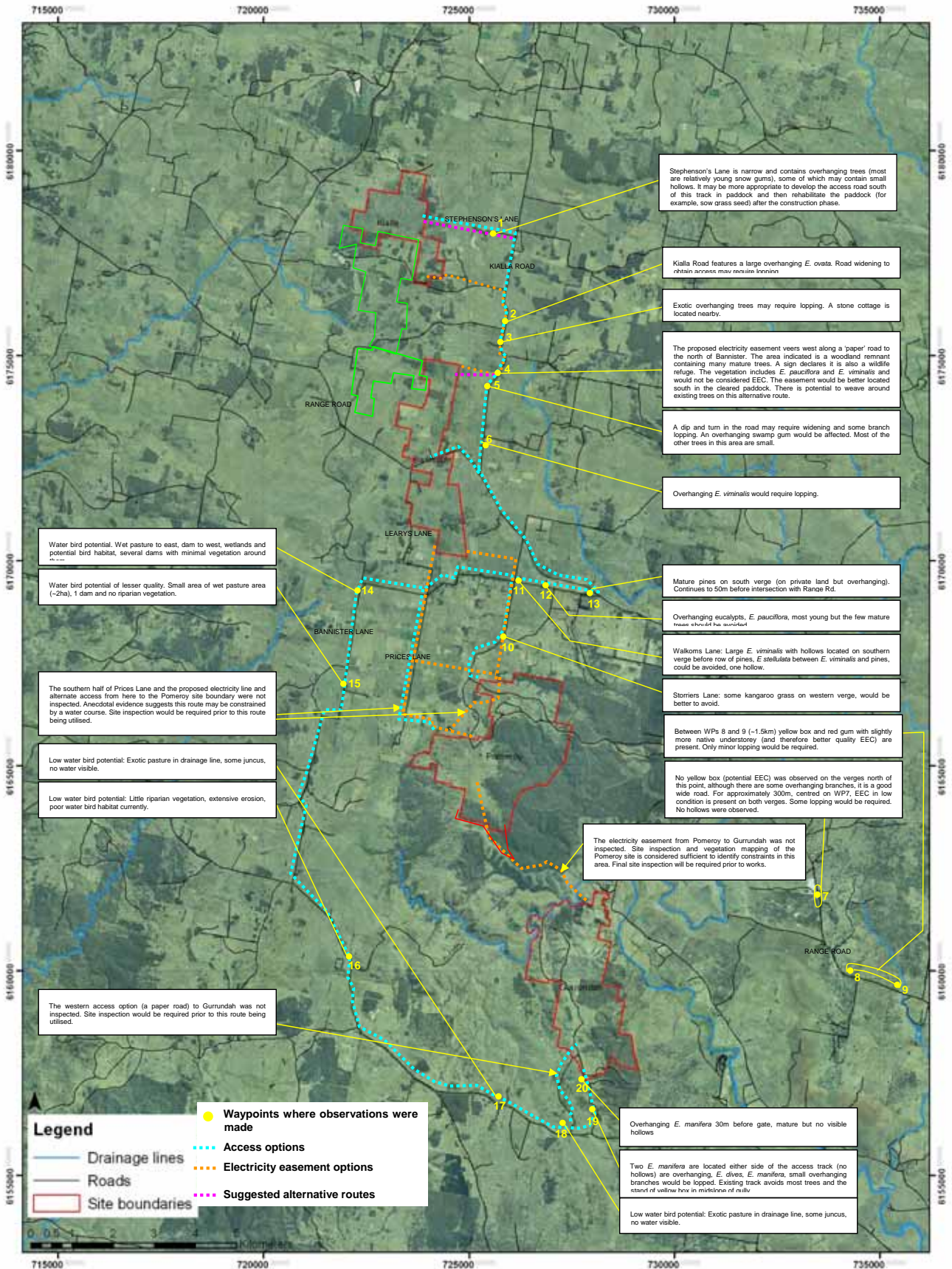


Figure 6-5 Easement and access routes: annotated assessment

Features such as overhanging trees, EEC road verge vegetation and wetlands are indicated. Two suggested deviations are indicated (pink dotted line) to avoid remnant trees along road sides.

7. DISCUSSION OF IMPACTS AND MITIGATION MEASURES

The development of the proposed Gullen Range wind farm would result in a number of impacts to local biodiversity. These can be considered in terms of the three phases of the development: construction, operation and decommissioning.

7.1. Construction impacts

Loss of habitat and habitat degradation are the key potential impacts of the construction phase. The discrete development footprint of the proposed wind farm (including 40 x 22m hardstand areas beneath turbines, 200 x 150m substation, 100 x 75m concrete batch plant, access roads and electricity easements) does not contain unique or quality breeding or foraging habitat for flora or fauna and as the turbine locations are proposed for sites that are largely cleared of native vegetation, the impact to the amount and quality of habitat onsite would be minimal. The exception to this statement is where the development overlaps dams, roadside remnants, isolated paddock trees, woodland remnants and the areas of potential threatened reptile habitat identified in the constraints maps.

Although of poor quality, dams within the works envelope provide a habitat resource. If these are removed during site development, alternative watering points should be established to compensate for their loss. Lopping branches in roadside remnants presents minimal impact however, where understorey would be affected in areas likely to contain EEC vegetation, greater impact would result. In modified landscapes, these road side areas can retain rare species lost to the more intensively managed pastures. A final site inspection should be carried out after road and electricity easements are finalised, to ensure that threatened species habitat and EEC vegetation has been avoided or that impacts are manageable. Impacts to isolated hollow-bearing trees in paddocks should be avoided. These are important habitat resources in modified landscapes. Similarly, the remnant woodland patches provide important refuge and linking habitat of varying degrees of quality. These should be avoided during works and a buffer established to ensure indirect impacts (such as noise and dust) are minimised.

Areas of potential threatened reptile habitat were mapped after surveying was undertaken in two seasons, autumn and spring 2007. A conservative approach has been taken in delineating these areas, aimed at retaining quality potential habitat despite the fact no threatened reptiles were identified in the surveys. The cryptic nature of these species would require near impractical levels of survey effort to confidently declare they do not occur onsite. Considering the modification of reptile habitat in the locality (clearing rocks from paddocks, heavy grazing, replacement of native pastures with exotic species), and the consequences of loss of habitat if the species do occur, the preservation of these areas is strongly recommended.

The sites contain livestock and their current management involves the operation of machinery and vehicles in largely cleared areas. The increased noise, vehicle emissions and dust expected during the construction phase are not anticipated to be cause for concern for fauna onsite. Temporarily de-stocking areas where construction works are underway would reduce potential for injury to stock during the construction phase. Adhering to predetermined access routes and low speeds (max. 40km/hr) would reduce the risk of vehicles colliding with stock or native fauna 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). These measures would also minimise the impact to fauna onsite during construction. Habitat degradation may be said to occur if infrastructure impedes the use of the site by resident species (avoidance impacts). This issue is discussed separately under Section 7.2.

In general, if the locations of works (including temporary activities such as concrete batching) are situated in already cleared areas featuring largely exotic vegetation, biodiversity impacts should be low. To ensure impacts are minimised, it is recommended that:

- Infrastructure should be confined to cleared areas, avoiding woodland patches. A 50m buffer around mature woodland patches should be established to ensure indirect impacts (such as noise and dust) are minimised where practical. Access tracks through these areas would not be appropriate.
- A 250m long easement (20m wide) would be required through woodland that is listed as an EEC (Tableland Basalt Forest) at the south of the Pomeroy site. In this location, mature trees are located only in the gully. The easement should be routed in the area previously thinned. Suitable power line clearance should be achieved so as to avoid the more mature gully vegetation. Construction impacts on the EEC from running a powerline through this area should be temporary.
- Isolated mature trees of an age to begin forming hollows (>60cm diameter at breast height) in cleared areas should be retained.
- The final infrastructure layout (including access tracks and electricity easements) should avoid potential habitat for the threatened shrubs *Bossiaea oligosperma*, *Dillwynia glauca*, *Pultenaea pedunculata*, spring-flowering orchids *Caladenia tessellata*, *Diuris aequalis* and the threatened reptiles Striped Legless Lizard *Delma impar*, Pink-Tailed Worm-Lizard *Aprasia parapulchella*, and the Grassland Earless Dragon *Tympanocryptis pinguicollis* (refer to constraints maps, Figures 6-1 – 6-4).

Particularly, if the **Grassland Earless Dragon** is present in the location identified at Gurrundah north, a viable population of this species could be placed at risk of extinction by the development of a track and turbine through this area. Revised site planning now shows the core area of potential habitat would be avoided by works. Development on the periphery, which is more marginal habitat, is acceptable. Continued grazing at current intensity is recommended in this area to preserve the existing habitat qualities.

- Weed and sediment erosion controls should be implemented to prevent onsite habitat degradation during and following the proposed works. A Construction Environmental Plan would be the appropriate vehicle for these controls. Weeds such as serrated tussock should be treated before the commencement of works to avoid spreading the infestation and the movement of contaminated soils between different parts of the site should be avoided.
- All areas of disturbed soil should be rehabilitated progressively as soon as practicable after disturbance, in order to resist erosion and colonisation by weeds. This may require restricting stock access and implementing revegetation activities.
- Where practical, dams within 100m of a turbine on involved properties should be filled in to reduce the potential to attract birds and bats which might collide with turbines. Dams removed due to site development should be reinstated in more appropriate locations to retain this habitat resource onsite. This recommendation may require revision, subject to the results of the monitoring program (mentioned in Section 7.2).
- The proposed substation location at Pomeroy is endorsed by the findings of this assessment. It has no biodiversity constraints to development.
- A final site inspection would be required for the electricity easement between Pomeroy and Gurrundah to allow micrositing of the easement in areas of least vegetation.
- A final site inspection would be required if the alternative access off Prices Lane to Pomeroy becomes the preferred option.
- A final site inspection would be required if the western access option (a paper road) to Gurrundah becomes the preferred option.

A flora assessment should be conducted as part of the construction environmental management plan, to microsite infrastructure such as tracks away from better quality patches of understorey.

7.2. Operational impacts

No operational flora impacts are anticipated. The key fauna impacts are expected to be related to the operational phase of the wind farm. Bird and bat strike are the foremost concerns, as inappropriately sited turbines can cause frequent and large numbers of mortalities for certain species. For flocking / colonial species and species which occur at low density in the landscape, collisions may constitute a threat to a local population.

The following discussion presents a review of relevant experiences at other wind farm development sites, in Australia and overseas, and 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).

Risks to birds and bats from operational wind farms can be categorised as either:

- i. Direct collision impacts (most notably with turbine blades), or
- ii. Indirect impacts on habitat utilisation (for example, avoidance behaviour).

7.2.1. 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. These factors can be related to characteristics specific to the species, the sites and the infrastructure being considered.

Behavioural traits and biology/physiology

Species at most risk are those which fly over open farm country at blade height (32-135m above the ground). This includes species foraging, moving between foraging habitats, or making seasonal or nomadic long-distance movements. For bats, collisions have been shown to be overwhelmingly correlated to seasonal dispersal, with acclimatization allowing resident bats to forage and breed around the turbines (Erickson *et al.* 2002). Similarly, many birds have been found to make their nests on turbines (pers. comm. N. Graham-Higgs, tour of a Welsh wind farm, 2007). 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 dense flocking patterns. For bats, 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 instead on their vision:

“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).

The exception to this may be the microbat *Tadarida australis* whose echolocation may synchronise with moving blades, masking the blade movement (Hall and Richards 1972, cited in 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 most bats foraging and investigating turbines and using echolocation appear more able to avoid turbines than those migrating by sight alone over less familiar territory.

Some bird species 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 bird groups which are most vulnerable to blade strike; gulls, raptors and

migrant songbirds (Airiola 1987, cited in Bird Studies Canada 2001). 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 dense and/or fast-moving flocks and night-flying species (URS 2004). For biological or physiological reasons, it has been suggested that some birds may not be able to see rotating blades ('motion smear'). Raptors appear to have no difficulty avoiding turbines when simply flying or soaring (Bird Studies Canada 2001). It has been suggested that some raptors may focus intensely on prey beyond the turbine without perceiving the blades (Thelander *et al.* 2003).

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 therefore likely to pose less of a collision risk than summer and autumn months.

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.

Site conditions and habitat features

Many studies have shown that poor weather conditions increase the occurrence of turbine collisions (Bird Studies Canada 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.

The relative location of key habitat areas (such as updraft zones, wetlands and linear habitat features) and natural diurnal and seasonal migration routes also affects risks to birds and bats. The topography at Kialla, Banister and Pomeroy does not suggest large updraft potential; sites have large flat ridges rather than steep ridge lines. The northern end of Gurrundah has more steeply sloping topography. Many bat 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). The non linear arrangement of woodland fragments at the 'Gullen Range' sites would not appear to constitute this threat. The large dam to the north of the Kialla location and creeks to the west of the Pomeroy and Gurrundah sites however, may result in waterbirds flying in close proximity to the turbines. The capacity of populations to 'habituate' to the turbines, and adjust life cycle behaviours accordingly, appears to vary between areas and species. It is recommended that turbines are located as far as possible from updraft zones, wetlands and windrows or linear vegetation patches.

Abundant prey species for birds and bats (such as insects, rabbits and lambs) which utilise habitats near turbines would generate increased risk for species which predate on them. For the sites considered, this increased risk would apply to bats who forage around isolated paddock trees near turbines, and raptors which forage on the ridges.

Flight paths for waterbird species, migrating birds and migrating bats that cross the site would also increase the risk to these species, based on topography, connectivity of woodland and the

distribution of riparian corridors in the local area. Figure 3.1 indicates likely corridors in the region. The sites are located on the western edge of the Wollondilly catchment, between the Wollondilly and the Lachlan catchments. The sites do not appear to interfere with existing regional corridors.

Infrastructure related 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 and bat 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 Bird Studies Canada 2001). In the US, some warning lights on towers have been shown to attract migrating birds at night (Cochran and Graber 1958, cited in Bird Studies Canada 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.

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). This would equate to between 160 – 480 mortalities per year for the 'Gullen Range' 160MW development proposal. 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, so it could be argued that this figure is an exaggeration for local conditions. Looking at wind farms in Europe, 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).

Species found to have collided with turbines or observed as incidental carcass finds during monitoring in Tasmania and Victoria include the European Skylark, Richard's Pipit, Australian Magpie, White-striped Mastiff Bat, Brown Falcon and Wedge-tailed Eagle (Biosis 2002). At the Toora Wind Farm in Victoria, no bird carcasses were found during a year of monitoring or during informal inspections and 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). Therefore, development specific factors appear to override species-specific vulnerabilities. It should be noted however that monitoring data for Australian wind farms is not obtained in a standard manner and is not made always publicly available, limiting the evaluation of impacts for new developments. Further, 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.

7.2.2. 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). 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:

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

The proposal is unlikely to influence the movement of waterbirds along wet corridors (refer to Figures 3-1 and 6-5) but may be more likely to influence the movement of woodland birds moving between woodland patches onsite and in the locality. The southernmost sites, Pomeroy and Gurrundah, contain extensive woodland habitat to the east of where turbines are proposed. There is potential for the birds and bats in these areas to avoid moving west to use smaller woodland remnants. 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 that these smaller woodland patches would not be preferred habitat to many other woodland birds.

A range of mitigation measures is available for incorporation into the development design, to address the risk of the operational phase of the development. Note, not all of these measures have been rigorously tested.

- It is recommended that turbine placement avoids the constraints identified in Figures 6-1 to 6-4.
- Aviation lighting, 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.
- Power poles and overhead powerlines should be bird-safe using flags or marker balls, large wire size, wire insulation, wire and conductor spacing.
- To reduce the attractiveness of the site to foraging raptors, rabbits should be controlled on the turbine ridges and carrion should be removed from the site as quickly as possible.
- A monitoring program should be designed to document mortalities, remove carcasses and assess the effectiveness of controls. Standardised and publicly available data should be collected to increase the knowledge base on this subject. Bat collision rates should be monitored 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 (set out in the monitoring program), 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.

7.2.3. *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:

- A flora and fauna assessment should be undertaken prior to decommissioning to identify biodiversity constraints.
- Weed and sediment erosion control principles should be developed and implemented.
- Disturbed ground should be stabilised and rehabilitated as soon as practicable after works.

8. CONCLUSION AND MITIGATION SUMMARY

A number of environmental gains are associated with wind farm development. They have potential to address Anthropogenic Climate Change, a process recognised in New South Wales as a Key Threatening Process, by reducing reliance on the burning of fossil fuels for energy. 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). Particularly relevant to the Goulburn area, electricity generated by wind farms does not require water cooling, as compared to fossil fuel power plants. Less intensive grazing beneath turbines in drought years may be achievable as a result of the additional income from lease agreements and would have benefits for soil health and biodiversity. However, through clearing, soil disturbance and the installation of infrastructure, direct and indirect biodiversity impacts have been identified and would require mitigation to ensure that impacts are avoided where possible or minimised where avoidance is not possible.

8.1. Direct habitat impacts - offsetting

Direct impacts to flora and fauna habitat will be minimal, as the infrastructure footprint is comparatively small and areas of conservation significance have been mapped to allow infrastructure placement to avoid them. Indirect impacts can similarly be managed to reduce the risk of habitat degradation. This assessment considers that there is ample ability to offset onsite for the minor amount of proposed clearing within the site boundaries. Woodland at Pomeroy could be protected in perpetuity. Weed control at Pomeroy to address existing serrated tussock infestations is proposed. These measures would ensure that the net biodiversity outcome is positive.

The final infrastructure layout will determine the precise amount of clearing required. At that time, formal agreements should be sought with the affected involved land owners to secure offsetting for areas of habitat permanently removed by the proposal. It appears that, by locating infrastructure in cleared paddocks, most of which are dominated by exotic species, addressing noxious weed infestations and by agreeing to manage those areas which have been identified as exclusion zones in the constraints mapping, that the project is well able to achieve a net benefit in terms of environmental outcomes onsite. This should also be viewed in terms of the wider environmental benefits of establishing renewable energy generation in rural area, which has significant broad level environmental benefits.

8.2. Direct impacts – fauna monitoring

Direct impacts to fauna exist for species which can move at the height of turbines (birds and bats) as well as reptiles which may utilise habitats that would be developed for the location of infrastructure. Studies have shown that the number of birds killed per unit of wind generated energy produced is low compared to other human-related causes of death (for example, vehicle collision and power line electrocution). Furthermore, there are measures which can be taken to monitor and otherwise mitigate these direct impacts. Indirect impacts, such as avoidance behaviour, may affect the utilisation of resources in the local area. These impacts are considered to be manageable.

The key mitigation strategies considered necessary to reduce the potential impacts to an acceptable level are outlined below (summarized from Section 7). Impacts would be predominantly in the short-term for flora while ongoing impacts are more relevant to fauna. On the basis of these measures, no species or community listed under the NSW *TSC Act* or Commonwealth *EPBC Act* is considered likely to be subjected to a significant adverse impact.

8.3. Construction impacts

- Infrastructure should be confined to cleared areas, avoiding woodland patches. A 50m buffer around mature woodland patches should be established to ensure indirect impacts (such as noise and dust) are minimised where practical. Access tracks through these areas would not be appropriate.
- A 250m long easement (20m wide) would be required through woodland that may soon be listed as an EEC at the south of the Pomeroy site. In this location, mature trees are located only in the gully. The easement should be routed in the area previously thinned. Suitable power line clearance should be achieved so as to avoid the more mature gully vegetation.
- Isolated mature trees (>60cm diameter at breast height) in cleared areas should be retained.
- The final infrastructure layout (including access tracks and electricity easements) should avoid potential habitat for the threatened shrubs *Bossiaea oligosperma*, *Dillwynia glauca*, *Pultenaea pedunculate*, spring-flowering orchids *Caladenia tessellata*, *Diuris aequalis* and the threatened reptiles Striped Legless Lizard *Delma impar*, Pink-Tailed Worm-Lizard *Aprasia parapulchella*, and the Grassland Earless Dragon *Tympanocryptis pinguicolla* (refer to constraints maps, Figures 6-1 – 6-4).
- Particularly, if the Grassland Earless Dragon is present in the location identified at Gurrundah north, a viable population of this species could be placed at risk of extinction by the development of a track and turbine through this area. Revised site planning now shows the core area of potential habitat would be avoided by works. Development on the periphery, which is more marginal habitat, is acceptable. Continued grazing at current intensity is recommended in this area to preserve the existing habitat qualities.
- Weed and sediment erosion controls should be implemented to prevent onsite habitat degradation during and following the proposed works. A Construction Environmental Plan would be the appropriate vehicle for these controls. Weeds such as serrated tussock should be treated before the commencement of works to avoid spreading the infestation.
- All areas of disturbed soil should be rehabilitated progressively as soon as practicable after disturbance, in order to resist erosion and colonisation by weeds. This may require restricting stock access and implementing revegetation activities.
- Where practical, dams within 100m of a turbine on involved properties should be filled in to reduce the potential to attract birds and bats which might collide with turbines. Dams removed due to site development should be reinstated in more appropriate locations to retain this habitat resource onsite. This recommendation may require revision, subject to the results of the monitoring program (mentioned in Section 7.2).
- The proposed substation location at Pomeroy is endorsed by the findings of this assessment. It has no biodiversity constraints to development.
- A final site inspection would be required for the electricity easement between Pomeroy and Gurrundah to allow micrositing of the easement in areas of least vegetation.
- A final site inspection would be required if the alternative access off Prices Lane to Pomeroy becomes the preferred option.
- A final site inspection would be required if the western access option (a paper road) to Gurrundah becomes the preferred option.

8.4. Operational impacts

- It is recommended that turbine placement avoids the constraints identified in Figures 6-1 to 6-4.
- Aviation lighting, 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.
- Power poles and overhead powerlines should be bird-safe using flags or marker balls, large wire size, wire insulation, wire and conductor spacing.
- To reduce the attractiveness of the site to foraging raptors, rabbits should be controlled on the turbine ridges and carrion should be removed from the site as quickly as possible.
- A monitoring program should be designed to document mortalities, remove carcasses and assess the effectiveness of controls. Standardised and publicly available data should be collected to increase the knowledge base on this subject. Bat collision rates should be monitored 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 (set out in the monitoring program), 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.

8.5. Decommissioning impacts

- A flora and fauna assessment should be undertaken prior to decommissioning to identify biodiversity constraints.
- Weed and sediment erosion control principles should be developed and implemented.
- Disturbed ground should be stabilised and rehabilitated as soon as practicable after works.

The proposal represents a renewable energy generation project and thereby has broad scale environmental benefits in addressing the increasing emission of greenhouse gases. At the local level, the implementation of the project-specific mitigation measures proposed would ensure that biodiversity values will be maintained or improved.

With the implementation of effective bird and bat monitoring and avoiding identified areas of constraint, the proposal is unlikely to reduce the long-term viability of a local population of the species, population or ecological community or accelerate the extinction of the species, population or ecological community or place it at risk of extinction. The proposal will not adversely affect critical habitat. These statements are supported by the Assessments of significance, Appendix E, in this report.

9. REFERENCES

- Anderson, R., Morrison M., Sinclair, K. and Strickland, D. 1999. Studying wind energy/bird interactions: a guidance document. Report to National Wind Coordinating Committee, Washington, D.C.
- Australian Bat Society 2005, Australian Bat Society newsletter. Number 25.
- Australian Museum 2003, 'White-throated Needletail *Hirundapus caudacutus* fact sheet', retrieved 13 Dec 2005 from <http://www.amonline.net.au/factsheets/needletail.htm>
- Bailey, L. L., Simons, T. R. & Pollock, K. H. 2004, 'Estimating site occupancy and species detection probability parameters for terrestrial salamanders'. *Ecological Applications*, 14 (3), pp. 692–702.
- Barrer, P. (1992). A survey of *Aprasia parapulchella* along parts of the lower Molonglo River corridor 1-13.
- Benson, K. (1996). Habitat selection by *Tympanocryptis pinguicolla* over winter using artificial spider burrows at Hume, in the ACT. Unpublished report, School of Resource, Environmental and Heritage Sciences, Faculty of Applied Science University of Canberra.
- Biosis Research 2002, Codrington Wind Farm Avian Avoidance Behaviour Report, March 2002
- Bishop, T. (1996). *Field Guide to the Orchids of New South Wales and Victoria*. UNSW Press.
- Blakers, M., Davies, S.J.J.F. and Reilly, P. N. (1984). *The Atlas of Australian Birds*. Royal Australasian Ornithologists Union, Melbourne.
- Bird Studies Canada 2001, Potential impacts of wind turbines on birds at North Cape, Prince Edward Island, A report for the Prince Edward Island Energy Corporation, December 2001.
- Clarke, G.M. (2001) Survey and genetic analysis of NSW populations of the endangered golden sun moth, *Synemon plana* 2000 90.
- Coulson, G. 1995, Management directions for the Striped Legless Lizard (*Delma impar*) in the Australian Capital Territory.
- Daly, G. 2004. 'Surveys of reptiles and amphibians on the south-western slopes of NSW'. *Herpetofauna*, 34, 2-16.
- Department of Environment and Conservation (2005) Draft Green and Golden Bell Frog *Litoria aurea* Recovery Plan, February 2005.
- Department of Environment and Heritage (2003) Nationally Threatened Species and Ecological Communities Information Sheet. Murray Cod.
- Dorrough, J. 1995, Past Present Habitat of the Striped Legless Lizard, *Delmar impar* (Pygopodidae), in the Australian Capital Territory, report to the SCT Parks and Conservation Service.
- Emison, W.B., Beardsell, C.M., Norman, F.I., Loyn, R.H. and Bennett, S. (1987). *Atlas of Victorian Birds*. Department of Conservation, Forests and Lands and Royal Australasian Ornithologists Union, Melbourne.

- Erickson, W., Johnson, G., Young, D. Strickland, D., Good, R. Bourassa, M. Bay, K. and Sernka, K. 2002. Synthesis and Comparison of Baseline Avian and Bat Use, Raptor Nesting and Mortality Information from Proposed and Existing Wind Developments, report prepared for Bonneville Power Administration December 2002, by WEST, Inc., Wyoming, USA.
- Falconer, R. (2004). *Down by the riverside: a field and management guide to native plants in and about the rivers of the Goulburn district, NSW*. Goulburn Field Naturalists Society, NSW.
- Fallding, M. (2002). *Planning Framework for Natural Ecosystems of the ACT and NSW Southern Tablelands*, Prepared by the Land and Environment Planning, NSW National Parks and Wildlife Service, Hurstville.
- Fischer, J., Lindenmayer, D. & Cowling, A. 2004, 'The challenge of managing multiple species at multiple scales: reptiles in an Australian grazing landscape'. *Journal of Applied Ecology*, 41, pp. 32–44.
- Friends of Grasslands (2006) Endangered Plant Discovered. News of Friends of Grasslands. Nov-Dec 2006.
- Fleay, D. (1968). *Nightwatchmen of Bush and Plain*. Jacaranda Press, Brisbane.
- Gibbons, P. and Lindenmayer, D. B. 1997, 'Conserving Hollow-dependent Fauna in Timber-production Forests', *Environmental Series Monograph Series No. 3*, NSW National Parks and Wildlife Service, Sydney.
- Gibbons P. and Lindenmayer D.B. (2002). *Tree hollows and wildlife conservation in Australia*. CSIRO Publishing: Melbourne
- Green, K. and Osborne, W.S. (1994). *Wildlife of the Australian Snow Country*, Reed Books.
- Hall, L.S. and Richards, G.C. 1979, 'Bats of eastern Australia', Queensland Museum Booklet 12.
- Harden G.J. (ed.) (1993). *Flora of NSW* (NSW University Press: Sydney).
- Harden G.J. (ed.) (2002). *Flora of NSW* (NSW University Press: Sydney).
- Hawkesbury Nepean Catchment Management Authority 2006, Upper Wollondilly River Subcatchment website, accessed July 2007 from <http://www.hn.cma.nsw.gov.au/topics/2047.html>
- Hecnar, S. J. & M'Closkey, R. T. 1998, 'Effects of human disturbance on fived-lined skink', *Eumeces fasciatus*, abundance and distribution. *Biological Conservation*, 85, pp. 213–222.
- Hero, J.M., Littlejohn, M. and Marantelli, G. (1991). *The Frogwatch Guide to Victorian Frogs*. Department of Conservation and Environment, Melbourne.
- Hodos, W., A. Potocki, T. Storm, & M. Gaffney. 2001. Reduction of motion smear to reduce avian collisions with wind turbines. Pp. 88-105. In S. S. Schwartz, (ed.) Proceedings of the National Avian- Wind Planning Meeting IV. Prepared for the Avian Subcommittee of the National Wind Coordinating Committee by RESOLVE, Inc. Washington, DC.
- Kerlinger, P. and Kerns, J. (2003) FAA Lighting of Wind Turbines and Bird Collisions. Presentation at the National Wind Coordinating Committee-Wildlife Working Group Meeting, Washington, D.C., Nov. 17 18.

- Klippel, K. (1992). *Wildlife Data Search: Threatened Animal Species of New South Wales*, Breakout Press, NSW.
- Lane, B. and Associates 2005, Wind Farms and Birds: Interim standards for risk assessment. Prepared for the Australian Wind Energy Association, July 2004.
- Langston, R H W and Pullen, J D 2002. 'Wind farms and birds: An analysis of the effects of wind farms on birds, and guidance on environmental assessment criteria and site selection issues.' Report by BirdLife to the Standing Committee of the Convention on the Conservation of European Wildlife and Natural Habitats (Berne Convention), Strasbourg, December 2002.
- Lumsden, L. F. and Bennett, A. F. 2004. 'Scattered trees in rural landscapes: foraging habitat for insectivorous bats in south-eastern Australia'. *Biological Conservation*, 122, 205-222.
- NSW NPWS (undated). *Identification Guidelines for Endangered Ecological Communities: White Box Yellow Box Blakely's Red Gum Woodland (Box-Gum Woodland)*. NSW National Parks and Wildlife Service. Retrieved Nov 2005 from http://www.nationalparks.nsw.gov.au/PDFs/box-gum_id_guidelines.pdf
- NSW NPWS 1999b, Threatened Species Information: Freckled Duck *Stictonetta naevosa*, NPWS Hurstville, http://www.nationalparks.nsw.gov.au/PDFs/tsprofile_freckled_duck.pdf
- NSW NPWS 2003, Biodiversity Indicators: Key habitats and conservation status of vegetation in the Southern Tablelands, NSW and ACT. Report prepared by the NSW National Parks and Wildlife Service, Southern Directorate, February 2003.
- NSW NPWS 2004b, 'Booroolong Frog: Vulnerable species listing', NPWS, <http://www.nationalparks.nsw.gov.au/npws.nsf/Content/Booroolong+Frog+-+endangered+species+listing>
- NSW NPWS (2005). *Mundoonen Nature Reserve Plan of Management*, NSW National Parks and Wildlife Service, Part of the Department of Environment and Conservation (NSW), May 2005
- Osborne, W.S. & Jones, S.R. (1995). 'Recovery plan for the Pink-tailed Worm Lizard (*Aprasia parapulchella*)' in *ACT Parks and Conservation Service Technical Report 10*
- Osborne, W.S. & McKergow, F.V.C. (1993) Distribution, population density and habitat of the Pink-tailed Legless Lizard *Aprasia parapulchella* in Canberra Nature Park, ACT 14-23
- Pittock, B. (ed.) 2003. 'Climate Change: An Australian Guide to the Science and Potential Impacts. *Australian Green House Office*. Retrieved 125 Jan from: <http://www.greenhouse.gov.au/science/guide/pubs/science-guide.pdf>
- Pizzey, G. and Knight, F. (1997). *A Field Guide to the Birds of Australia*, Collins, Sydney.
- Pizzey, G. and Knight, F. (2003). *A Field Guide to the Birds of Australia*, Collins, Sydney.
- Rhodes 2001. Bat Survey of proposed windfarm site, Musselroe Bay, North-east Tasmania, 4-6 December 2001. A report to Hydro Tasmania.
- Russell, R. 1983. 'Yellow-bellied Glider *Petaurus australis*' in *The Australian Museum Complete Book of Australian Mammals*, ed. R. Strahan, Angus and Robertson, Sydney.
- Sass, S. 2007. Determinants of reptile diversity in a fragmented landscape. Charles Sturt University, Honours thesis.

- Sass, S. 2003. 'A survey of the reptiles of Wagga Wagga'. *Herpetofauna*. 33, 18-23
- Schodde, R. and Mason, I. J. (1999). *The Directory of Australian Birds: Passerines*. CSIRO, Collingwood, Victoria.
- Schodde, R. and Tidemann, S.C. (eds.) (1995). *Readers Digest Complete Book of Australian Birds*. 2nd. edn. Readers Digest Services, Sydney.
- Smith, W.J.S. & P. Robertson (1999) National Recovery Plan for the Striped Legless Lizard (*Delma impar*): 1999-2003.
- Strahan, R. (ed). (1995). *The Mammals of Australia*. Reed Books, Australia.
- Strickland, D. 2004, Overview of non-collision related impacts from wind projects in proc. wind energy and birds/bats workshop: understanding and resolving bird and bat impacts, Washington, DC May 18-19, 2004.
- Thelander, C.G. Smallwood, K.S. and Ruge L. 2003. 'Bird Risk Behaviors and Fatalities at the Altamont Pass Wind Resource Area Period of Performance: March 1998 – December 2000'. BioResource Consultants Ojai, California December 2003.
- Thomas V, Gellie N, Harrison T (2000). *Forest ecosystem classification and mapping for the southern Comprehensive Regional Assessment*. NSW National Parks and Wildlife Service, Queanbeyan.
- Thompson, G. G., Withers, P. C., Pianka, E. R. & Thompson, S. A. 2003, 'Assessing biodiversity with species accumulation curves; inventories of small reptiles by pit-trapping in Western Australia'. *Austral Ecology*, 28, pp. 361-383.
- Tozer, M.G., Turner, K., Simpson, C., Keith, D.A., Beukers, P., MacKenzie, B., Tindall, D. and Pennay, C. (2006). Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands. NSW Department of Environment and Conservation and NSW Department of Natural Resources, Sydney.
- Turner, F. B., Jennrich, R. I. & Wentraub, J. D. 1969, 'Home ranges and body size of lizards'. *Ecology*, 50, pp. 1071–1081.
- URS 2004, Crookwell II Wind Farm – Environmental Impact Statement, prepared for the Wind Farm Joint Venture (WFJV).
- Victorian Department of Conservation and Environment 1992, 'Tiger Quoll *Dasyurus maculatus*', Action Statement No. 15.
- Wager, R. & P. Jackson (1993). The Action Plan For Australian Freshwater Fishes.
- Walsh, N. G. and Entwisle, T. J. (1994). *Flora of Victoria Vol 2*. Inkata, Melbourne.
- Winkelman, J.E. 1994. Bird/wind turbine investigations in Europe. Pages 43-48 in Proceedings of the National Avian-Wind Power Planning Meeting, Denver, CO, 20-21 July 1994. Proceeding prepared by LGL Ltd., environmental research associates, King City, Ontario.

APPENDICES

APPENDIX A: FLORA LIST

A.1: Composite flora list

- X present on or around edges of location
 A present on approaches to location
 P planted on location
 ? tentative identification only
 * introduced species are preceded by an asterisk.

Note

'New' location indicates the follow-up survey of three properties in the Kialla – Bannister location (Elliott, Gay, Leonard properties) as indicated on Figures 2.2 and 2.3.

'Ban' location (Bannister) includes a short section of Range Road verge with remnant forest near access gate to southern end.

Scientific name	Common name	Family	Locations				
			Kia	New	Ban	Pom	Gur
TREES							
<i>Acacia dealbata</i> ssp <i>dealbata</i>	silver wattle	Fabaceae	X	X	X	X	
<i>Acacia deanei</i> ssp. <i>paucijuga</i>	green wattle	Fabaceae				X	X
<i>Acacia decurrens</i>		Fabaceae					X
<i>Acacia falciformis</i>	broad-leaf hickory	Fabaceae				X	X
<i>Acacia melanoxylon</i>	blackwood	Fabaceae	X	X	X	X	X
<i>Acacia parramattensis</i>		Fabaceae				X	X
<i>Callitris endlicheri</i>	black cypress pine	Cupressaceae					X
* <i>Crataegus monogyna</i>	hawthorn	Malaceae		X	X	X	
<i>Eucalyptus bridgesiana</i>	apple box	Myrtaceae	A	X	X	X	
<i>Eucalyptus dalrympleana</i> ssp <i>dalrympleana</i>	mountain gum	Myrtaceae	X	X	X	X	
<i>Eucalyptus dives</i>	broad-leafed peppermint	Myrtaceae	X	X	X	X	X
<i>Eucalyptus macrorhyncha</i>	red stringybark	Myrtaceae					A
<i>Eucalyptus mannifera</i>	brittle gum	Myrtaceae				X	X
<i>Eucalyptus melliodora</i>	yellow box	Myrtaceae				X	X
<i>Eucalyptus ovata</i>	swamp gum	Myrtaceae		X			
<i>Eucalyptus pauciflora</i>	snow gum	Myrtaceae	X	X	X	X	X
<i>Eucalyptus radiata</i> ssp <i>radiata</i>	narrow-leaved peppermint	Myrtaceae		X	X		
<i>Eucalyptus rossii</i>	scribbly gum	Myrtaceae				X	X
<i>Eucalyptus stellulata</i>	black sallee	Myrtaceae			X	X	
<i>Eucalyptus viminalis</i>	ribbon or manna gum	Myrtaceae		X	X	X	
<i>Exocarpos cupressiformis</i>	native cherry	Santalaceae		X	X	X	X
* <i>Malus X domestica</i>	apple	Malaceae			X	X	
* <i>Pinus radiata</i>	radiata pine	Pinaceae			X		
SHRUBS, SUB-SHRUBS							

Scientific name	Common name	Family	Locations				
			Kia	New	Ban	Pom	Gur
<i>Acacia dealbata</i> ssp <i>alpina</i>	silver wattle	Fabaceae					X
<i>Acacia gunnii</i>	ploughshare wattle	Fabaceae				X	X
<i>Acacia rubida</i>	red-stem wattle	Fabaceae				X	P
<i>Acrotriche serrulata</i>	honeypots	Epacridaceae				X	
<i>Amyema pendulum</i>	A mistletoe	Loranthaceae	X	X	X	X	
<i>Bossiaea buxifolia</i>		Fabaceae				X	X
<i>Brachyloma daphnoides</i>	daphne heath	Epacridaceae		X			X
<i>Cassinia arcuata</i>	Chinese scrub	Asteraceae				X	
<i>Cassinia aculeata</i>	dolly bush	Asteraceae				X	?
<i>Cassinia laevis</i>	cough bush	Asteraceae					X
<i>Cassinia longifolia</i>	dogwood	Asteraceae					X
<i>Choretrum pauciflorum</i>	dwarf sour bush	Santalaceae					X
<i>Daviesia latifolia</i>		Fabaceae	X	X	X	X	
<i>Dillwynia phyllicoides</i>		Fabaceae					X
<i>Dillwynia sericea</i>		Fabaceae					X
* <i>Genista monspessulana</i>	Cape broom	Fabaceae			X		
<i>Gompholobium huegelii</i>	pale wedge pea	Fabaceae				?	?
<i>Gompholobium inconspicuum</i>		Fabaceae					?
<i>Hibbertia obtusifolia</i>	guineaflower	Dilleniaceae	X	X	X	X	X
<i>Hovea heterophylla</i>	deleted	Fabaceae	X	X	X	X	X
<i>Indigofera australis</i>	austral indigo	Fabaceae				X	
<i>Leptospermum continentale</i>		Myrtaceae	X				
<i>Leptospermum lanigerum</i>	woolly teatree	Myrtaceae				X	
<i>Leptospermum myrtifolium</i>	swamp teatree	Myrtaceae	X				X
<i>Leucopogon attenuatus</i>		Epacridaceae					?
<i>Leucopogon fraseri</i>		Epacridaceae		X		X	
<i>Leucopogon virgatus</i>		Epacridaceae					X
<i>Melichrus urceolatus</i>	urn heath	Epacridaceae	X	X		X	X
<i>Monotoca scoparia</i>	prickly broom heath	Epacridaceae					X
<i>Olearia erubescens</i>		Asteraceae				X	
<i>Persoonia linearis</i>	narrow-leaved geebung	Proteaceae				X	X
<i>Pimelea curviflora</i> var <i>sericea</i>	curved rice-flower	Thymeleaceae				X	X
<i>Pimelea linifolia</i> ssp <i>caesia</i>						X	X
<i>Pimelea treyvaudii</i>		Thymeleaceae					X
<i>Pultenaea subspicata</i>		Fabaceae					?
* <i>Rosa rubiginosa</i>	briar rose	Rosaceae			X	X	
<i>Rubus parvifolius</i>	small-leaved bramble	Rosaceae				X	X
* <i>Rubus ulmifolius</i>	blackberry	Rosaceae	X	X	X	X	X
* <i>Sambucus nigra</i>	common elder	Sambucaceae	X				

Scientific name	Common name	Family	Locations				
			Kia	New	Ban	Pom	Gur
FERNS							
<i>Asplenium flabellifolium</i>	necklace fern	Aspleniaceae				X	
<i>Cheilanthes austrotenuifolia</i>		Sinopteridaceae				X	X
<i>Cyathea australis</i>	rough tree fern	Cyatheaceae				X	
<i>Doodia aspera</i>	prickly rasp fern	Blechnaceae				X	
<i>Hypolepis muelleri</i>	harsh ground fern	Dennstaedtiaceae	X				
<i>Pteridium esculentum</i>	bracken	Dennstaedtiaceae	X	X	X	X	X
<i>Ophioglossum lusitanicum</i>	adder's tongue	Ophioglossaceae		X			
VINES AND TWINERS							
<i>Cassytha melantha</i>	devil's twine	Lauraceae				X	
<i>Convolvulus erubescens</i>	bindweed	Convolvulaceae		X		X	
<i>Glycine clandestina</i>	twining glycine	Fabaceae	X	X	X	X	X
<i>Hardenbergia violacea</i>	native sarsaparilla	Fabaceae	X	X		X	X
FORBS							
<i>Acaena echinata</i>		Rosaceae		X		X	X
<i>Acaena novae-zelandiae</i>		Rosaceae	X	X	X	X	
* <i>Acetosella vulgaris</i>	sheep sorrel	Polygonaceae	X	X	X	X	X
<i>Ajuga australis</i>	austral bugle	Lamiaceae				X	
<i>Acianthus</i> sp.	gnat orchid	Orchidaceae				X	X
<i>Alisma plantago-aquatica</i>	water plantain	Alismataceae				X	
* <i>Anagallis arvensis</i>	scarlet pimpernel	Primulaceae				X	
* <i>Arctotheca calendula</i>	capeweed	Asteraceae		X	X	X	X
<i>Asperula conferta</i>	common woodruff	Rubiaceae	X	X	X	X	
<i>Asperula scoparia</i>	prickly woodruff	Rubiaceae		X		X	
<i>Brachyscome spathulata</i>		Asteraceae		X	?	?	
* <i>Capsella bursa-pastoris</i>	shepherd's purse	Brassicaceae			X		
* <i>Carduus nutans</i>	nodding thistle	Asteraceae		X	X	X	
* <i>Carduus tenuiflorus</i>	winged slender thistle	Asteraceae		X	?	X	
* <i>Carthamus lanatus</i>	saffron thistle	Asteraceae		X	X	X	
* <i>Centaurium erythraea</i>	centaury	Gentianaceae			X	X	
<i>Centella asiatica</i>		Apiaceae	X	X		X	
<i>Centipeda</i> sp.	sneezeweed	Asteraceae	X	X			
<i>Chamaesyce drummondii</i>		Euphorbiaceae					X
<i>Chenopodium pumilio</i>	crumbweed	Chenopodiaceae			X	X	X
<i>Chiloglottis trilabra</i>		Orchidaceae	X	X	X	X	
* <i>Chondrilla juncea</i>	skeleton weed	Asteraceae			X		
<i>Chrysocephalum semipapposum</i>	clustered everlasting	Asteraceae				X	
* <i>Cirsium vulgare</i>	black or spear thistle	Asteraceae	X	X	X	X	X
<i>Cotula australis</i>		Apiaceae					X
<i>Craspedia ?variabilis</i>	billy buttons	Asteraceae		X	X		

Scientific name	Common name	Family	Locations				
			Kia	New	Ban	Pom	Gur
<i>Crassula sieberiana</i>	Australian stonecrop	Crassulaceae		X			X
* <i>Crepis capillaris</i>	smooth hawk's beard	Asteraceae		X		X	
* <i>Cucumis myriocarpus</i>	paddy melon	Cucurbitaceae			X		
<i>Cymbonotus</i> sp.	bear's ear	Asteraceae		X		X	X
<i>Cynoglossum suaveolens</i>	sweet hound's tongue	Boraginaceae			X		X
<i>Daucus glochidiatus</i>	native carrot	Apiaceae				X	X
<i>Desmodium varians</i>	slender tick trefoil	Fabaceae			X	X	
<i>Dianella longifolia</i>	blue flax lily	Phormiaceae			X	X	
<i>Dianella revoluta</i>	blue flax lily	Phormiaceae					X
<i>Dichondra repens</i>	kidney weed	Convolvulaceae	X	X	X	X	X
<i>Diuris chryseopsis</i>	snake orchid	Orchidaceae		X			
<i>Diuris sulphurea</i>	tiger orchid	Orchidaceae		X			
<i>Drosera auriculata / peltata</i>	sundew	Droseraceae		X			
<i>Einadia nutans</i>		Chenopodiaceae					X
<i>Epilobium</i> sp.	willow herb	Onagraceae				X	
<i>Eriochilus cucullatus</i>	parson's bands	Orchidaceae	X		X	X	X
* <i>Erodium cicutarium</i>	common storksbill	Geraniaceae		X		X	X
<i>Euchiton gymnocephalus</i>	slender cudweed	Asteraceae	X	X	X	X	X
* <i>Euphorbia lathyris</i>	caper spurge	Euphorbiaceae				X	
<i>Galium propinquum</i>	bedstraw	Rubiaceae	X	X		X	
<i>Geranium retrorsum</i>	native geranium	Geraniaceae			X	X	
<i>Geranium solanderi</i> var. <i>solanderi</i>	native geranium	Geraniaceae	X	X	X	X	X
* <i>Gnaphalium calviceps</i>	silver cudweed	Asteraceae	X	X	X	X	
<i>Gonocarpus tetragynus</i>	raspwort	Haloragaceae	X	X	X	X	X
<i>Goodenia hederacea</i> ssp <i>hederacea</i>		Goodeniaceae				X	X
<i>Gratiola peruviana</i>	brooklime	Scrophulariaceae				X	
<i>Haloragis heterophylla</i>		Haloragaceae		X		X	
<i>Helichrysum scorpioides</i>	button everlasting	Asteraceae		X	X	X	
<i>Hydrocotyle laxiflora</i>	stinking pennywort	Apiaceae	X	X	X	X	X
<i>Hydrocotyle peduncularis</i>		Apiaceae	X			X	
<i>Hypericum gramineum</i>	native St Johns wort	Clusiaceae	X	X	X	X	X
<i>Hypericum japonicum</i>		Clusiaceae	X				
* <i>Hypochaeris glabra</i>		Asteraceae		X			
* <i>Hypochaeris radicata</i>	cat's ear, flatweed	Asteraceae	X	X	X	X	X
<i>Hypoxis hygrometrica</i>	weathergrass	Hypoxidaceae				X	
<i>Isotoma fluviatilis</i>	swamp isotome	Lobeliaceae	X			X	X
<i>Lagenifera stipitata</i>	blue bottle daisy	Asteraceae	X		X		
<i>Leucochrysum albicans</i> ssp <i>albicans</i> var. <i>tricolor</i>	hoary sunray	Asteraceae					?
<i>Lythrum hyssopifolia</i>		Lythraceae				X	
* <i>Marrubium vulgare</i>	horehound	Lamiaceae			X	X	
* <i>Medicago arabica</i>	medic	Fabaceae			X	X	X

Scientific name	Common name	Family	Locations				
			Kia	New	Ban	Pom	Gur
<i>*Modiola caroliniana</i>	orange flowered mallow	Malvaceae				X	
<i>*Onopordum acanthium</i>	Scotch thistle	Asteraceae			X	X	
<i>Opercularia aspera</i>	stinkweed	Rubiaceae		X		X	
<i>Oreomyrrhis eriopoda</i>	Australian caraway	Apiaceae		X	X	X	
<i>Oxalis ?perennans</i>	native oxalis	Oxalidaceae		X	X		
<i>Oxalis ?radicosa</i>		Oxalidaceae	X			X	X
<i>*Paronychia brasiliiana</i>	Brazilian whitlow	Caryophyllaceae				X	X
<i>Patersonia sericea</i>		Iridaceae					X
<i>Persicaria decipiens</i>	knotweed	Polygonaceae				X	
<i>Persicaria hydropiper</i>	water pepper	Polygonaceae				X	
<i>Persicaria prostrata</i>		Polygonaceae					X
<i>*Petrohragia sp.</i>	proliferous pink	Caryophyllaceae		X			X
<i>*Plantago lanceolata</i>	ribbed plantain	Plantaginaceae			X		
<i>Plantago varia</i>		Plantaginaceae	X	X	X	X	X
<i>Poranthera microphylla</i>		Euphorbiaceae	X	X		X	
<i>*Prunella vulgaris</i>	self-heal	Lamiaceae				X	
<i>Pterostylis sp. aff. parviflora</i>		Orchidaceae					X
<i>Pterostylis sp.</i>	greenhood orchid	Orchidaceae	X			X	
<i>Ranunculus inundatus</i>		Ranunculaceae				X	X
<i>Ranunculus ?lappaceus</i>	common buttercup	Ranunculaceae		X		X	
<i>Rumex brownii</i>	native dock	Polygonaceae	X	X	X	X	X
<i>*Rumex crispus</i>	curled dock	Polygonaceae			X		
<i>Scleranthus fasciculatus</i>		Caryophyllaceae	X	X	X	X	
<i>Senecio hispidulus var. hispidulus</i>	hill fireweed	Asteraceae				X	
<i>Senecio tenuiflorus</i>		Asteraceae			X	X	
<i>Senecio prenanthoides</i>		Asteraceae		X	X	X	
<i>*Silybum marianum</i>	variegated thistle	Asteraceae		X	X	X	
<i>*Sisymbrium officinale</i>	hedge mustard	Brassicaceae		X	X		
<i>Solenogyne dominii</i>		Asteraceae	X	X	X	X	X
<i>Solenogyne gunnii</i>		Asteraceae	X	X	X	X	
<i>*Sonchus asper</i>	prickly sow thistle	Asteraceae		X		X	
<i>*Sonchus oleraceus</i>	sow thistle	Asteraceae				X	
<i>Stackhousia monogyna</i>	creamy candles	Stackhousiaceae		X		X	
<i>*Stellaria media</i>	common chickweed	Caryophyllaceae	X	X	X	X	X
<i>Stellaria pungens</i>	prickly starwort	Caryophyllaceae		X	X	X	
<i>Stylidium graminifolium s. lat.</i>	trigger plant	Stylidiaceae		X			X
<i>Stypandra glauca</i>	nodding blue lily	Anthericaceae					X
<i>*Taraxacum officinale</i>	dandelion	Asteraceae	X		X	X	
<i>*Trifolium dubium</i>	suckling clover	Fabaceae		X			
<i>*Trifolium avense</i>	hare's foot clover	Fabaceae		X			
<i>*Trifolium repens</i>	white clover	Fabaceae	X	X	X	X	X
<i>*Trifolium sp. seedlings</i>	clover	Fabaceae	X		X	X	X

Scientific name	Common name	Family	Locations				
			Kia	New	Ban	Pom	Gur
<i>Lachnagrostis filiformis</i>	blown grass	Poaceae				X	
* <i>Lolium perenne</i>	perennial ryegrass	Poaceae	X	X	X	X	X
<i>Microlaena stipoides</i>	weeping grass	Poaceae	X	X	X	X	X
* <i>Nassella trichotoma</i>	serrated tussock	Poaceae			X	X	X
<i>Panicum effusum</i>	hairy panic	Poaceae				X	
<i>Pennisetum alopecuroides</i>	swamp foxtail	Poaceae				X	
* <i>Phalaris aquatica</i>	phalaris	Poaceae			X	X	
<i>Phragmites australis</i>	common reed	Poaceae				X	
<i>Poa labillardierei</i>	silver or poa tussock	Poaceae	X	X		X	X
<i>Poa meionectes</i>		Poaceae			?	?	
<i>Poa sieberiana</i> var. <i>cyanophylla</i>		Poaceae	X	X	X	X	X
<i>Poa sieberiana</i> var. <i>sieberiana</i>		Poaceae	X	X	X	X	X
* <i>Setaria</i> sp.	pigeon grass	Poaceae				X	
<i>Sporobolus caroli</i>	fairy grass	Poaceae				X	
<i>Themeda australis</i>	kangaroo grass	Poaceae	X	X	X	X	X
* <i>Vulpia</i> sp.	rat's tail fescue	Poaceae		X			
GRAMINOIDS							
<i>Carex appressa</i>	tall sedge	Cyperaceae				X	X
<i>Carex fascicularis</i>	tassel sedge	Cyperaceae				X	
<i>Carex incomitata</i>		Cyperaceae		X	X	X	
<i>Carex inversa</i>	knob sedge	Cyperaceae	X	X	X	X	X
<i>Cyperus sphaeroideus</i>		Cyperaceae				X	
<i>Eleocharis ?acuta</i>	spike-rush	Cyperaceae				X	
* <i>Juncus articulatus</i>	jointed rush	Juncaceae				X	
<i>Juncus ?filicaulis</i>		Juncaceae				X	
<i>Juncus</i> sp.		Juncaceae	X	X	X	X	X
<i>Lepidosperma gunnii</i>		Cyperaceae					X
<i>Lepidosperma laterale</i>	variable sword-sedge	Cyperaceae				X	X
<i>Lomandra filiformis</i> ssp <i>coriacea</i>		Lomandraceae	X	X	X	X	X
<i>Lomandra filiformis</i> ssp <i>filiformis</i>		Lomandraceae		X	X	X	
<i>Lomandra longifolia</i>	spiny matrush	Lomandraceae	X		X	X	X
<i>Lomandra multiflora</i> ssp <i>multiflora</i>		Lomandraceae			X	X	X
<i>Luzula</i> sp.		Juncaceae		X	X		
<i>Sparganium subglobosum</i>		Sparganiaceae				X	
<i>Typha orientalis</i>	cumbungi	Typhaceae				X	

A.1: Species lists for areas which could be regarded as belonging to an Endangered Ecological Community

1. Elliot property, Bannister site, potential turbine site at c. AGD 723160 6175590, "improved" pasture on basalt with scattered trees or tree clusters (but derived from clearing of Tableland Basalt Forest EEC and typical of the condition of smaller remnants of this community remaining in grazed paddocks.

Scientific name	Common name	Abundance
TREES		
<i>Eucalyptus dalrympleana</i> ssp <i>dalrympleana</i>	mountain gum	0-3
<i>Eucalyptus pauciflora</i>	snow gum	1
<i>Eucalyptus radiata</i> ssp <i>radiata</i>	narrow-leaved peppermint	1
FERNS		
<i>Pteridium esculentum</i>	bracken	0-3
FORBS		
* <i>Acetosella vulgaris</i>	sheep sorrel	2
<i>Asperula scoparia</i>	prickly woodruff	1
* <i>Carduus nutans</i>	nodding thistle	2
* <i>Carduus tenuiflorus</i>	winged slender thistle	2
* <i>Carthamus lanatus</i>	saffron thistle	1
<i>Convolvulus erubescens</i> s. lat		1
* <i>Erodium cicutarium</i>	common storksbill	1
* <i>Geranium mollis</i>	native geranium	1
<i>Geranium solanderi</i> var. <i>solanderi</i>	native geranium	1
* <i>Hypochaeris glabra</i>		2
* <i>Hypochaeris radicata</i>	cat's ear, flatweed	2
* <i>Silybum marianum</i>	variegated thistle	2
* <i>Sisymbrium officinale</i>	hedge mustard	2
* <i>Trifolium subterraneum</i>	subterranean clover	4
GRASSES		
* <i>Anthoxanthum odoratum</i>	sweet vernal grass	2
* <i>Bromus diandrus</i>	brome	3
* <i>Bromus hordaceus</i>	brome	3
* <i>Bromus racemosus</i>	brome	1
* <i>Holcus lanatus</i>	Yorkshire fog	1
* <i>Hordeum leporinum</i>	barley grass	2
<i>Poa labillardierei</i>	silver or poa tussock	3
<i>Themeda australis</i>	kangaroo grass	1

2. Elliot property, Bannister site, species list from a more intact larger remnant, at AGD 722640 6175840, but apparently on sandstone, not basalt or other high clay soil type, and dominated by *Eucalyptus dives*, so not belonging to any currently listed EECs.

Scientific name	Common name	Abundance
TREES		
<i>Eucalyptus dalrympleana</i> ssp <i>dalrympleana</i>	mountain gum	1
<i>Eucalyptus dives</i>	broad-leafed peppermint	0-4
SHRUBS, SUB-SHRUBS		
<i>Hibbertia obtusifolia</i>	guineaflower	1
FERNS		
<i>Pteridium esculentum</i>	bracken	1-4
<i>Ophioglossum lusitanicum</i>	adder's toungue	1
FORBS		
<i>Acaena</i> sp.		1
<i>Asperula conferta</i>	common woodruff	2
<i>Convolvulus erubescens</i> s. lat	bindweed	1
<i>Diuris chryseopsis</i>	snake orchid	0-2
<i>Drosera auriculata / peltata</i>	sundew	2
<i>Hydrocotyle laxiflora</i>	stinking pennywort	2
<i>Hypericum gramineum</i>	native St Johns wort	1
* <i>Hypochoeris radicata</i>	cat's ear, flatweed	1
<i>Opercularia ?aspera</i>	stinkweed	1
<i>Oxalis ?perennans</i>	native oxalis	1
<i>Plantago varia</i>		2
<i>Ranunculus ?lappaceus</i>	common buttercup	2
<i>Solenogyne gunnii</i>		2
<i>Stackhousia monogyne</i>	creamy candles	1
<i>Triptilodiscus pygmaeus</i>		1
<i>Veronica calycina</i>	hairy speedwell	1
<i>Viola betonicifolia</i>	narrow-leaved violet	2
<i>Wurmbea dioica</i>	early Nancy	1
GRASSES		
* <i>Aira</i> sp.	hair grass	1
* <i>Anthoxanthum odoratum</i>	sweet vernal grass	0-4
<i>Austrodanthonia</i> sp.	wallaby grass	1
<i>Elymus scaber</i>	common wheat grass	1
<i>Microlaena stipoides</i>	weeping grass	3
<i>Poa labillardierei</i>	silver or poa tussock	1
<i>Poa meionectes</i>		
<i>Poa sieberiana</i> var. <i>sieberiana</i>		0-4
<i>Themeda australis</i>	kangaroo grass	0-5
GRAMINOIDS		
<i>Lomandra filiformis</i> ssp <i>coriacea</i>		1
<i>Lomandra filiformis</i> ssp <i>filiformis</i>		1
<i>Luzula flaccida</i>		1

3. Elliot property, Bannister site, drainage line in NE corner of property at AGD 723090 6176655. Potentially Natural Temperate Grassland EEC.

Scientific name	Common name	Abundance
TREES		
<i>Eucalyptus ovata</i>	swamp gum	1
FERNS		
<i>Pteridium esculentum</i>	bracken	0-2
FORBS		
<i>Asperula scoparia</i>	prickly woodruff	1-2
<i>Bulbine bulbosa</i>	bulbine lily	0-2
<i>Centella asiatica</i>		0-3
<i>Centipeda</i> sp.	sneezeweed	1
<i>Dichondra repens</i>	kidney weed	1
<i>Diuris sulphurea</i>	tiger orchid	1
* <i>Gnaphalium calviceps</i>	silver cudweed	1
<i>Haloragis heterophylla</i>		1
* <i>Hypochaeris radicata</i>	cat's ear, flatweed	2
<i>Rumex brownii</i>	native dock	1
<i>Scleranthus fasciculatus</i>		1
<i>Solenogyne gunnii</i>		2
* <i>Trifolium dubium</i>	suckling clover	1
* <i>Trifolium subterraneum</i>	subterranean clover	1
GRASSES		
* <i>Aira</i> sp.	hair grass	1
* <i>Anthoxanthum odoratum</i>	sweet vernal grass	0-4
? <i>Austrodanthonia</i> sp.	wallaby grass	1
* <i>Briza minor</i>	shivery grass	0-3
* <i>Holcus lanatus</i>	Yorkshire fog	1
<i>Microlaena stipoides</i>	weeping grass	1
<i>Poa labillardierei</i>	silver or poa tussock	2-4
<i>Poa sieberiana</i> var. <i>cyanophylla</i>		0-2
<i>Themeda australis</i>	kangaroo grass	0-4
GRAMINOIDS		
<i>Carex</i> sp.		1
<i>Carex inversa</i>	knob sedge	1
<i>Juncus</i> sp.		1
<i>Luzula ovata</i>		1

4. Bannister site, (NW corner of Willis property), mature Tableland Basalt Forest EEC with few weeds.

Scientific name	Common name	Abundance
TREES		
<i>Acacia dealbata</i> ssp <i>dealbata</i>	silver wattle	2
<i>Acacia melanoxylon</i>	blackwood	1
* <i>Crataegus monogyna</i>	hawthorn	1
<i>Eucalyptus dalrympleana</i> ssp <i>dalrympleana</i>	mountain gum	1
<i>Eucalyptus radiata</i> ssp <i>radiata</i>	narrow-leaved peppermint	4
SHRUBS, SUB-SHRUBS		
<i>Amyema</i> sp.	a mistletoe	1
* <i>Rubus ulmifolius</i>	blackberry	2
FERNS		
<i>Pteridium esculentum</i>	bracken	3
FORBS		
<i>Acaena novae-zelandiae</i>		2
<i>Chiloglottis ?trilabra</i>		1
<i>Geranium</i> sp.	native geranium	1
<i>Gonocarpus tetragynus</i>	raspwort	1
<i>Hydrocotyle laxiflora</i>	stinking pennywort	1
* <i>Hypochaeris radicata</i>	cat's ear, flatweed	2
<i>Lagenifera stipitata</i>	blue bottle daisy	1
<i>Plantago varia</i>		1
<i>Senecio prenanthoides</i>		1
<i>Stellaria pungens</i>	prickly starwort	3
* <i>Trifolium</i> sp.	clover	1
<i>Viola betonicifolia</i>	narrow-leaved violet	2
GRASSES		
* <i>Anthoxanthum odoratum</i>	sweet vernal grass	1
<i>Microlaena stipoides</i>	weeping grass	4
<i>Poa</i> sp.		4
GRAMINOIDS		
<i>Carex inomitata</i>		1
<i>Lomandra filiformis</i> ssp <i>coriacea</i>		1

5. Pomeroy site, disturbed yellow box woodland within development zone, EEC but low site quality

Scientific name	Common name	Abundance
TREES		
* <i>Crataegus monogyna</i>	hawthorn	1
<i>Eucalyptus melliodora</i>	yellow box	2
SHRUBS, SUB-SHRUBS		
* <i>Rubus ulmifolius</i>	blackberry	1
FORBS		
* <i>Arctotheca calendula</i>	capeweed	1
<i>Rumex brownii</i>	native dock	1
* <i>Trifolium</i> sp.	sub clover	1
* <i>Trifolium subterraneum</i>	subterranean clover	
GRASSES		
<i>Austrodanthonia pilosa</i> var. <i>pilosa</i>	wallaby grass	2-3
<i>Cynosurus</i> sp.	dog's tail grass	2
* <i>Dactylis glomerata</i>	cocksfoot	3
<i>Microlaena stipoides</i>	weeping grass	0-4
* <i>Nassella trichotoma</i>	serrated tussock	3-4
* <i>Phalaris aquatica</i>	phalaris	2

6. Pomeroy site, mature woodland in gully head (AGD 726330 6165940)

Scientific name	Common name	Abundance
TREES		
<i>Acacia deanei</i> ssp. <i>paucijuga</i>	green wattle	1
<i>Acacia falciformis</i>	broad-leaf hickory	1
<i>Acacia melanoxylon</i>	blackwood	1
<i>Eucalyptus bridgesiana</i>	apple box	3
<i>Eucalyptus dalrympleana</i> ssp. <i>dalrympleana</i>	mountain gum	
<i>Eucalyptus mannifera</i>	brittle gum	1
<i>Eucalyptus melliodora</i>	yellow box	3
<i>Eucalyptus rossii</i>	scribbly gum	1
<i>Eucalyptus viminalis</i>	ribbon or manna gum	1
SHRUBS, SUB-SHRUBS		
<i>Amyema pendulum</i>	a mistletoe	2
<i>Cassinia aculeata</i>	dolly bush	1
<i>Hovea heterophylla</i>		1
<i>Leucopogon fraseri</i>		1
<i>Melichrus urceolatus</i>	urn heath	1
<i>Muellerina eucalyptoides</i>	a mistletoe	1
* <i>Rosa rubiginosa</i>	briar rose	1
VINES AND TWINERS		
<i>Glycine clandestina</i>	twining glycine	1
FORBS		

Scientific name	Common name	Abundance
<i>Acaena novae-zelandiae</i>		2
* <i>Acetosella vulgaris</i>	sheep sorrel	1
<i>Asperula conferta</i>	common woodruff	2
* <i>Crepis capillaris</i>	smooth hawk's beard	1
<i>Geranium solanderi</i> var. <i>solanderi</i>	native geranium	1
<i>Gonocarpus tetragynus</i>	raspwort	2
<i>Hydrocotyle laxiflora</i>	stinking pennywort	2
<i>Hypericum gramineum</i>	native St Johns wort	1
* <i>Hypochaeris radicata</i>	cat's ear, flatweed	1
<i>Oreomyrrhis eriopoda</i>	Australian carraway	1
<i>Oxalis ?perennans</i>	native oxalis	1
<i>Plantago varia</i>		3
<i>Poranthera microphylla</i>		1
<i>Scleranthus fasciculatus</i>		1
<i>Solenogyne gunnii</i>		1
<i>Stellaria pungens</i>	prickly starwort	1
<i>Veronica calycina</i>	hairy speedwell	1
<i>Veronica gracilis</i>		1
<i>Viola betonicifolia</i>	narrow-leaved violet	1
GRASSES		
<i>Austrodanthonia pilosa</i> var. <i>pilosa</i>	wallaby grass	4
<i>Bothriochloa macra</i>	red-stem grass	1
<i>Cynosurus</i> sp.	dog's tail grass	2
<i>Elymus scaber</i>	common wheat grass	1
<i>Microlaena stipoides</i>	weeping grass	2
* <i>Nassella trichotoma</i>	serrated tussock	1
<i>Poa sieberiana</i> var. <i>cyanophylla</i>		2
<i>Poa sieberiana</i> var. <i>sieberiana</i>		3
<i>Themeda australis</i>	kangaroo grass	0-4
GRAMINOIDS		
<i>Juncus ?filicaulis</i>		1
<i>Lomandra filiformis</i> ssp <i>filiformis</i>		1
<i>Lomandra multiflora</i> ssp <i>multiflora</i>		1

6. Gurrundah site, area of grazed ecotonal yellow box woodland in gully head on eastern side, rock 30-100% cover, bare ground 10-50% cover

Scientific name	Common name	Abundance
TREES		
<i>Acacia falciformis</i>	broad-leaf hickory	1
<i>Eucalyptus mannifera</i>	brittle gum	1
<i>Eucalyptus melliodora</i>	yellow box	1
SHRUBS, SUB-SHRUBS		
<i>Bossiaea buxifolia</i>		1
<i>Brachyloma daphnoides</i>	daphne heath	1
<i>Dillwynia sericea</i>		1
<i>Hibbertia obtusifolia</i>	guineaflower	1
<i>Melichrus urceolatus</i>	urn heath	1
<i>Persoonia linearis</i>	narrow-leaved geebung	1
<i>Pimelea curviflora</i> var. <i>sericea</i>		1
<i>Pimelea linifolia</i> ssp. <i>caesia</i>		1
FORBS		
<i>Acaena echinata</i>		1
* <i>Acetosella vulgaris</i>	sheep sorrel	1
* <i>Arctotheca calendula</i>	capeweed	1
<i>Chamaesyce drummondii</i>		1
<i>Chenopodium pumilio</i>	crumbweed	1
* <i>Cirsium vulgare</i>	black or spear thistle	1
<i>Daucus glochidiatus</i>	native carrot	1
<i>Dichondra repens</i>	kidney weed	1
<i>Einadia nutans</i>		1
<i>Gonocarpus tetragynus</i>	raspwort	1
<i>Goodenia hederacea</i> ssp. <i>hederacea</i>		1
<i>Hydrocotyle laxiflora</i>	stinking pennywort	0-2
* <i>Hypochaeris radicata</i>	cat's ear, flatweed	1
<i>Oxalis ?perennans</i>	native oxalis	1
* <i>Trifolium</i> sp.	clover	1
<i>Wahlenbergia communis</i>	tufted bluebell	1
GRASSES		
<i>Aristida ramosa</i> var. <i>ramosa</i>	wire grass	1
<i>Austrodanthonia</i> sp.	wallaby grass	2
<i>Austrostipa scabra</i> ssp. <i>falcata</i>	corkscrew grass	1
<i>Joycea pallida</i>	robust wallaby grass	4
<i>Microlaena stipoides</i>	weeping grass	4
* <i>Nassella trichotoma</i>	serrated tussock	1
<i>Poa sieberiana</i> var. <i>sieberiana</i>		1
<i>Themeda australis</i>	kangaroo grass	0-3
GRAMINOIDS		
<i>Lepidosperma laterale</i>	variable sword-sedge	2
<i>Lomandra filiformis</i> ssp. <i>coriacea</i>		2
<i>Lomandra longifolia</i>	spiny matrush	1

APPENDIX B: FAUNA LIST

B.1: Faunal species recorded during surveying for each location

* indicates introduced species.

Bold indicates species listed as threatened under the NSW *TSC Act* or Commonwealth *EPBC Act*.

Location	Common name	Scientific name	
Kialla	Australian Magpie	<i>Gymnorhina tibicen</i>	Bird
Kialla	Australian Raven	<i>Corvus coronoides</i>	Bird
Kialla	Brown Thornbill	<i>Acanthiza pusilla</i>	Bird
Kialla	Buff-rumped Thornbill	<i>Acanthiza reguloides</i>	Bird
Kialla	Common Starling *	<i>Sturnus vulgaris</i>	Bird
Kialla	Crimson Rosella	<i>Platycercus elegans</i>	Bird
Kialla	Eastern Rosella	<i>Platycercus eximius</i>	Bird
Kialla	Galah	<i>Cacatua roseicapilla</i>	Bird
Kialla	Golden Whistler	<i>Pachycephala pectoralis</i>	Bird
Kialla	Grey Butcherbird	<i>Cracticus torquatus</i>	Bird
Kialla	Grey Currawong	<i>Strepera versicolor</i>	Bird
Kialla	Grey Fantail	<i>Rhipidura fuliginosa</i>	Bird
Kialla	Grey Shrike-thrush	<i>Colluricincla harmonica</i>	Bird
Kialla	Laughing Kookaburra	<i>Dacelo novaeguineae</i>	Bird
Kialla	Lewin's Honeyeater	<i>Meliphaga lewinii</i>	Bird
Kialla	Magpie-lark	<i>Grallina cyanoleuca</i>	Bird
Kialla	Noisy Friarbird	<i>Philemon corniculatus</i>	Bird
Kialla	Red Wattlebird	<i>Anthochaera carunculata</i>	Bird
Kialla	Richard's Pipit	<i>Anthus novaeseelandiae</i>	Bird
Kialla	Rufous Songlark	<i>Cincloramphus mathewsi</i>	Bird
Kialla	Rufous Whistler	<i>Pachycephala rufiventris</i>	Bird
Kialla	Spotted Pardalote	<i>Pardalotus punctatus</i>	Bird
Kialla	Striated Thornbill	<i>Acanthiza lineata</i>	Bird
Kialla	Sulphur-crested Cockatoo	<i>Cacatua galerita</i>	Bird
Kialla	Superb Fairy-wren	<i>Malurus cyaneus</i>	Bird
Kialla	Wedge-tailed Eagle	<i>Aquila audax</i>	Bird
Kialla	White-browed Scrubwren	<i>Sericornis frontalis</i>	Bird
Kialla	White-throated Treecreeper	<i>Cormobates leucophaeus</i>	Bird
Kialla	White-winged Chough	<i>Corcorax melanorhamphos</i>	Bird
Kialla	Yellow-tailed Black-Cockatoo	<i>Calyptorhynchus funereus</i>	Bird
Kialla	Black Wallaby	<i>Wallabia bicolor</i>	Mammal
Kialla	Common Bent-wing Bat	<i>Miniopterus schreibersii</i>	Mammal
Kialla	Common Ringtail Possum	<i>Pseudocheirus peregrinus</i>	Mammal
Kialla	Common Wombat	<i>Vombatus ursinus</i>	Mammal
Kialla	Deer sp.		Mammal
Kialla	Eastern Grey Kangaroo	<i>Macropus giganteus</i>	Mammal
Kialla	Large-footed Myotis	<i>Myotis adversus</i>	Mammal
Kialla	Copper-tailed Skink	<i>Ctenotus taeniolatus</i>	Reptile
Kialla	Delicate Skink	<i>Lampropholis delicata</i>	Reptile
Kialla	Eastern Bearded Dragon	<i>Pogona barbata</i>	Reptile
Kialla	Garden Skink	<i>Lampropholis guichenoti</i>	Reptile
Kialla	Highland Copperhead	<i>Austrelaps ramsayi</i>	Reptile
Kialla	Southern Grass Skink	<i>Pseudemoia entrecasteauxii</i>	Reptile
Kialla	Three-toed Skink	<i>Hemiergis decresiensis</i>	Reptile
Kialla	White's Skink	<i>Egernia whitii</i>	Reptile

Location	Common name	Scientific name	
Bannister	Spotted Marsh Frog	<i>Limnodynastes tasmaniensis</i>	Amphibian
Bannister	Verreaux's Tree Frog	<i>Litoria verreauxii</i>	Amphibian
Bannister	Australian Hobby	<i>Falco longipennis</i>	Bird
Bannister	Australian Magpie	<i>Gymnorhina tibicen</i>	Bird
Bannister	Australian Owllet-nightjar	<i>Aegotheles cristatus</i>	Bird
Bannister	Australian Raven	<i>Corvus coronoides</i>	Bird
Bannister	Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>	Bird
Bannister	Brown Falcon	<i>Falco berigora</i>	Bird
Bannister	Brown Thornbill	<i>Acanthiza pusilla</i>	Bird
Bannister	Buff-rumped Thornbill	<i>Acanthiza reguloides</i>	Bird
Bannister	Common Starling *	<i>Sturnus vulgaris</i>	Bird
Bannister	Crimson Rosella	<i>Platycercus elegans</i>	Bird
Bannister	Eastern Rosella	<i>Platycercus eximius</i>	Bird
Bannister	Galah	<i>Cacatua roseicapilla</i>	Bird
Bannister	Golden Whistler	<i>Pachycephala pectoralis</i>	Bird
Bannister	Grey Fantail	<i>Rhipidura fuliginosa</i>	Bird
Bannister	Grey Shrike-thrush	<i>Colluricincla harmonica</i>	Bird
Bannister	Laughing Kookaburra	<i>Dacelo novaeguineae</i>	Bird
Bannister	Little Wattlebird	<i>Anthochaera chrysoptera</i>	Bird
Bannister	Magpie-lark	<i>Grallina cyanoleuca</i>	Bird
Bannister	Nankeen Kestrel	<i>Falco cenchroides</i>	Bird
Bannister	Noisy Friarbird	<i>Philemon corniculatus</i>	Bird
Bannister	Pied Currawong	<i>Strepera graculina</i>	Bird
Bannister	Red Wattlebird	<i>Anthochaera carunculata</i>	Bird
Bannister	Red-rumped Parrot	<i>Psephotus haematonotus</i>	Bird
Bannister	Richard's Pipit	<i>Anthus novaeseelandiae</i>	Bird
Bannister	Rufous Whistler	<i>Pachycephala rufiventris</i>	Bird
Bannister	Silvereye	<i>Zosterops lateralis</i>	Bird
Bannister	Southern Boobook	<i>Ninox novaeseelandiae</i>	Bird
Bannister	Striated Pardalote	<i>Pardalotus striatus</i>	Bird
Bannister	Sulphur-crested Cockatoo	<i>Cacatua galerita</i>	Bird
Bannister	Superb Fairy-wren	<i>Malurus cyaneus</i>	Bird
Bannister	Tawny Frogmouth	<i>Podargus sTrigoides</i>	Bird
Bannister	Wedge-tailed Eagle	<i>Aquila audax</i>	Bird
Bannister	Welcome Swallow	<i>Hirundo neoxena</i>	Bird
Bannister	White-plumed Honeyeater	<i>Lichenostomus penicillatus</i>	Bird
Bannister	White-throated Treecreeper	<i>Cormobates leucophaeus</i>	Bird
Bannister	Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>	Bird
Bannister	Yellow-tailed Black-Cockatoo	<i>Calyptorhynchus funereus</i>	Bird
Bannister	Black Wallaby	<i>Wallabia bicolor</i>	Mammal
Bannister	Brown Hare	<i>Lepus capensis</i>	Mammal
Bannister	Common Bent-wing Bat	<i>Miniopterus schreibersii</i>	Mammal
Bannister	Common Brushtail Possum	<i>Trichosurus vulpecula</i>	Mammal
Bannister	Common Wombat	<i>Vombatus ursinus</i>	Mammal
Bannister	Deer sp.		Mammal
Bannister	Eastern Grey Kangaroo	<i>Macropus giganteus</i>	Mammal
Bannister	European Rabbit	<i>Oryctolagus cuniculus</i>	Mammal
Bannister	Large-footed Myotis	<i>Myotis adversus</i>	Mammal
Bannister	Sugar Glider	<i>Petaurus breviceps</i>	Mammal
Bannister	Copper-tailed Skink	<i>Ctenotus taeniolatus</i>	Reptile
Bannister	Eastern Bearded Dragon	<i>Pogona barbata</i>	Reptile
Bannister	Garden Skink	<i>Lampropholis guichenoti</i>	Reptile

Location	Common name	Scientific name	
Pomeroy	Bibron's Toadlet	<i>Pseudophryne bibronii</i>	Amphibian
Pomeroy	Common Froglet	<i>Crinia signifera</i>	Amphibian
Pomeroy	Lesueur's Frog	<i>Litoria lesueuri</i>	Amphibian
Pomeroy	Smooth Toadlet	<i>Uperoleia laevigata</i>	Amphibian
Pomeroy	Verreaux's Tree Frog	<i>Litoria verreauxii</i>	Amphibian
Pomeroy	Australian Magpie	<i>Gymnorhina tibicen</i>	Bird
Pomeroy	Australian Raven	<i>Corvus coronoides</i>	Bird
Pomeroy	Australian Wood Duck	<i>Chenonetta jubata</i>	Bird
Pomeroy	Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>	Bird
Pomeroy	Brown Falcon	<i>Falco berigora</i>	Bird
Pomeroy	Brown Thornbill	<i>Acanthiza pusilla</i>	Bird
Pomeroy	Buff-rumped Thornbill	<i>Acanthiza reguloides</i>	Bird
Pomeroy	Common Starling *	<i>Sturnus vulgaris</i>	Bird
Pomeroy	Crimson Rosella	<i>Platycercus elegans</i>	Bird
Pomeroy	Eastern Rosella	<i>Platycercus eximius</i>	Bird
Pomeroy	Eastern Yellow Robin	<i>Eopsaltria australis</i>	Bird
Pomeroy	Eurasian Coot	<i>Fulica atra</i>	Bird
Pomeroy	Galah	<i>Cacatua roseicapilla</i>	Bird
Pomeroy	Grey Butcherbird	<i>Cracticus torquatus</i>	Bird
Pomeroy	Grey Currawong	<i>Strepera versicolor</i>	Bird
Pomeroy	Grey Fantail	<i>Rhipidura fuliginosa</i>	Bird
Pomeroy	Grey Shrike-thrush	<i>Colluricincla harmonica</i>	Bird
Pomeroy	Grey Teal	<i>Anas gracilis</i>	Bird
Pomeroy	Laughing Kookaburra	<i>Dacelo novaeguineae</i>	Bird
Pomeroy	Magpie-lark	<i>Grallina cyanoleuca</i>	Bird
Pomeroy	Masked Lapwing	<i>Vanellus miles</i>	Bird
Pomeroy	Mistletoebird	<i>Dicaeum hirundinaceum</i>	Bird
Pomeroy	Nankeen Kestrel	<i>Falco cenchroides</i>	Bird
Pomeroy	Noisy Friarbird	<i>Philemon corniculatus</i>	Bird
Pomeroy	Pacific Black Duck	<i>Anas superciliosa</i>	Bird
Pomeroy	Pied Cormorant	<i>Phalacrocorax varius</i>	Bird
Pomeroy	Powerful Owl	<i>Ninox strenua</i>	Bird
Pomeroy	Rainbow Bee-eater	<i>Merops ornatus</i>	Bird
Pomeroy	Red Wattlebird	<i>Anthochaera carunculata</i>	Bird
Pomeroy	Red-browed Finch	<i>Neochmia temporalis</i>	Bird
Pomeroy	Restless Flycatcher	<i>Myiagra inquieta</i>	Bird
Pomeroy	Richard's Pipit	<i>Anthus novaeseelandiae</i>	Bird
Pomeroy	Rufous Whistler	<i>Pachycephala rufiventris</i>	Bird
Pomeroy	Silvereye	<i>Zosterops lateralis</i>	Bird
Pomeroy	Southern Boobook	<i>Ninox novaeseelandiae</i>	Bird
Pomeroy	Spotted Pardalote	<i>Pardalotus punctatus</i>	Bird
Pomeroy	Striated Thornbill	<i>Acanthiza lineata</i>	Bird
Pomeroy	Sulphur-crested Cockatoo	<i>Cacatua galerita</i>	Bird
Pomeroy	Superb Fairy-wren	<i>Malurus cyaneus</i>	Bird
Pomeroy	Tawny Frogmouth	<i>Podargus sTrigoides</i>	Bird
Pomeroy	Wedge-tailed Eagle	<i>Aquila audax</i>	Bird
Pomeroy	Welcome Swallow	<i>Hirundo neoxena</i>	Bird
Pomeroy	White-browed Scrubwren	<i>Sericornis frontalis</i>	Bird
Pomeroy	White-eared Honeyeater	<i>Lichenostomus leucotis</i>	Bird
Pomeroy	White-throated Treecreeper	<i>Cormobates leucophaeus</i>	Bird
Pomeroy	White-winged Chough	<i>Corcorax melanorhamphos</i>	Bird
Pomeroy	White-winged Triller	<i>Lalage sueurii</i>	Bird
Pomeroy	Willie Wagtail	<i>Rhipidura leucophrys</i>	Bird
Pomeroy	Yellow Thornbill	<i>Acanthiza nana</i>	Bird

Location	Common name	Scientific name	
Pomeroy	Yellow-faced Honeyeater	<i>Lichenostomus chrysops</i>	Bird
Pomeroy	Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>	Bird
Pomeroy	Yellow-tailed Black-Cockatoo	<i>Calyptorhynchus funereus</i>	Bird
Pomeroy	Black Rat	<i>Ratus ratus</i>	Mammal
Pomeroy	Brown Antechinus	<i>Antechinus stuartii</i>	Mammal
Pomeroy	Common Bent-wing Bat	<i>Miniopterus schreibersii</i>	Mammal
Pomeroy	Common Brushtail Possum	<i>Trichosurus vulpecula</i>	Mammal
Pomeroy	Common Wombat	<i>Vombatus ursinus</i>	Mammal
Pomeroy	Deer sp.		Mammal
Pomeroy	Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>	Mammal
Pomeroy	Eastern Grey Kangaroo	<i>Macropus giganteus</i>	Mammal
Pomeroy	Eastern Wallaroo	<i>Macropus robustus robustus</i>	Mammal
Pomeroy	Goat (feral)	<i>Capra hircus</i>	Mammal
Pomeroy	Mountain Brushtail Possum	<i>Trichosurus caninus</i>	Mammal
Pomeroy	Pig (feral)	<i>Sus scrofa</i>	Mammal
Pomeroy	Red-necked Wallaby	<i>Macropus rufogriseus</i>	Mammal
Pomeroy	Short-beaked Echidna	<i>Tachyglossus aculeatus</i>	Mammal
Pomeroy	Sugar Glider	<i>Petaurus breviceps</i>	Mammal
Pomeroy	White-striped Freetail Bat	<i>Tadarida australis</i>	Mammal
Pomeroy	Yellow-footed Antechinus	<i>Antechinus flavipes</i>	Mammal
Pomeroy	Bougainville's Skink	<i>Lerista bougainvillii</i>	Reptile
Pomeroy	Southern Grass Skink	<i>Pseudemoia entrecasteauxii</i>	Reptile
Pomeroy	Three-toed Skink	<i>Hemiergis decresiensis</i>	Reptile
Pomeroy	White's Skink	<i>Egernia whitii</i>	Reptile
Pomeroy	Yellow-bellied Water Skink	<i>Eulamprus heatwolei</i>	Reptile
Pomeroy surrounds	Australian Magpie	<i>Gymnorhina tibicen</i>	Bird
Pomeroy surrounds	Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>	Bird
Pomeroy surrounds	Brown Falcon	<i>Falco berigora</i>	Bird
Pomeroy surrounds	Chestnut Teal	<i>Anas castanea</i>	Bird
Pomeroy surrounds	Common Starling *	<i>Sturnus vulgaris</i>	Bird
Pomeroy surrounds	Crimson Rosella	<i>Platycercus elegans</i>	Bird
Pomeroy surrounds	Eastern Rosella	<i>Platycercus eximius</i>	Bird
Pomeroy surrounds	Galah	<i>Cacatua roseicapilla</i>	Bird
Pomeroy surrounds	Laughing Kookaburra	<i>Dacelo novaeguineae</i>	Bird
Pomeroy surrounds	Richard's Pipit	<i>Anthus novaeseelandiae</i>	Bird
Pomeroy surrounds	Wedge-tailed Eagle	<i>Aquila audax</i>	Bird
Pomeroy surrounds	Welcome Swallow	<i>Hirundo neoxena</i>	Bird
Pomeroy surrounds	White-faced Heron	<i>Egretta novaehollandiae</i>	Bird
Pomeroy surrounds	Willie Wagtail	<i>Rhipidura leucophrys</i>	Bird
Pomeroy surrounds	Brown Hare	<i>Lepus capensis</i>	Mammal
Pomeroy surrounds	Eastern Grey Kangaroo	<i>Macropus giganteus</i>	Mammal
Pomeroy surrounds	Blotched Blue-tongued Lizard	<i>Tiliqua nigrolutea</i>	Reptile
Gurrundah	Bibron's Toadlet	<i>Pseudophryne bibronii</i>	Amphibian
Gurrundah	Plains Froglet	<i>Crinia parinsignifera</i>	Amphibian
Gurrundah	Smooth Toadlet	<i>Uperoleia laevigata</i>	Amphibian
Gurrundah	Spotted Marsh Frog	<i>Limnodynastes tasmaniensis</i>	Amphibian
Gurrundah	Verreaux's Tree Frog	<i>Litoria verreauxii</i>	Amphibian
Gurrundah	Australasian Grebe	<i>Tachybaptus novaehollandiae</i>	Bird
Gurrundah	Australian Magpie	<i>Gymnorhina tibicen</i>	Bird
Gurrundah	Australian Raven	<i>Corvus coronoides</i>	Bird
Gurrundah	Australian Wood Duck	<i>Chenonetta jubata</i>	Bird
Gurrundah	Bar-shouldered Dove	<i>Geopelia humeralis</i>	Bird
Gurrundah	Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>	Bird
Gurrundah	Brown Thornbill	<i>Acanthiza pusilla</i>	Bird

Location	Common name	Scientific name	
Gurrundah	Common Bronzewing	<i>Phaps chalcoptera</i>	Bird
Gurrundah	Common Starling *	<i>Sturnus vulgaris</i>	Bird
Gurrundah	Crimson Rosella	<i>Platycercus elegans</i>	Bird
Gurrundah	Fuscous Honeyeater	<i>Lichenostomus fuscus</i>	Bird
Gurrundah	Galah	<i>Cacatua roseicapilla</i>	Bird
Gurrundah	Grey Fantail	<i>Rhipidura fuliginosa</i>	Bird
Gurrundah	Grey Teal	<i>Anas gracilis</i>	Bird
Gurrundah	Jacky Winter	<i>Microeca fascinans</i>	Bird
Gurrundah	Laughing Kookaburra	<i>Dacelo novaeguineae</i>	Bird
Gurrundah	Little Eagle	<i>Hieraaetus morphnoides</i>	Bird
Gurrundah	Little Lorikeet	<i>Glossopsitta pusilla</i>	Bird
Gurrundah	Magpie-lark	<i>Grallina cyanoleuca</i>	Bird
Gurrundah	Pacific Black Duck	<i>Anas superciliosa</i>	Bird
Gurrundah	Pied Butcherbird	<i>Cracticus nigrogularis</i>	Bird
Gurrundah	Pied Currawong	<i>Strepera graculina</i>	Bird
Gurrundah	Rainbow Bee-eater	<i>Malurus cyaneus</i>	Bird
Gurrundah	Red Wattlebird	<i>Anthochaera carunculata</i>	Bird
Gurrundah	Red-browed Finch	<i>Neochmia temporalis</i>	Bird
Gurrundah	Red-rumped Parrot	<i>Psephotus haematonotus</i>	Bird
Gurrundah	Richard's Pipit	<i>Anthus novaeseelandiae</i>	Bird
Gurrundah	Robin sp.		Bird
Gurrundah	Rufous Whistler	<i>Pachycephala rufiventris</i>	Bird
Gurrundah	Scarlet Robin	<i>Petroica multicolor</i>	Bird
Gurrundah	Silvereye	<i>Zosterops lateralis</i>	Bird
Gurrundah	Spotted Pardalote	<i>Pardalotus punctatus</i>	Bird
Gurrundah	Striated Pardalote	<i>Pardalotus striatus</i>	Bird
Gurrundah	Striated Thornbill	<i>Acanthiza lineata</i>	Bird
Gurrundah	Sulphur-crested Cockatoo	<i>Cacatua galerita</i>	Bird
Gurrundah	Welcome Swallow	<i>Hirundo neoxena</i>	Bird
Gurrundah	White-plumed Honeyeater	<i>Lichenostomus penicillatus</i>	Bird
Gurrundah	White-winged Chough	<i>Corcorax melanorhamphos</i>	Bird
Gurrundah	Willie Wagtail	<i>Rhipidura leucophrys</i>	Bird
Gurrundah	Yellow Thornbill	<i>Acanthiza nana</i>	Bird
Gurrundah	Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>	Bird
Gurrundah	Black Wallaby	<i>Wallabia bicolor</i>	Mammal
Gurrundah	Common Bent-wing Bat	<i>Miniopterus schreibersii</i>	Mammal
Gurrundah	Common Ringtail Possum	<i>Pseudocheirus peregrinus</i>	Mammal
Gurrundah	Eastern Grey Kangaroo	<i>Macropus giganteus</i>	Mammal
Gurrundah	Squirrel Glider	<i>Petaurus norfolcensis</i>	Mammal
Gurrundah	Black Wallaby	<i>Wallabia bicolor</i>	Mammal
Gurrundah	White-striped Freetail Bat	<i>Tadarida australis</i>	Mammal
Gurrundah	Yellow-footed Antechinus	<i>Antechinus flavipes</i>	Mammal
Gurrundah	Bougainville's Skink	<i>Lerista bougainvillii</i>	Reptile
Gurrundah	Copper-tailed Skink	<i>Ctenotus taeniolatus</i>	Reptile
Gurrundah	Eastern Bearded Dragon	<i>Pogona barbata</i>	Reptile
Gurrundah	Garden Skink	<i>Lampropholis guichenoti</i>	Reptile
Gurrundah	Red-naped Snake	<i>Furina diadema</i>	Reptile
Gurrundah	Tree Dragon	<i>Amphibolurus muricatus</i>	Reptile

B: 2 Microbat analysis

An Anabat detector to record the calls of microchiropteran bats (microbats) was used at all four sites; over one night at Kialla and two nights at each of the remaining three sites. The detector was located in areas expected to attract the greatest amount of bat activity; near hollow bearing trees, mine shafts and water sources (refer to survey effort maps, Figures 5.1 – 5.4).

Only files with call characteristics (shape and frequency) suggestive of threatened species were sent for further identification. Ecotone Consultants analysed the calls in August 2007. The results of the identification and associated confidence levels are shown below.

Site	Total number of files (all species)	Threatened species	Number of files	Confidence level of best call	Habitat type
<i>Kialla</i>	428	Common Bent-wing Bat	7	Possible	Woodland fragment containing several stags and mature trees bearing hollows, near dam (almost dry).
		Large-footed Myotis	11	Probable	Woodland fragment containing several stags and mature trees bearing hollows, near dam (almost dry).
<i>Bannister</i>	287	Common Bent-wing Bat	2	Possible	Edge of woodland fragment containing mature trees bearing hollows, near dam and adjacent to cleared paddock with scattered trees.
		Large-footed Myotis	8	Probable	Edge of woodland fragment containing mature trees bearing hollows, near dam and adjacent to cleared paddock with scattered trees.
<i>Pomeroy</i>	738	Common Bent-wing Bat	22	Possible	Riparian woodland strip containing mature hollow-bearing trees, adjacent to cleared paddock and, Drainage line within extensive woodland remnant containing mature hollow-bearing trees.
		Eastern False Pipistrelle	1	Possible	Drainage line within extensive woodland remnant containing mature hollow-bearing trees.
<i>Gurrundah</i>	93	Common Bent-wing Bat	20	Probable	Scattered trees in paddock, adjacent to dam, and, Within and extensive woodland fragment containing small hollows and at least one mine shaft.

The confidence levels of anabat call analysis can be influenced by several factors; how far the bat was from the detector, whether the bat is in search phase or feeding phase and whether there is an overlap in call characteristics between two or more species. Furthermore, the reference calls used to identify species were not obtained from the Goulburn area and there are observable differences in the call characteristics of the many species across their range and within different habitat types (for example, in open areas when compared to closed forests).

It can be seen that all sites have potential to contain at least one species of threatened microbat. While confidence levels are not high, as a precautionary measure, these species have been assumed by this assessment to occur onsite.

APPENDIX C: FOLLOW-UP SPRING REPTILE SURVEY

Aim of survey

The follow up spring reptile survey was conducted by two persons over two days (surveying from 7 – 9.30 am). The aim was to undertake active hand searches of areas identified as good potential habitat in previous surveying and to map on a finer scale areas of quality habitat that overlapped areas proposed for development. Target species included Striped Legless Lizard *Delma impar*, Pink-tailed Worm-lizard *Aprasia parapulchella*, and the Grassland Earless Dragon *Tympanocryptis pinguicolla*. The searches included:

- | | |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Bannister</i> | <ul style="list-style-type: none"> • Rocky knoll south of the monitoring tower |
| <i>Pomeroy</i> | <ul style="list-style-type: none"> • In the central portion of site, around the monitoring tower on the northern aspect |
| <i>Gurrundah</i> | <ul style="list-style-type: none"> • Large native grassland area between Sugarloaf Trig and woodland remnant • Rock outcropping east of the sheds |

Results

Bannister

At Bannister, a heavy thistle infestation was present, native grass and forb habitat which was present at the time of the autumn survey. Approximately 1000 rocks were rolled at this site.

This patch has been impacted by temporal variation of habitat attributes. Whilst the exact causes of this variation are unknown, it is likely that the heavy thistle infestation may have impacted on the black ant population, with this food source now existing in very low abundance. The site now also has a heavy presence of large, predatory centipedes, with most exceeding 100mm. The presence of these predators, the low numbers of black ants, and the heavy thistle infestation and subsequent change in native flora species composition, have reduced the quality of the patch to provide habitat for threatened herpetofauna. While the presence of these species cannot be ruled out, if they are present, they are persisting in low numbers considering the survey effort undertaken at this site.

It is considered unlikely that the Pink-Tailed Worm-Lizard would be present, with few black ants (an indicator of quality Pink-tailed Worm-lizard habitat) now present, the extensive cover of weeds and abundance of large centipedes (which constitute predators).

Similarly, it is unlikely that the Striped Legless Lizard would be present, due to the degree of fragmentation that has already occurred on the site, and the extent of the thistle infestation. However, reptile populations in fragmented landscapes are known to retreat to rock outcrops as fragmentation and degradation occur in the surrounding landscape, so it is important to retain such areas as they may act as a population source as temporal variation occurs.

Considering the ecology of these species, the landscape context of the site, and the microhabitat and attributes present at the time of the autumn and spring surveys, the basalt outcropping has been evaluated to provide marginal habitat for the Striped Legless Lizard and Pink-Tailed Worm-Lizard. The best areas of potential habitat are mapped below.

Pomeroy

At Pomeroy, the site had been heavily grazed. Native grasses had been heavily browsed, producing conditions much different from our first survey. The search was extensive, with almost all rocks in the outcrop rolled (approximately 250).

Ant density was good, with around 50% black ant coverage (an important food source for Pink-tailed Worm-lizards and considered as a surrogate for determining suitable habitat for this species). Considering the extent of the search, the potential for the Pink-tailed Worm-lizard is considered low despite suitable habitat being present. However, the species cannot be said with confidence to be absent, due to its cryptic nature.

The best quality Pink-Tailed Worm-Lizard habitat is mapped below.

Due to the extensive grazing that has occurred since the autumn survey, potential habitat for the Striped Legless Lizard is not considered to be present. Temporal variation in agriculture dominated landscapes is common with changes in resource availability attributed to increased levels of grazing. Changes in microhabitats have occurred at this site, suggesting that low dispersal organisms such as *Aprasia* or *Delma* species would find conditions difficult to survive these effects. The saxicolous tendencies of the Pink-tailed Worm-lizard give the species potential to shelter themselves from impacts of this disturbance regime to the site.

Gurrundah – rock outcropping east of sheds

Although the site has been heavily grazed since the autumn survey, the habitat present is still of high quality for the Pink-Tailed Worm-Lizard. Searches of the site revealed high levels of black ants and termites beneath loose rocks and fallen timber. Many native flora species are persisting in abundance, an indication that heavy grazing intensity may not have been prolonged. Examples of this include Nodding blue lily *Stypandra glauca*, present on the higher slopes, and the native grasses *Themeda triandra*, *Poa* spp. and *Austrodanthonia* spp. A delineation of different areas of habitat quality has been provided, indicating the likelihood of potential occurrence for Pink-tailed Worm-Lizard based on the microhabitat features and resources recorded during the autumn and spring surveys.

Gurrundah – native grassland south of Sugarloaf Trig

The area of potential habitat for the Grassland Earless Dragon is delineated in the map below. The site has experienced moderate levels of grazing since our first survey, with the ground structure around 60% native grass; 40% bare ground. The Grassland Earless Dragon seems to show a preference for native grassland with patches of bare ground scattered between grass tussocks. These features are likely to provide the species with microhabitat to permit thermoregulation in these cold climates. Small surface rocks characterise the inter-tussock spaces. These rocks are important micro-habitat elements within the grassland habitat. Rocks and arthropod holes provide important thermal refuges during temperature extremes, although no arthropod holes were observed.

Historically, the Grassland Earless Dragon ranged from Bathurst through to Cooma, including the ACT region. The only populations now known are in the ACT and adjacent NSW at Queanbeyan, and on the Monaro between Cooma and south-west of Nimmitabel. The site is likely to have been included in the historic range of this species.

The site matches the description of preferred habitat for this species. The recovery plan states that preferred habitat is native grassland dominated by wallaby grasses (*Danthonia* spp.), spear grasses (*Stipa* spp.), tussock grasses (*Poa* sp.) and possibly Kangaroo Grass (*Themeda triandra*). Captures in the ACT suggest that the species prefers well-drained natural temperate grasslands which are relatively undisturbed and with minimal pasture improvement. There appears to be a preference for shorter grassland with an open structure or with open areas, and some aspects of the structure of the grassland (such as distribution of tussocks and low, open grass) may be important (Benson 1996, Langston 1996).

The movement of adult animals has been documented as up to 40m per day (Langston 1996), with some movements in excess of 230 m over longer periods. Little is known about movements of juveniles and dispersal behaviour. Many species of reptile, including the Grassland Earless Dragon, occupy small home ranges. Cryptic species or those that occur at low densities are difficult to detect (Bailey *et al.* 2004). An example of the cryptic nature of reptiles and the difficulty in detecting species presence is highlighted by a study in Western Australia where after 25,000 pitfall trap nights were conducted and over 17,000 individual reptiles captured, a new species was trapped (Thompson *et al.* 2003). The small home ranges of many species (Turner *et al.* 1969) combined with low dispersal capabilities indicate that in most cases the record of one species can be considered to constitute a population. For the site in question, these factors make it difficult to determine conclusively whether a population is present and if so, what constitutes fragmentation of habitat that could affect a local population.

Key threats to this species appear to be loss and fragmentation of habitat and degradation of habitat including changed fire regimes, grazing regimes, weed invasion, use of agricultural chemicals, rock removal, and the impacts of introduced animals. Most sites where this species persists are subject to grazing by native and/or introduced herbivores and hence the continued grazing regime is not considered to be a threat so long as the intensity is managed.

The short life cycle (they typically die after one year) is likely to make the species vulnerable to unpredictable perturbations, which prevent recruitment in any one year. Therefore, even a relatively short construction period where areas are revegetated after construction may constitute a serious impact to a local population. The ability of the species to recover is limited by their low fecundity.

The Grassland Earless Dragon is listed as endangered at both the state and federal level. Pursuant to state and federal legislation, assessments of significance (Appendix E) determined that there would be potential for a significant impact if the species is present in the identified area and the development does not avoid impact within the core of this area.

Conclusion

While three of the four areas discussed above represent small discrete areas of habitat that are easily avoided during development, the fourth site is more problematic from the point of view of the proposal. The proposal at the time of this assessment would see a turbine and access track dissect the area of potential habitat at Gurrundah north. This area may be inhabited by the Grassland Earless Dragon, a small and very cryptic species whose presence cannot be ruled out even after extensive surveying.

As the presence of the species cannot be ruled out, it is recommended that it be assumed to occur there. Considering the lifecycle of this species, the manageability of impacts within areas of habitat would be low as fragmentation and degradation of habitat are likely to preclude dispersal and continued habitation by this species. Therefore avoidance of impact is considered the most appropriate approach in relation to the development.

In summary, it is recommended that:

- The reptile habitats mapped for Bannister and Pomeroy should be avoided.
- The moderate and high quality reptile habitats mapped for Gurrundah south should be avoided.
- The low quality reptile habitat mapped for Gurrundah south should be avoided, if possible.
- The reptile habitat mapped for Gurrundah north is a more significant constraint. It is a strong recommendation of this report that the core area of habitat mapped for Gurrundah north be avoided during site development. Impacts to the periphery, which is more marginal habitat, are acceptable. Grazing is recommended to be managed in this area at the current level of intensity to preserve the existing habitat qualities.

If the area cannot be avoided, the proposal should be referred to DEWR under the *EPBC Act* as a controlled action and to the DECC under the *TSC Act*.

- A 10m buffer should be applied to these habitat outlines, to take into account the accuracy limitation of the hand-held GPS.

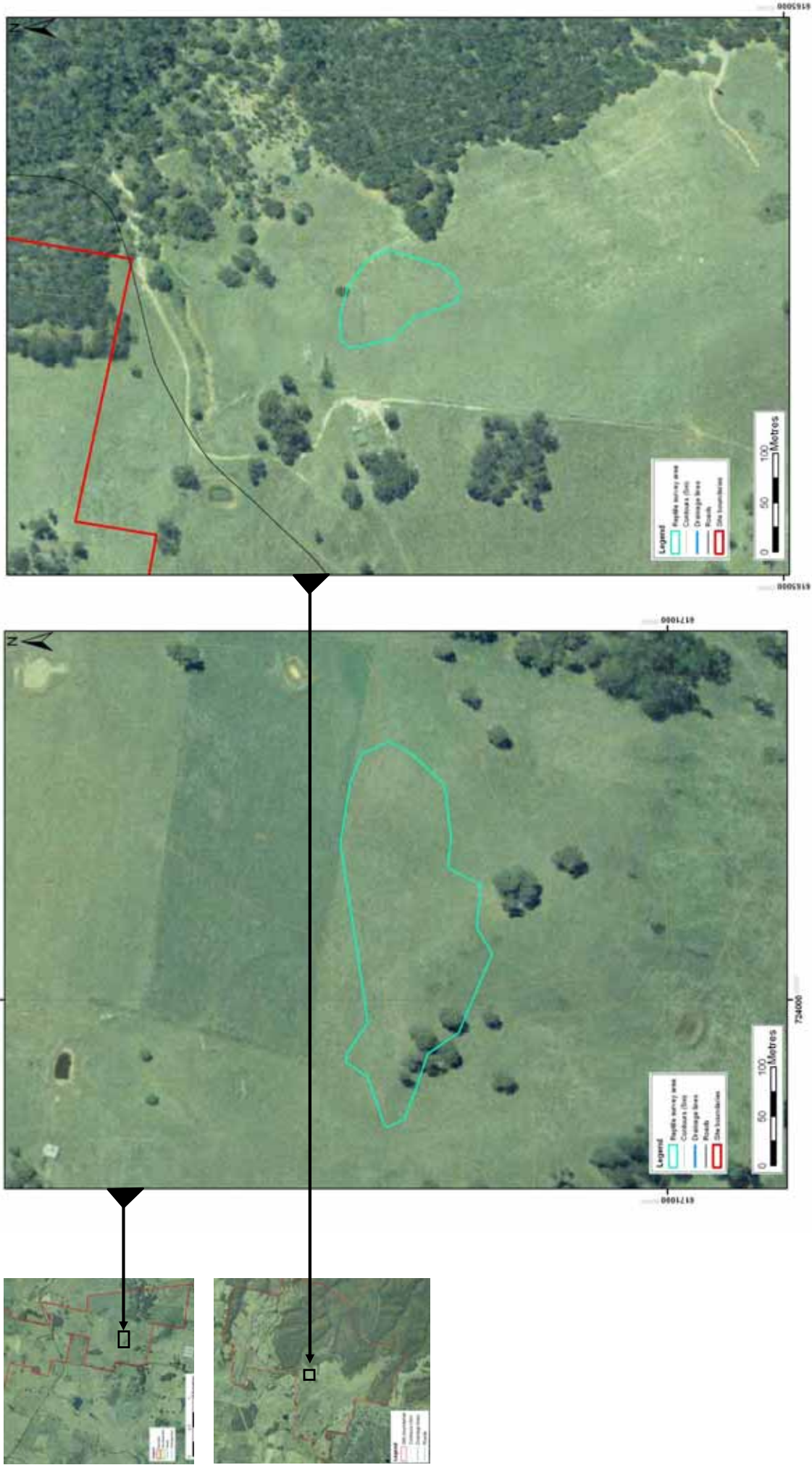


Figure C-1 Quality threatened reptile constraints mapping: Bannister, Pomeroy.

Quality potential habitat for threatened reptiles is outlined in light blue.

A 10m buffer should be applied to these habitat outlines, due to the accuracy level of the hand held gps that was used. Shape files have been supplied to Epuron, separately.

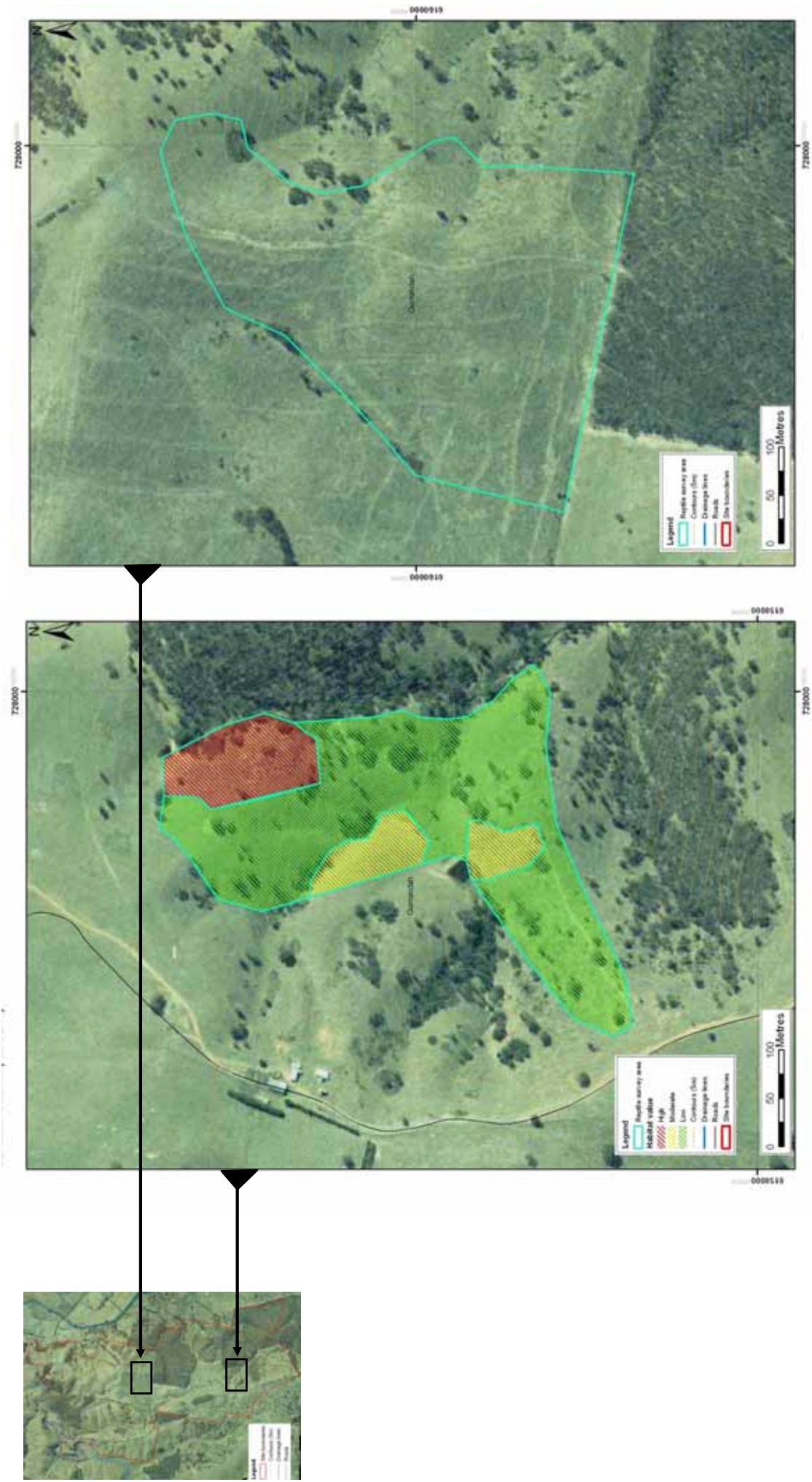


Figure C-2 Quality threatened reptile constraints mapping: Gurrundah north, Gurrundah south.

Quality potential habitat for threatened reptiles is outlined in light blue. A low, moderate and high rating is given to Gurrundah south.

A 10m buffer should be applied to these habitat outlines, due to the accuracy level of the hand held gps that was used. Shape files have been supplied to Epuron, separately.

APPENDIX D: THREATENED SPECIES EVALUATION

D.1 Flora impact evaluation

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

Species	Category*	Habitat required	Potential for impact
<i>Eucalyptus recurva</i> shrub (Myrtaceae)	E, e	This species is known only from a few sites in the Nerriga to Braidwood area. The location is remote from its known distribution and the species was not detected.	Low
<i>Bossiaea oligosperma</i> shrub (Fabaceae)	V, v	Grows in the Windellama area south-east of Goulburn, in open forest dominated by brittle gum (<i>E. mannifera</i>). Suitable habitat (relatively undisturbed dry open forest) is present in the large remnant on Gurrundah, but it is very unlikely that this area will be affected by the proposal. The area close to the ridge top was searched and the species was not found.	Low
<i>Dillwynia glaucula</i> shrub (Fabaceae)	E	Occurs in the Windellama area, with a few occurrences further south along the eastern edge of the Monaro (J. Miles, pers. obs.). It grows in dry woodland or open forest, occasionally persisting on rocky outcrops in secondary grassland on roadsides (as at Michelago, south of Canberra). It was not recorded on the site.	Low
<i>Pultenaea pedunculata</i> shrub (Fabaceae)	E	This is a prostrate shrub which can form extensive mats. It usually grows on bare ground, such as on eroded gully walls and roadside cuttings, usually on soils derived from Ordovician siltstones. It occurs in the Windellama area and in Bungonia State Conservation Area, where it grows in woodland or open forest with a sparse groundcover. Suitable habitat (relatively undisturbed dry open forest) is present in the large remnant on Gurrundah and some of the regrowth forest around the eastern side of Pomeroy, but it is very unlikely that these areas will be affected by the proposal. The area close to the ridge top was searched and the species was not found.	Low
<i>Grevillea renwickiana</i> prostrate shrub (Proteaceae)	E	There are six populations of this species known between Nerriga and Charley's Forest, north of Braidwood. Some are within Morton NP and some on private property or road verges. It grows in open forest or woodland on poor soils. The site is well outside its known range, and it was not recorded.	Low
<i>Kunzea cambagei</i> shrub (Myrtaceae)	V, v	The 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.	Nil
<i>Pomaderris cotoneaster</i> shrub (Rhamnaceae)	E, e	Recorded from a few rocky or riparian sites in forest in Bungonia State Conservation Area and the adjacent parts of Morton National Park (J. Miles, pers. obs.). No suitable habitat occurs on the sites and the species was not recorded.	Nil
<i>Pomaderris delicata</i> 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.	Low
<i>Pomaderris pallida</i> 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. A little suitable habitat is present along creeks on Pomeroy, but it is outside the area likely to be affected by the proposal.	Low

Species	Category*	Habitat required	Potential for impact
<i>Caladenia tessellata</i> 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 <i>Eucalyptus dives</i> and <i>E. macrorhyncha</i> (K. McDougall, pers. comm.). Suitable habitat (relatively undisturbed dry open forest) is present in the large remnant on Gurrundah and some of the regrowth forest around the eastern side of Pomeroy, but it is very unlikely that these areas will be affected by the proposal. This is a spring-flowering orchid so the survey timing was not suitable for its detection.	Low
<i>Diuris aequalis</i> terrestrial orchid (Orchidaceae)	E, v	In the Braidwood area this species is generally found in drier woodland dominated by <i>Eucalyptus dives</i> and <i>E. mannifera</i> , although further north it may occur in association with snow gum, <i>E. pauciflora</i> (R Rehwinkel, pers. comm.), and north of Goulburn (Mt Rae area) it occurs in moist forest dominated by <i>E. radiata</i> or <i>E. fastigata</i> (J. Miles, pers. obs.). There is a single old record from the Goulburn area and it still occurs near Wombeyan Caves. Suitable habitat (relatively undisturbed open forest) is present in the large remnant on Gurrundah, remnant and regrowth forest patches on Kialla and Bannister and some of the regrowth forest around the eastern side of Pomeroy, but it is very unlikely that these areas will be affected by the proposal. This is a spring-flowering orchid so the survey timing was not suitable for its detection.	Low
<i>Diuris pedunculata</i> terrestrial orchid (Orchidaceae)	E, e	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 are some areas of moist grassland on Pomeroy and Kialla, in areas which are within the development envelope. However, the degree of prior disturbance from clearing, pasture improvement and grazing, makes it very improbable that this species would occur on the site. The survey timing was not suitable for its detection.	Low
<i>Diuris tricolor</i> (syn. <i>D. sheaffiana</i>) terrestrial orchid (Orchidaceae)	V, v	Sporadically distributed from Narrandera across the western slopes to northern NSW. Usually in grassy <i>Callitris</i> 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. It is very unlikely to occur on the sites.	Low
<i>Prasophyllum petilum</i> terrestrial orchid (Orchidaceae)	E, e	Known from three sites at Boorowa, Hall and Captain's Flat, growing in Natural Temperate Grassland, Box-Gum Woodland or moist grassy flats, with kangaroo grass or wallaby grasses (<i>Austrodanthonia</i> 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 parts of the sites, but the degree of prior disturbance makes it very unlikely that this species would occur.	Low
<i>Ammobium craspedioides</i> 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 <i>E. blakelyi</i> , <i>E. melliodora</i> , <i>E. bridgesiana</i> , <i>E. dives</i> , <i>E. macrorhyncha</i> , <i>E. mannifera</i> and <i>E. rubida</i> , many of which 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 parts of the site which would be affected by the proposed development.	Low

Species	Category*	Habitat required	Potential for impact
<i>Calotis glandulosa</i> 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.	Low
<i>Goodenia macbarronii</i> 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 (DECC website). The nearest records on the DECC Atlas are well to the west of the Goulburn area. There is no suitable habitat (seepage areas) on the site.	Nil
<i>Lepidium hyssopifolium</i> 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.	Low
<i>Lepidium pseudopapillosum</i> 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 <i>Lepidium ginninderrense</i> , so <i>L. pseudopapillosum</i> is no longer regarded as occurring in NSW.	Nil
<i>Lepidium ginninderrense</i> forb (Brassicaceae)	v	Occurs on a single site on Belconnen Naval Transmission 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.	Low
<i>Leucochrysum albicans</i> ssp <i>albicans</i> var. <i>tricolor</i> 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. A single non-flowering plant which is probably this species was found on Gurrundah, in pasture near the western edge of the large fenced remnant (near an old steam engine). The single plant was under a log, where it had some protection from grazing. The level of grazing pressure on this site makes it unlikely that a larger population of this species occurs on the site and was not detected. The species was also seen in three locations on the verges of Range Road, none of them close to any of the sites.	Moderate
<i>Rutidosia leptorhynchoides</i> 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 sites.	Low
<i>Swainsona recta</i> 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. The absence of records from the Goulburn area and degree of grazing pressure on grassy woodland remnants makes it unlikely that it would occur on the sites.	Low

Species	Category*	Habitat required	Potential for impact
<i>Swainsona sericea</i> 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 DECC 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 parts of the site likely to be affected by the proposal.	Low
<i>Cullen parvum</i> forb (Fabaceae)	E, e	A perennial forb to 30cm high, recorded mainly from grassland or forest on the plains of the Murrumbidgee and Murray Rivers (Harden 2002). This species was recently located in remnant box-gum woodland at Galong, about 100km west of Goulburn (FOG 2006). Suitable habitat may occur on the less degraded parts of the sites, but is very unlikely to be found on the parts of the site likely to be affected by the proposal.	Low
<i>Thesium australe</i> 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 (<i>Themeda triandra</i>), preferring moist sites in grassland or grassy woodland. Kangaroo grass is uncommon on the site, and although there are a few small areas where it is dominant on Pomeroy, it is under heavy grazing pressure and generally in dry rather than moist sites. It is very unlikely that <i>Thesium australe</i> occurs on the site.	Low
<i>Plinthanthesis rodwayi</i> grass (Poaceae)	E, v	Known only from two locations within Budawang National Park, where it grows on poor sandy soils. The site is well removed from its known area of distribution, and there is no suitable habitat present.	Nil
<i>Amphibromus fluitans</i> River Swamp Wallaby-grass	V, v	"Grows mostly in permanent swamps" (Harden 1993). "Apparently confined to permanent swamps principally along the Murray River" (Walsh and Entwistle 1994). No suitable habitat occurs on any of the sites.	Nil
<i>Dodonaea procumbens</i> Trailing Hop-bush	V, v	A prostrate shrub recorded mostly from the Monaro region, where it grows in shallow soil among outcrops of Ordovician metamorphosed shale, in grassy woodland dominated by <i>Eucalyptus pauciflora</i> , <i>E. dives</i> or <i>E. rubida</i> , or in secondary grassland. It tolerates some degree of disturbance and sometimes occurs on roadside cuttings but is seldom seen in grazed sites. Suitable habitat could occur on Gurrundah and Pomeroy but the species was not recorded and the degree of grazing disturbance, plus the remoteness of the sites from the main area of distribution of this species makes it unlikely that it would occur on any of the sites.	Low
<i>Baloskion longipes</i> 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.	Nil

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 *TSC Act 1995*.

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

D.2 Fauna impact evaluation

Threatened species considered to have potential to occur onsite were, derived from the DECC NPWS Wildlife Atlas listings for the Gunning, Crookwell and Goulburn 1:100,000 map sheets and the EPBC 'Matters of National Significance' report using a 50km buffer from the development envelope. As the works would not impact aquatic habitats, only terrestrial species have been considered.

An unmitigated risk factor score out of five has been assigned based on several factors of equal rating:

1. Occurs locally,
2. Could breed onsite,
3. Could forage onsite,
4. Could occur in the path of turbines or infrastructure,
5. Given 4, is a flocking or colonial species.

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

Species	Class*	Habitat requirements and study area suitability	Potential to be impacted	Risk factor score (out of 5)
AMPHIBIANS				
Green and Golden Bell Frog <i>Litoria aurea</i>	E	Occurs in or near water or very wet areas. It is present in forests, woodlands and shrublands, in open or disturbed areas (Hero <i>et al.</i> 1991). Breeding takes place in permanent lakes, swamps and dams with still water (Hero <i>et al.</i> 1991). Disturbance tolerant. Although historically detected from altitudes above 700m ASL, higher altitude populations seem to have been hit harder by recent declines (DEC 2003).	Historic records occur south-west of Goulburn however this species is presumed all but extinct from the southern tablelands. One key population is known to occur near Hoskinstown. Marginal potential habitat occurs in the study area in farm dams. Habitat may be lost if dams are filled to reduce water bird collision.	3
Yellow-spotted Bell-frog <i>Litoria castanea</i>	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. Marginal potential habitat occurs onsite.	2
Littlejohn's Tree Frog <i>Litoria littlejohni</i>	V	Distributed along the eastern slopes of the Great Dividing Range from near Wyong, south to Buchan in north-eastern Victoria (NPWS Website). Appears restricted to sandstone woodland and heath communities at mid to high altitude (280-1000m) on the slopes of the Great Dividing Range (Barker <i>et al.</i> 1995). Appears to breed in flowing rocky streams or in dams with emergent vegetation (Barker <i>et al.</i> 1995).	The nearest records are well east of the study area, in Moreton NP. Marginal potential habitat occurs onsite.	2

Species	Class*	Habitat requirements and study area suitability	Potential to be impacted	Risk factor score (out of 5)
Booroolong Frog <i>Litoria booroolongensis</i>	E	Lives along permanent streams with some fringing vegetation cover such as ferns, sedges or grasses. It typically inhabits rocky western-flowing creeks and their headwaters, although a small number of animals have also been recorded in eastern-flowing streams (NSW NPWS 2004b). Adults occur on or near cobble banks and other rock structures within stream margins. Shelters under rocks or amongst vegetation near the ground on the stream edge. Sometimes basks in the sun on exposed rocks near flowing water during summer. Eggs are laid in submerged rock crevices and tadpoles grow in slow-flowing connected or isolated pools.	The closest records occur well north of the study area. Potential marginal habitat in the rocky eastern-flowing drainage line at Pomeroy. Potential habitat would not be affected by works.	2
BIRDS				
Speckled Warbler <i>Chthonicola sagittate</i>	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.	Local records are present from Kingsdale and north of Gunning. Potential foraging habitat is present in all woodland remnants within the study area. Breeding habitat is more likely to be found in the larger remnants at Pomeroy and Gurrundah. Stock access and drought have reduced the quality of this habitat by modifying the understorey but this may be a temporary effect. Potential habitat would not be directly affected by works. Collision and avoidance impacts may apply.	4
Magpie Goose <i>Anseranas semipalmate</i>	TSC V	A wetland species, only vagrant in southern NSW.	Recorded near Collector, south of the study area. Optimum habitat is not located within the study area. Local movements would be more likely restricted to wet habitat corridors which occur adjacent to the site. Low collision risk.	2
Gang-gang Cockatoo <i>Callocephalon fimbriatum</i>	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.	Local records occur near Goulburn and Crookwell. Several areas contain mature vegetation suitable for foraging and breeding. Potential habitat would not be directly affected by works. Collision and avoidance impacts may apply.	5

Species	Class*	Habitat requirements and study area suitability	Potential to be impacted	Risk factor score (out of 5)
Glossy Black Cockatoo <i>Calyptorhynchus lathami</i>	V	A species of open forests and woodland, dependent mainly on the seeds of <i>Allocasuarina</i> trees as a food source (Blakers <i>et al.</i> 1984). Large trees with hollows are required for breeding sites (Emison <i>et al.</i> 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.	One local record, south at Collector. Several areas contain mature vegetation suitable for breeding. Potential habitat would not be directly affected by works. Collision and avoidance impacts may apply.	4
Blue-billed Duck <i>Oxyura australis</i>	V	Requires wetland habitats, preferring well vegetated freshwater swamps, large dams, lakes (Pizzey and Knight 1997).	One local record occurs, near Collector. Optimum habitat is not located within the study area. Local movements would be more likely restricted to wet habitat corridors and large dams which occur adjacent to the site.	3
Freckled Duck <i>Stictonetta naevosa</i>	V	Requires wetland habitats, preferring large permanent swamps. 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 Lake George. Optimum habitat is not located within the study area. Local movements would be more likely restricted to wet habitat corridors and large dams which occur adjacent to the site.	2
Square-tailed Kite <i>Lophoictinia isura</i>	V	Preferred habitat is open eucalypt forest and woodland (Schodde and Tidemann 1995). The species hunts for passerine birds in the tree tops (Klippel 1992).	Recorded from Mundoonen Nature Reserve east of Yass. More extensive areas of woodland suitable for this species are located at Pomeroy and Gurrundah. Potential habitat would not be directly affected by works. Collision and avoidance impacts may apply.	4
Australasian Bittern	TSC V	Inhabits dense reeds, rushes or cane grass in freshwater wetlands, including swamps, lakes, impoundments, rivers or creeks. They may also be seen in flooded rank pastures and along drainage ditches or channels (Blakers <i>et al.</i> 1984; Emison <i>et al.</i> 1984).	Known from Lake George. Optimum habitat is not located within the study area. Local movements would be more likely restricted to wet habitat corridors and wetlands which occur adjacent to the site.	1
Australian Painted Snipe <i>Rostratula benghalensis australis</i>	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.	Not recorded locally. Optimum habitat is not located within the study area. Local movements would be more likely restricted to wet habitat corridors and wetlands which occur adjacent to the site.	1

Species	Class*	Habitat requirements and study area suitability	Potential to be impacted	Risk factor score (out of 5)
Black-necked Stork <i>Ephippiorhynchus asiaticus</i>	E	<p>Species is widespread across coastal northern and eastern Australia, becoming increasingly uncommon further south into NSW, and rarely south of Sydney. Some birds may move long distances and can be recorded well outside their normal range.</p> <p>Inhabits permanent freshwater wetlands including margins of billabongs, swamps, shallow floodwaters, and adjacent grasslands and savannah woodlands; can also be found occasionally on inter-tidal shorelines, mangrove margins and estuaries. Feeds in shallow, still water on a variety of prey including fish, frogs, eels, turtles, crabs and snakes.</p>	<p>One local record occurs south of Goulburn. Optimum habitat is not located within the study area. Local movements would be more likely restricted to wet habitat corridors and wetlands which occur adjacent to the site.</p>	2
Brown Treecreeper <i>Climacterus picumnus</i>	V	<p>Occurs in eucalypt woodlands, mallee and drier open forest of eastern Australia, preferring woodlands lacking dense understorey (Schodde and Tidemann 1995). 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.</p>	<p>Recorded from Mundoonen Nature Reserve east of Yass.</p> <p>Several areas contain hollows and are connected enough to allow this species to utilise habitat.</p> <p>Potential habitat would not be directly affected by works. Collision and avoidance impacts may apply.</p>	4
Diamond Firetail <i>Stagonopleura guttata</i>	V	<p>Occurs predominantly west of the Great Dividing Range (Blakers <i>et al.</i> 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 1995), 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.</p>	<p>Recorded locally.</p> <p>Potential foraging and breeding habitat is present within the study area.</p> <p>Potential habitat would not be directly affected by works. Collision and avoidance impacts may apply.</p>	5

Species	Class*	Habitat requirements and study area suitability	Potential to be impacted	Risk factor score (out of 5)
Regent Honeyeater <i>Xanthomyza phrygia</i>	E E m	Distributed through the eastern third of New South Wales, where it inhabits eucalypt forests and woodlands (Blakers <i>et al.</i> 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 <i>et al.</i> 1984). Large numbers can appear in an area to take advantage of a food source. Key eucalypt species include Yellow Box and Blakely's Red Gum and Red Stringybark, which occur onsite.	Recorded locally. Potential foraging habitat is present, particularly in the more extensive areas of woodland at Pomeroy and Gurrundah. Potential habitat would not be directly affected by works. Collision and avoidance impacts may apply.	4
Hooded Robin <i>Melanodryas cucullata</i>	V	Widespread, occurring in pairs or solitary in lightly timbered country (Schodde and Tidemann 1995). 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 1995), nesting on dead limbs or stumps. Populations are unable to survive in remnants smaller than 100-200 hectares (NPWS 2004).	No local records. Poor potential habitat with the exception of the more extensive areas of woodland at Pomeroy and Gurrundah. Potential habitat would not be directly affected by works. Collision and avoidance impacts may apply.	2
Superb Parrot <i>Polytelis swainsonii</i>	V v	Nesting habitat on SW Slopes is often open Yellow Box, Blakely's Red Gum Woodland or isolated paddock trees. 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.	Recorded locally at Breadalbane. West of Yass forms part of core breeding population in region. Migrates north in winter to the upper Namoi and Gwydir Rivers. Marginal potential foraging and nesting habitat is present within the study area, due to the lack of native understorey, with the exception of one paddock at Kialla. Collision and avoidance impacts may apply to this flocking species.	5
Swift Parrot <i>Lathamus discolor</i>	e	A non-breeding winter migrant to southern and eastern NSW, where it inhabits eucalypt forests and woodlands (Blakers <i>et al.</i> 1984). Feeds on eucalypt blossom and psyllids.	Recorded west of the study area, near Boorowa. Marginal potential foraging habitat is present. Only minimal woodland would be impacted by the proposal.	3

Species	Class*	Habitat requirements and study area suitability	Potential to be impacted	Risk factor score (out of 5)
Powerful Owl <i>Ninox strenua</i>	V	Breeding pairs defend large (up to 1000 ha), permanent territories (Blakers <i>et al.</i> 1984), usually centred around gullies (Fleay 1968). Nests in large tree hollows (Emison <i>et al.</i> 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 <i>et al.</i> 1984). Known from the Muddoonen Nature Reserve and near Collector.	Recorded in the more extensive woodland, east of the Pomeroy site. Locally recorded at Collector and Muddoonen Nature Reserve. Foraging and potential breeding habitat present within this area. Only minimal woodland would be impacted by the proposal. Collision / avoidance impacts may apply.	4
Grass Owl <i>Tyto capensis</i>	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).	Not recorded locally. Suitable habitat is not located within the study area. Potential collision and avoidance impact may occur when moving between areas of habitat.	1
INSECTS				
Golden Sun Moth <i>Synemon plana</i>	E 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 (<i>Austrodanthonia</i> spp.) roots. Bare ground between the tussocks is thought to be an important microhabitat feature. Within small patches of habitat the Golden Sun Moth is locally abundant, however most in areas such as cemeteries, along railway lines, roadside verges and elsewhere where weed invasion and disturbance do not threaten habitat integrity.	Distributed between Queanbeyan, Gunning, Young and Tumut. All of the known sites are less than 720 m above sea level (Clarke 2001). Surveys in Nov. and Dec. 1997 covered much of the potential grassland habitat for this species in south-eastern NSW. Wallaby grass occurs within the study area although sites may be too high and too degraded for this species. It is highly unlikely that suitable habitat occurs onsite.	1
MAMMALS				
Eastern Pygmy Possum <i>Cercartetus nanus</i>	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.	One local record exists from Muddoonen Nature Reserve. Potential habitat is marginal due to lack of shrub strata and preferred species. Only minimal woodland would be impacted by the proposal.	3

Species	Class*	Habitat requirements and study area suitability	Potential to be impacted	Risk factor score (out of 5)
Tiger or Spotted-tailed Quoll <i>Dasyurus maculatus</i>	V e	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.	Not recorded locally. Potential habitat is marginal due to poor habitat structure and drier vegetation types within the study area. Only minimal woodland would be impacted by the proposal.	2
Brush-tailed Rock-wallaby <i>Petrogale penicillata</i>	E v	Generally living in loose colonies within a range of 15 ha, they inhabit rocky areas near grassy areas within sclerophyll forest, with a preference for areas with rocky platforms and caves (Klippel, 1992).	Previous records are well east of the study area. Woodland habitat at Pomeroy may constitute potential marginal habitat.	2
Yellow-bellied Glider <i>Petaurus australis</i>	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 (<i>Eucalyptus viminalis</i> and <i>Corymbia gummifera</i>) and winter flowering ironbarks. It is principally distributed on the coast although several inland records exist.	No local records. Potential habitat is marginal. Only minimal woodland would be impacted by the proposal.	2
Squirrel Glider <i>Petaurus norfolcensis</i>	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 (<i>Eucalyptus</i> and <i>Acacia</i>). No local records.	Recorded onsite at Gurrundah. Potential habitat for foraging and breeding occurs in the more extensive areas of woodland at Gurrundah and Pomeroy. Only minimal woodland would be impacted by the proposal.	3
Koala <i>Phascolarctos cinereus</i>	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. Species preferred by this species are present onsite however, habitat structure is poor being degraded and non continuous and generally isolated and heavily fragmented.	Known from Mudoonen Nature Reserve, near Gurrundah and Crookwell. Potential habitat is marginal due to poor habitat structure and fragmentation. Only minimal woodland would be impacted by the proposal.	3

Species	Class*	Habitat requirements and study area suitability	Potential to be impacted	Risk factor score (out of 5)
Grey-headed Flying Fox <i>Pteropus poliocephalus</i>	V, v	Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Individual camps may have tens of thousands of animals and are used for mating, birth and the rearing of young. Feed on the nectar and pollen of native trees, in particular Eucalyptus, Melaleuca and Banksia, and fruits of rainforest trees and vines. Also forage in cultivated gardens and fruit crops and can inflict severe crop damage.	No local records occur. Potential roosting habitat occurs in the riparian belt of the Gurrundah Creek at Pomeroy and potentially on the Wollondilly River at Gurrundah. Potential habitat is marginal due to poor habitat structure and fragmentation. Only minimal woodland would be impacted by the proposal.	4
Eastern False Pipistrelle <i>Falsistrellus tasmaniensis</i>	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.	Not recorded locally. Potential foraging and breeding habitat is present in the more extensive woodlands at Pomeroy and Gurrundah. Only minimal woodland would be impacted by the proposal but collision / avoidance impacts may apply.	3
Common bent-wing bat <i>Miniopterus schreibersii</i>	v cd	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 in large maternity sites (Strahan <i>et al.</i> 1995). Typically, the species forages in well timbered habitats, above the tree canopy (Dwyer, in Strahan <i>et al.</i> 1995).	Local records occur 15km south of Goulburn and in the Shoalhaven. Potential foraging habitat may be present in wooded areas. Potential breeding and roosting sites may occur at Gurrundah, in old mines. Only minimal woodland would be impacted by the proposal but collision / avoidance impacts may apply.	5
Eastern Freetail Bat <i>Mormopterus norfolkensis</i>	v	The Eastern Freetail-bat is found along the east coast from south Queensland to southern NSW. It occurs in dry sclerophyll forest and woodland east of the Great Dividing Range. Roosts mainly in tree hollows but will also roost under bark or in man-made structures. Solitary and probably insectivorous.	Not recorded locally. Potential foraging habitat may be present in wooded areas. Potential breeding and roosting sites may occur within the study area. Only minimal woodland would be impacted by the proposal but collision / avoidance impacts may apply.	4

Species	Class*	Habitat requirements and study area suitability	Potential to be impacted	Risk factor score (out of 5)
Large-eared Pied Bat <i>Chalinolobus dwyeri</i>	v	Vulnerable status is largely attributed to the destruction of roosting sites (from mining), and diminishing prey (due to habitat loss). This is a cave roosting species that roosts in small groups, hibernating in winter.	Not recorded locally. Potential foraging habitat may be present in wooded areas. Potential breeding and roosting sites may occur at Gurrundah, in old mines. Only minimal woodland would be impacted by the proposal but collision / avoidance impacts may apply.	3
Eastern Long-eared bat <i>Nyctophilus timoriensis</i>	V, 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. Potential foraging and breeding habitat occurs within the study areas. Foraging pattern suggests collision risk is low but avoidance impacts may apply while migrating.	2
REPTILES				
Broad-headed Snake <i>Hoplocephalus bungaroides</i>	E v	Preferred habitats are sandstone communities of the Sydney Basin, typified by exposed sandstone outcrops in woodland, open woodland and/or heath.	Recorded well east of the study area in Morton NP. No suitable habitat occurs within the study area.	0
Striped Legless Lizard <i>Delma impar</i>	v v	Inhabits temperate lowland grasslands and secondary grasslands, including some areas dominated by introduced species (such as <i>Phalaris aquatica</i> , <i>Nasella trichotoma</i> and <i>Hypochaeris radicata</i>), 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.	Recorded just south of Goulburn. Potential habitat occurs onsite at all four sites: at Kialla in native grassland in the central portion of the site around the monitoring tower; at Bannister on the rocky knoll to the south of the monitoring tower; at Gurrundah between Sugarloaf Trig and the woodland remant; at Pomeroy in the central portion of site around the monitoring tower on the northern aspect. Ongoing grazing disturbance reduces the habitat quality at these locations. Works would impact a small amount of potential habitat in the long term.	4

Species	Class*	Habitat requirements and study area suitability	Potential to be impacted	Risk factor score (out of 5)
Pink-tailed Worm Lizard <i>Aprasia parapulchella</i>	V 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). Favoured 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 several sites in eastern NSW including the ACT, Albury, Tarcutta, Tumut, West Wyalong and Bathurst. Also found in three sites in Victoria. Potential habitat occurs onsite: at Bannister at the southern end of site around rock outcropping; at Pomeroy in the central portion of the site around the monitoring tower on the northern aspect; at Gurrundah on the rocky slope east of shearing shed Ongoing grazing disturbance reduces the habitat quality at many locations. Works would impact a small amount of potential habitat in the long term.	4
Little Whip Snake <i>Suta Flagellum</i>	v	Little is known in relation to the ecological requirements of this species. It is a nocturnal species, feeding on skinks and frogs. It is found " <i>mostly in eucalypt woodland and associated grasslands, especially on stony hills, where it shelters under rocks and logs</i> " (Cogger 1992).	This species is known from Crookwell. Potential habitat occurs onsite at Kialla in the forested far south-west corner; at Pomeroy in the forested eastern portions of the site; at Gurrundah in the large woodland remnant south of Sugarloaf Trig. Ongoing grazing disturbance reduces the habitat quality at many locations. Works would impact a small amount of potential habitat in the long term.	4
Grassland Earless Dragon <i>Tympanocryptis pinguicolla</i>	E e	Preferred habitat is naturally treeless grasslands on black clay, brown clay loams and podzolic soils, particularly those containing <i>Themeda</i> , <i>Austrodanthonia</i> and <i>Austrostipa</i> spp. that have not been extensively grazed. Threats include habitat clearing, grazing, rock removal, changed fire regimes and weed invasion.	This species has been recorded from the basalt-plains north and west of Melbourne and from the Southern Tablelands of NSW and the A.C.T. There are several records from near Cooma. Potential habitat occurs onsite at Kialla in native grassland in the central portion of site around the monitoring tower; at Gurrundah between Sugarloaf Trig and the woodland remnant. Ongoing grazing disturbance reduces the habitat quality at many locations. Works would impact a small amount of potential habitat in the long term.	4
MIGRATORY				

Species	Class*	Habitat requirements and study area suitability	Potential to be impacted	Risk factor score (out of 5)
White-bellied Sea-Eagle <i>Haliaeetus leucogaster</i>	m	Soars on air currents, hovers low over prey, makes angled power dives, travels large distances overland. 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.	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).	2
White-throated Needletail <i>Hirundapus caudacutus</i>	m	High-flying, vertical flight and diving displays. May form large flocks. 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.	3
Rainbow Bee-eater <i>Merops ornatus</i>	m	Migrant, suitable foraging habitat onsite. A species of open woodlands and riverbanks. Foraging could occur in the area. This species can form loose colonies when breeding, in northern Australia.	Observed onsite at Pomeroy.	4
Black-faced Monarch <i>Monarcha melanopsis</i>	m	Occurs from rainforests, eucalypt woodlands, coastal scrub, and damp gullies in rainforest (Pizzey & Knight, 1997). A moderately common summer visitor to the region, found in wetter forest types.	Records are predominantly coastal. Unlikely to occur within the study area.	1
Satin Flycatcher <i>Myiagra cyanoleuca</i>	m	Typically a species of densely vegetative gullies in tall forests (Pizzey and Knight 2003). 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. It is not a flocking species.	One record occurs near Gunning. Habitat within the study area would be marginal.	3
Rufous Fantail <i>Rhipidura rufifrons</i>	m	Occurs in understorey of rainforest and wet eucalypt forest and gullies. A moderately common summer visitor to the region.	Widespread species. Habitat within the study area would be marginal.	3

Species	Class*	Habitat requirements and study area suitability	Potential to be impacted	Risk factor score (out of 5)
Great Egret <i>Ardea alba</i>	m	Migratory / dispersive, suitable habitat nearby. Primarily inhabits wetlands and paddocks (Pizzey and Knight 2003). While foraging and nesting would be confined to offsite areas, movements to other foraging areas or during migration may result in collisions with turbines. It is likely however, that long-distance movements would follow wetland corridors and thereby avoid the site.	Known from the area.	3
Cattle Egret <i>Ardea ibis</i>	m	Migratory / dispersive, suitable habitat nearby. Primarily inhabits wetlands and paddocks (Pizzey and Knight 2003). While foraging and nesting would be confined to offsite areas, movements to other foraging areas or during migration may result in collisions with turbines. It is likely however, that long-distance movements would follow wetland corridors and thereby avoid the site.	Known from the area.	3
Double-banded Plover <i>Charadrius bicinctus</i>	m	A small wader inhabiting beaches, mud flats, grasslands and bare ground.	Records are concentrated on the coast. No suitable habitat occurs within the study area.	0
Latham's Snipe <i>Gallinago hardwickii</i>	m	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 and Knight 1995), where they probe for aquatic invertebrate and seed (Green and Osborne 1994).	Recorded from south of Lake George and it may use riparian corridors to move across the landscape.	3
Fork-tailed Swift <i>Apus pacificus</i>	m	Forages over open country and nests in cliffs and tall trees. Occasional mass movements occur and this species may spend nights on the wing (Pizzey and Knight 2003).	Migrant, habitat may occur within the area. It therefore has potential to forage at turbine height as well as be susceptible to collision while migrating in groups at night.	4

*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*
EPBCm listed as nationally Migratory in the *Environment Protection Biodiversity Conservation Act 1999*

APPENDIX E: ASSESSMENT OF SIGNIFICANCE

Assessments of Significance were considered necessary to properly characterise threatened or significant species identified as being at moderate to high unmitigated impact as a result of the proposed development. Dependant on the level of listing, different assessments are required, pursuant to State and Commonwealth legislation, as set out below.

Species	*Status	Assessment required
Glossy Black Cockatoo	V	NSW <i>Environmental Planning and Assessment Act 1979</i> Seven-part Test
Blue-billed Duck	V	NSW <i>Environmental Planning and Assessment Act 1979</i> Seven-part Test
Square-tailed Kite	V	NSW <i>Environmental Planning and Assessment Act 1979</i> Seven-part Test
Brown Treecreeper	V	NSW <i>Environmental Planning and Assessment Act 1979</i> Seven-part Test
Regent Honeyeater	E, e, m	NSW <i>Environmental Planning and Assessment Act 1979</i> Seven-part Test Commonwealth <i>Environment Protection Biodiversity Conservation Act 1999</i> Critically endangered and endangered species impact criteria Commonwealth <i>Environment Protection Biodiversity Conservation Act 1999</i> Migratory species impact criteria
Powerful Owl	V	NSW <i>Environmental Planning and Assessment Act 1979</i> Seven-part Test
Speckled Warbler	V	NSW <i>Environmental Planning and Assessment Act 1979</i> Seven-part Test
Fork-tailed Swift	m	Commonwealth <i>Environment Protection Biodiversity Conservation Act 1999</i> Migratory species impact criteria
White-throated Needletail	m	Commonwealth <i>Environment Protection Biodiversity Conservation Act 1999</i> Migratory species impact criteria
Rainbow Bee-eater	m	Commonwealth <i>Environment Protection Biodiversity Conservation Act 1999</i> Migratory species impact criteria
Satin Flycatcher	m	Commonwealth <i>Environment Protection Biodiversity Conservation Act 1999</i> Migratory species impact criteria
Rufous Fantail	m	Commonwealth <i>Environment Protection Biodiversity Conservation Act 1999</i> Migratory species impact criteria
Great Egret	m	Commonwealth <i>Environment Protection Biodiversity Conservation Act 1999</i> Migratory species impact criteria
Cattle Egret	m	Commonwealth <i>Environment Protection Biodiversity Conservation Act 1999</i> Migratory species impact criteria
Latham's Snipe	m	Commonwealth <i>Environment Protection Biodiversity Conservation Act 1999</i> Migratory species impact criteria
Gang-gang Cockatoo	V	NSW <i>Environmental Planning and Assessment Act 1979</i> Seven-part Test
Diamond Firetail	V	NSW <i>Environmental Planning and Assessment Act 1979</i> Seven-part Test
Swift Parrot		
Superb Parrot	V, v	NSW <i>Environmental Planning and Assessment Act 1979</i> Seven-part Test Commonwealth <i>Environment Protection Biodiversity Conservation Act 1999</i> Vulnerable species impact criteria
Eastern False Pipistrelle	V	NSW <i>Environmental Planning and Assessment Act 1979</i> Seven-part Test
Large-eared Pied Bat	v	Commonwealth <i>Environment Protection Biodiversity Conservation Act 1999</i> Vulnerable species impact criteria
Eastern Freetail Bat	V	NSW <i>Environmental Planning and Assessment Act 1979</i> Seven-part Test
Grey-headed Flying Fox	V, v	NSW <i>Environmental Planning and Assessment Act 1979</i> Seven-part Test Commonwealth <i>Environment Protection Biodiversity Conservation Act 1999</i> Vulnerable species impact criteria
Grassland Earless Dragon	E, e	NSW <i>Environmental Planning and Assessment Act 1979</i> Seven-part Test Commonwealth <i>Environment Protection Biodiversity Conservation Act 1999</i> Endangered species impact criteria
Common bent-wing bat	V	NSW <i>Environmental Planning and Assessment Act 1979</i> Seven-part Test
White box- Yellow Box – Blakely's Red Gum Grassy Woodland	E, e	NSW <i>Environmental Planning and Assessment Act 1979</i> Seven-part Test Commonwealth <i>Environment Protection Biodiversity Conservation Act 1999</i> Critically endangered and endangered impact criteria

*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*

EPBCm listed as nationally Migratory in the *Environment Protection Biodiversity Conservation Act 1999*

E.1 Seven-part Test (TSC Act listed species and communities):

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, listed at the state level under the *Threatened Species Conservation Act 1995*.

The following Seven-part Test assesses the significance of the likely impacts associated with the 'Gullen Range' Wind Farm proposal on the following species and Endangered Ecological Communities:

Glossy Black Cockatoo, Blue-billed Duck, Square-tailed Kite, Brown Treecreeper, Regent Honeyeater, Powerful Owl, Speckled Warbler, Gang-gang Cockatoo, Diamond Firetail, Superb Parrot, Eastern False Pipistrelle, Eastern Freetail Bat, Grey-headed Flying Fox, Common Bent-wing Bat, Grassland Earless Dragon, Tableland Basalt Forest and White box- Yellow Box – Blakely's Red Gum Grassy Woodland EEC.

- 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.*

Considering the potential impacts posed by wind farm infrastructure (refer to Section 7), species at risk of a life cycle impact which may place a population at risk of extinction may include those species:

- For birds and bats:
 - With large bodies and awkward flight characteristics (**Glossy Black Cockatoo, Blue-billed Duck, Gang-gang Cockatoo**),
 - Raptors and migrating birds (**Square-tailed Kite, Powerful Owl, Regent Honeyeater**),
 - Species which could move in large numbers in the path of turbines, (**Regent Honeyeater, Grey-headed Flying Fox, Common Bent-wing Bat**),
 - Species which could move in the path of turbines and which occur at low density or have low breeding potential (**Speckled Warbler, Superb Parrot, Common Bent-wing Bat**),
 - Night migrating species or, for bats, species which use visual navigation over echolocation during migration, (potentially, **Eastern False Pipistrelle and Common Bent-wing Bat**),
- For all species:
 - Species which would avoid important habitat resources located near the infrastructure (**none identified**),
 - Species for which a high proportion of potential habitat may be removed or modified as a consequence of the proposal (**Grassland Earless Dragon**).

Unmitigated on-going collisions have potential to place a local population of the 11 above mentioned bird and bat species at risk. Considering the high mobility of these species and the location of previous records, all of these species could be considered to occur in the area and therefore have potential for a lifecycle impact that may put a local population at risk.

Loss of habitat has potential to place a local population of the **Grassland Earless Dragon** at risk, although this species is not known to occur onsite. The species ranged from Bathurst to Cooma, including the ACT region. The only populations now known are in the ACT and adjacent NSW at Queanbeyan, and on the Monaro between Cooma and south-west of

Nimmitabel. The site is likely to have been included in the historic range of this species. Surveying cannot be undertaken rigorously enough to rule out the presence of this species onsite, hence it has been assumed to occur.

- 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.

- 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.**

The Endangered Ecological Community **White box- Yellow Box – Blakely’s Red Gum Grassy Woodland** is unlikely to suffer a negative impact from the proposal. The occurrences of this community on the Gurrundah and Pomeroy sites are largely restricted to mid-slope positions which are unlikely to be developed. There may be some restrictions to access routes to avoid impacting on this community. The single occurrence of numerous mature Yellow Box trees on Pomeroy which does occur within the potential impact zone has a severely degraded understorey and does not fall within the definition of the EEC under Commonwealth legislation, although it would fit the description of a degraded remnant under state guidelines for EEC recognition. It is assumed that turbines will be sited in areas which do not require the removal of large numbers of trees, so this area is unlikely to be directly affected. Areas of pasture in the vicinity of the EEC stands are unlikely to qualify as EEC themselves, due to the pasture on basalt on Pomeroy being almost entirely exotic.

The Endangered Ecological Community **Tableland Basalt Forest** is unlikely to suffer a negative impact from the proposal. The occurrences of this community on the ‘old’ Kialla site is restricted to drainage line positions which are unlikely to be developed. Occurrences on ‘new’ Kialla sites are close to a dwelling, and are therefore unlikely to be developed. It is assumed that turbines will be sited in areas which do not require the removal of large numbers of trees, so the relatively undisturbed occurrences of this EEC on the Bannister site are unlikely to be directly affected. Some low quality small remnants with an almost entirely exotic understorey in the southern part of Bannister may be cleared, but these represent only a small proportion of the occurrence of this EEC in the vicinity, and are already severely degraded by grazing and weed invasion. Areas of pasture in the vicinity of the EEC stands are unlikely to qualify as EEC themselves, due to the pasture on basalt on Bannister being almost entirely exotic.

- 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.**

The potential habitat of **White box- Yellow Box – Blakely’s Red Gum Grassy Woodland** is unlikely to be significantly affected, since its principal habitat in the region appears to be lower to mid-slopes, not ridge tops. Constraints mapping has shown that these areas are able to be avoided. The potential habitat of **Basalt Tableland Forest** is unlikely to be significantly affected, since forest will not be cleared for the proposal and most pasture on basalt within the sites is already converted to exotic pasture.

For the bird and bat species considered, key habitats would not be directly modified; woodlands are the preferred habitat of these species and they would not be developed. The development envelope calculations (Table 2-1) show that works are confined to already cleared areas. The installation of turbines adjacent to woodlands however, may affect the utilisation of habitat; the ridgeline and woodland remnants near turbines may be avoided by some individual animals as they move between remnants or by migrating groups. Particularly in the southern portion of the Pomeroy site, turbines would be close to woodland and may lead to resident bats and birds avoiding this area. Development of this ridge may impede north-south movement in this area. The closest turbine here would be 1.06km from the river below and therefore, is not expected to have a large impact on use of the river corridor as a movement pathway. The isolation of habitats would not occur as the more extensive areas of woodland habitat, east of Pomeroy and Gurrundah, would not be affected. Refer to corridors, Figure 3-1.

Generally, given the existing level of disturbance within the study area, the habitats that would be directly and indirectly affected are not considered important to the long-term survival of any threatened species. The exceptions to this generality are the reptile habitats mapped out after the follow-up spring survey and the riparian corridor, south of Pomeroy.

The former areas have been identified as potential habitat and recommended for avoidance during construction works. For the of potential **Grassland Earless Dragon** habitat, avoidance was not possible. If this area was modified for the installation of a turbine and upgrade of the existing access track, the area’s habitat significance would be greatly reduced. While the area to be removed would be small (approximately 700m² for the turbine and 400m² for the access track), in terms of the species’ lifecycle and known movements, this impact would be considerable. The Recovery Plan for this species states that the movement of adult animals has been documented as up to 40m per day (Langston 1996), with some movements in excess of 230 m over longer periods. An upgraded track may therefore represent a barrier to dispersal for this species. Given the historic presence of this species in the area and the degree of decline suffered since settlement, if the species is present, this area would be highly important for the long-term persistence of this species. On account of the seriousness of the potential impact, the infrastructure has been repositioned on the periphery of the area, avoiding impact to the core area and thereby minimising the potential to fragment or reduce areas of better quality potential habitat.

The riparian corridor, south of Pomeroy, may be important due to the level of clearing in the broader landscape; riparian corridors become more important due to the refuge, foraging and breeding opportunities that the riparian vegetation provides in such landscapes. Given the distance that turbines would be from this corridor (no closer than 1.06km), the turbine does not appear to pose an unacceptable collision risk or be likely to alter use of this corridor, such that it would affect the long-term survival of any of the species considered. This area does suggest itself as an appropriate monitoring site to study the long-term effects of the operational wind farm on birds and bats in the locality.

- 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 recovery plan exists for the Large Forest Owls which includes the **Powerful Owl**. Relevant objectives include:

‘Ensure the impacts on large forest owls and their habitats are adequately assessed during planning and environmental assessment processes.’

‘Minimise further loss and fragmentation of habitat by protection and more informed management of significant owl habitat (including protection of individual nest sites).’

‘To raise awareness of the conservation requirements of the three large forest owls amongst the broader community, to involve the community in owl conservation efforts and in so doing increase the information base about owl habitats and biology.’

This assessment is designed to adequately assess the impact of the proposal on the Powerful Owl, among other species. The works would not affect habitat for this species directly and considering the pattern of clearing, the works are considered to have low potential to affect habitat or Powerful Owl movements indirectly. There is potential to increase the public awareness about this species during the assessment process, given the extensive public consultation involved in the Part 3A assessment process.

A national recovery plan exists for the **Grassland Earless Dragon** (this species is also listed at the national level). This plan identifies threats relevant to this proposal, including loss and fragmentation of habitat and degradation of habitat including changed fire regimes, grazing regimes, weed invasion, use of agricultural chemicals, rock removal, and the impacts of introduced animals. Most sites where this species is known to persist are subject to grazing by native and/or introduced herbivores, hence the continued grazing regime at the Gurrundah site is not considered to be a threat so long as the intensity is managed.

Relevant objectives of the recovery plan include:

‘to ensure the ability of *T. pinguicolla* to survive, flourish and maintain its potential for evolutionary development in the wild, across its natural geographic range. Implicit in this is the immediate objective of ensuring the long-term survival of the species throughout its extant distribution’.

After two search surveys (autumn and spring 2007) it has not been established that the area in question is inhabited by this species. However, cryptic species (adults of this species range in length from 50-70mm, snout to vent) and those that occur at low densities are difficult to detect (Bailey *et al.* 2004). An example of the cryptic nature of reptiles and the difficulty in detecting species presence is highlighted Thompson *et al.* 2003. Therefore, it is considered impractical to rule out the presence of this species within the area of identified potential habitat at north Gurrundah. On this basis, this evaluation assumes the species occurs, as a precautionary approach. On this assumption, as the site occurs within the geographic range of the species, loss or modification of this area would be in contravention of this objective.

No threat abatement plans are relevant to this proposal.

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.

Four identified Key Threatening Processes are relevant to this proposal:

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.

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, Cocksfoot, Yorkshire Fog, 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, although substantial serrated tussock infestations occur on Pomeroy, and could be spread by the soil disturbance associated with the construction phase.

Loss of Hollow-bearing Trees is listed as a Key Threatening Process. In NSW, terrestrial vertebrate species that are reliant on tree hollows for shelter and nests include at least 46 mammals, 85 birds, 32 reptiles and 16 frogs (Gibbons and Lindenmayer 1997, Gibbons and Lindenmayer 2002). Of these, 45 species are listed as threatened on Schedule 1 and Schedule 2 of the Threatened Species Conservation Act. By confining works to cleared areas and identifying and protecting hollow-bearing trees and their recruits onsite, the development would avoid increasing the impact of this Key Threatening Process in the area.

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

Conclusion

This assessment concludes that unacceptable impact to the EECs **White box- Yellow Box – Blakely's Red Gum Grassy Woodland** and **Tableland Basalt Forest** can be avoided. The existing remnants of the former are degraded and located in midslope positions that would not be the focus of works. Remnants of the latter can be avoided if large or in good quality and clearing of small, isolated degraded remnants would not constitute a significant impact. Impacts can be managed by way of an Environmental Management Plan that identifies areas to avoid when placing infrastructure and access routes and mitigates against soil, water and weed impacts that may indirectly affect these communities.

For the threatened birds and bats considered, **Glossy Black Cockatoo, Blue-billed Duck, Square-tailed Kite, Brown Treecreeper, Regent Honeyeater, Powerful Owl, Speckled Warbler, Gang-gang Cockatoo, Diamond Firetail, Superb Parrot, Eastern False Pipistrelle, Eastern Freetail Bat, Grey-headed Flying Fox and Common Bent-wing bat**, 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 difficult 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 and several of these species have characteristics that would increase the risk of collision, as discussed in point a). Although this assessment does not anticipate a population level impact, based on available information, it recognises it as a risk that must be addressed. An operational Environmental Management Plan that includes a monitoring program for collisions is recommended. 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. Standardised methodology and the public availability of data collected are recommended.

If the **Grassland Earless Dragon** is present in the location identified at Gurrundah north, a viable population of this species could be placed at risk of extinction by the development of a track and turbine through this location. If it is assumed that the species occurs, the habitat in question must be considered important, at risk of fragmentation and the proposed works in

contravention of the primary aim of the recovery plan for this species. It is recommended that the core area of potential habitat be avoided by works. Development of the periphery, which represents more marginal habitat, would be acceptable. Grazing should be managed in this area to preserve the existing habitat qualities. If this area cannot be avoided, the action should be referred to the Department of Environment and Climate Change.

E.2 Principal significant impact assessment (EPBC Act listed species and communities)

The *Environmental Protection and Biodiversity Conservation Act* 1999 specifies 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 the Commonwealth level. The following assessment characterises the significance of the likely impacts associated with the 'Gullen Range' Wind Farm on:

- The Endangered Ecological Communities **White Box - Yellow Box - Blakely's Red Gum Grassy Woodlands and Natural Temperate Grassland**,
- The threatened plant species **Hoary Sunray**,
- The threatened fauna species **Grassland Earless Dragon, Regent Honeyeater, Superb Parrot, Swift Parrot, Large-eared Pied Bat, Grey-headed Flying Fox**, and
- The listed migratory species **Regent Honeyeater, Fork-tailed Swift, White-throated Needletail, Rainbow Bee-eater, Satin Flycatcher, Rufous Fantail, Great Egret, Cattle Egret and Latham's Snipe**.

E2.1 EEC

White Box - Yellow Box - Blakely's Red Gum Grassy Woodlands

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 Endangered Ecological Community White Box - Yellow Box - Blakely's Red Gum Grassy Woodlands is unlikely to suffer a negative impact from the proposal. The occurrences of this community on the Gurrundah and Pomeroy locations are largely restricted to mid-slope positions which are unlikely to be developed. There may be some restrictions to access routes to avoid impacting on this community. The single occurrence of numerous mature Yellow Box trees on Pomeroy which does occur within the potential impact zone has a severely degraded understorey and is unlikely to fall within the definition of the EEC under Commonwealth legislation. It is assumed that turbines will be sited in areas which do not require the removal of large numbers of trees, so this area is unlikely to be directly affected. Adjacent pasture is too degraded by invasion of exotic species to fall within the definition of this EEC.

The Endangered Ecological Community Natural Temperate Grassland is unlikely to suffer a negative impact from the proposal. The single occurrence of this community on the "new" Kialla site is small and occurs in a drainage line which is unlikely to be developed, either as a turbine site or as part of an access route. All other native pasture is too degraded by invasion of exotic species to fall within the definition of this EEC, and is generally derived from clearing of woodland or forest rather than being natural grassland.

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. Nor is the potential habitat of White Box - Yellow Box - Blakely's Red Gum Grassy Woodlands likely to be significantly affected, since its principal habitat in the region appears to be lower to mid-slopes, not ridge tops.

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.

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 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. 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 EECs being necessitated by the proposal.

The invasion of native vegetation by exotic perennial grass is relevant to this proposal. The subject EECs in particular are vulnerable to the introduction and spread of perennial grasses such as African Love Grass, Serrated Tussock, Cocksfoot, Yorkshire Fog, Sweet Vernal 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 occurrences onsite are degraded to varying extents 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 EECs. The largely cleared, often exotic pasture areas proposed to be developed as turbine sites are of little or no value as habitat for the White Box - Yellow Box - Blakely's Red Gum Grassy Woodlands in the Goulburn area. No recovery plan has yet been prepared for this EEC. A Recovery Plan exists for Natural Temperate Grasslands. However, as the proposed development will avoid this small part of the site, no impacts are anticipated.

E2.2 Threatened flora

Hoary Sunray

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

Only a single plant³ was found within the potential impact zone on Gurrundah. The plant was located under a log, which provided some protection from grazing, suggesting that a population formerly occurred here but has been almost eliminated by grazing pressure. This species, as with most grassland or woodland daisies, does not have a long-lived soil seedbank, so it is unlikely that a reduction in grazing pressure would result in the return of the species to the site. A single plant does not constitute a viable population, and as the plant is relatively conspicuous it seems unlikely that at larger population occurs and was overlooked. The proposal is therefore very unlikely to lead to a decrease in the size of a population of this species.

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

The proposed development should not have a significant effect on potential habitat of the Hoary Sunray, given that this has been largely removed by grazing pressure.

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

The action would not have the effect of fragmenting habitat for the Hoary Sunray.

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

The largely cleared, often exotic pasture areas proposed to be developed as turbine sites are of little or no value as habitat for the Hoary Sunray in the Goulburn area.

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

As stated, the single specimen remaining does not constitute a population.

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?

As stated, the single specimen remaining does not constitute a population. Removal of this specimen is therefore not considered to generate a decline in this species at the local population level.

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?

The proposal is unlikely to require much clearing of native vegetation, since it utilises areas which are already largely cleared. With the implementation of weed and sediment control measures, this risk of this is low.

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

There is no National or State Recovery Plan for the Hoary Sunray.

³ Tentatively identified from a non-flowering specimen but assumed to be this taxon for the purpose of this report.

E2.3 Threatened fauna

Grassland Earless Dragon, Regent Honeyeater, Superb Parrot, Swift Parrot, Large-eared Pied Bat, Grey-headed Flying Fox.

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

The areas where turbines would be installed do not constitute quality habitat for any of the bird and bat species considered however, a risk assessment has determined that movements between areas of quality habitat may place these species at risk of collision with turbines. While the presence of the turbines may deter individuals from the immediate danger area, a risk remains that mortalities will occur, impacting on population size. There is potential for a long-term reduction in the size of a local population for all five subject species, as a result of ongoing fatal collisions with wind turbines, if collision rates are not monitored and long-term collision events are not mitigated.

Although there is a low amount of information available on bat migration routes, the site does not appear to be on a migration path for these species. Due to the speculation involved in the assessment, post-construction monitoring should be rigorously carried out to ensure turbines are shut down at appropriate times if large numbers of a threatened species are impacted.

For the **Grassland Earless Dragon**, an area of quality potential habitat would be modified. If present in the area during works, mortalities may result. The modification (including a small loss of potential habitat to develop a track and install a turbine) would lead to a reduction in available habitat. Coupled with expected mortalities, it could be expected that if a local population is present the action may result in a long-term decrease in the population size of this species.

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

The development of the wind farm would not reduce the area of occupancy for the bird and bat species considered. However, the presence of the turbines may influence the way these species use the site, by eliciting avoidance behaviour. Overall, the site is not considered to contain important resources for any of these species. The riparian corridor south of Pomeroy however, may constitute an important movement corridor. The distance between this area and the nearest turbine (1.06km) suggests that movement corridors will not be greatly impacted. This area does suggest itself as an appropriate monitoring site to study the long-term effects of the operational wind farm on birds and bats in the locality.

For the **Grassland Earless Dragon**, an area of quality potential habitat would be modified. The modification would include a small loss of potential habitat to develop a track and install a turbine (approximately 700m² for the turbine and 400m² for the access track). Therefore, if a local population is present, the action is anticipated to reduce the area of occupancy for this species. Repositioning of infrastructure to the periphery of the habitat would substantially reduce this risk.

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, however 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. These species are wide ranging and so the development would not be expected to fragment an existing population into two or more populations.

The installation of turbines along the spur at the southern boundary of Pomeroy may influence the north-south movement of birds and bats in this area but the pattern of existing woodland (located more extensively just east of this area) suggests that the impact would not be significant.

As discussed in the TSC Act Seven part test, point d), the development of a track in the area delineated as potential habitat for the Grassland Earless Dragon would be expected to fragment a local population, if a local population is indeed present in this location. As it has been determined that ruling out the presence of this species is impractical, given the survey effort that would be required to detect this cryptic species, this assessment assumes that the species is present.

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

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

Considering the extensive decline of the **Grassland Earless Dragon**, if this species is present, the area delineated in Gurrundah north could be considered critical to the survival of this species.

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

None of the bird or bat subject species are known to breed/reproduce onsite and given the marginal habitat available, this likelihood is considered to be low. Nearby more extensive woodland areas at Pomeroy and Gurrundah have greater potential for breeding. The location of the turbines is not expected to alter this potential.

As discussed above, for the **Grassland Earless Dragon**, modification of potential habitat at Gurrundah north would be expected to disrupt the lifecycle of a population, if it occurs onsite. Repositioning of infrastructure on the periphery of the habitat would substantially reduce this risk.

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?

Habitat that would be directly affected by the proposal is considered marginal with respect to the bird and bat subject species. The development may constitute a barrier to some species due avoidance behaviour but the large ranging movements of these species suggest that the proposal would not modify habitat to the extent that any of these species would decline.

As discussed above, for the **Grassland Earless Dragon**, modification of potential habitat at Gurrundah north would be expected to lead to a decline in this species, if this species occurs onsite.

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?

The pastures where development would be focussed are predominantly exotic. Weed and sediment erosion controls would be implemented as part of the development to ensure that existing infestations are treated and invasive species ingress is not exacerbated.

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

A recovery plan is available for the **Regent Honeyeater** states that the main causes for concern regarding this species centre on specialised habitat requirements, reductions in extent and quality of habitat, reliance on a small number of favoured sites, low population level and density. The development would not exacerbate known risks or be detrimental to recovery actions.

A recovery plan is available for the **Swift Parrot**. Factors affecting the status of the species include 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. Also, 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. The development may exacerbate known risks by altering use of habitat and by direct collision during over wintering in the local area. Monitoring is recommended by the recovery plan and would also be for this proposal.

A draft recovery plan for the **Superb Parrot** is currently in preparation by the Department of Environment and Water Resources.

As discussed in the TSC Act Seven part test, a recovery plan exists for the **Grassland Earless Dragon**. This plan identifies threats relevant to this proposal, including loss and fragmentation of habitat and degradation of habitat including changed fire regimes, grazing regimes, weed invasion, use of agricultural chemicals, rock removal, and the impacts of introduced animals. Most sites where this species is known to persist are subject to grazing by native and/or introduced herbivores, hence the continued grazing regime at the Gurrundah site is not considered to be a threat so long as the intensity is managed.

Relevant objectives of the recovery plan include:

‘to ensure the ability of *T. pinguicolla* to survive, flourish and maintain its potential for evolutionary development in the wild, across its natural geographic range. Implicit in this is the immediate objective of ensuring the long-term survival of the species throughout its extant distribution’.

After two search sessions (autumn and spring 2007) it has not been established that the area in question is inhabited by this species. However, cryptic species (adults of this species range in length from 50-70mm, snout to vent) and those that occur at low densities are difficult to detect (Bailey *et al.* 2004). An example of the cryptic nature of reptiles and the difficulty in detecting species presence is highlighted by Thompson *et al.* (2003). Therefore, it is considered impractical to rule out the presence of this species within the area of identified potential habitat at north Gurrundah. On this basis, this evaluation assumes the species occurs, as a precautionary approach. On this assumption, as the site occurs within the geographic range of the species, loss or modification of this area would be in contravention of this objective.

No other recovery plans for subject species have been drafted at this time. With monitoring and adaptive management to collision impacts at the site, the proposal is not anticipated to interfere with the recovery of these species.

E2.4 Migratory species

Regent Honeyeater, Fork-tailed Swift, White-throated Needletail, Rainbow Bee-eater, Satin Flycatcher, Rufous Fantail, Great Egret, Cattle Egret and Latham's Snipe.

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 range and manoeuvrability of the subject species, and the distances over which they range, the turbines are not be anticipated to impact the accessibility of important habitats. The installation of turbines along the spur at the southern boundary of Pomeroy may influence the north-south movement of birds and bats in this area but the pattern of existing woodland (located more extensively just east of this area) suggests that the impact would not be significant.

For the species that may breed in the area, breeding habitat would not be affected. Breeding habitat is more likely to occur in the more extensive woodlands patches which would not be directly affected by the development

- 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 are not encouraged further by the development.

- 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. There is also potential to affect foraging and movements for species that utilise more open habitats (Rainbow Bee-eater, Fork-tailed Swift, White-throated Needletail, Rufous Fantail). The Fork-tailed Swift and White-throated Needletail are both 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 the 'Gullen Range' wind farm 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. Habitat features identified by this report should be avoided. 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.

Specific to the **Grassland Earless Dragon**, it is recommended that the area of potential habitat at Gurrundah north be avoided by works. Grazing should be managed in this area to preserve the existing habitat qualities. If this area cannot be avoided, infrastructure should be placed on the periphery of the habitat only, to protect the core area of potential habitat.

APPENDIX F: BIRD RISK ASSESSMENT

F.1 Risk assessment

The following risk assessment investigates the risk to birds from the proposed wind farm development. 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 are considered.

Table F.-1 Bird species risk assessment

Species and risk factors	Behaviour and ecology	Risk
<p>Wedge-tailed Eagle <i>Aquila audax</i> 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.</p>	<p>Observed soaring over 30m at all sites excluding Gurrundah. 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. Mortalities for the related Golden Eagle in US attributed to the presence of prey around turbines (Thelander <i>et al.</i> 2003). Turbines with lower blade reaches were most deadly to Golden Eagles. Summer and winter had highest mortality rates (Thelander <i>et al.</i> 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).</p>	Mod.
<p>Nankeen Kestrel <i>Falco cenchroides</i> Observed onsite Forages in open country at blade height, family parties manoeuvre in air currents.</p>	<p>Observed at Bannister and Pomeroy soaring above 30m. Sedentary or nomadic. Soars around city buildings and spires (Pizzey 1985). Nests in tree hollows. Hollows are found in isolated paddock trees and in woodland fragments and more extensive areas of woodland at all sites.</p>	Mod.
<p>Brown Falcon <i>Falco berigora</i> Observed onsite Chases prey and dives at high speed Glides on air currents</p>	<p>Observed at Bannister and Pomeroy soaring above 30m. 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 <i>et al.</i> 2003).</p>	Mod.

Species and risk factors	Behaviour and ecology	Risk
<p>Australian Hobby <i>Falco longipennis</i> Observed onsite Forages in open country at blade height Fast determined pursuit of flying birds and insects</p>	<p>Few records exist in the local area however, this species was observed at Bannister soaring above 30m. Inhabits a 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.</p>	Mod.
<p>Fork-tailed Swift <i>Apus pacificus</i> Migrant, habitat may occur within the area</p>	<p>Forages over open country and nests in cliffs and tall trees. 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.</p>	Mod.
<p>White-throated Needle-tail <i>Hirundapus caudacutus</i> Migratory High-flying Vertical flight and diving displays May form large flocks</p>	<p>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.</p>	Low-mod.
<p>Swamp Harrier <i>Circus approximans</i> Known from the area Forages in open country at blade height</p>	<p>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. Little potential habitat in the immediate area.</p>	Low
<p>Brown Goshawk <i>Accipiter fasciatus</i> Known from the area Slips through trees and hedges to surprise prey Glides on air currents</p>	<p>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.</p>	Low

Species and risk factors	Behaviour and ecology	Risk
<p>Barn Owl <i>Tyto alba</i> Known from the area and other owl species Night-flying Forages in open country at blade height</p>	<p>Barn owls were not observed onsite.</p> <p>This species inhabits open forests, woodlands and grasslands with stands of timber, including farmlands. It 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.</p> <p>Owlet nightjars were observed at Bannister.</p> <p>Forest owls are generally confined to areas with tree cover, although dispersing juveniles may fly over open country. Highest density is expected at Pomeroy and Gurrundah, due to the extensive areas of forest.</p>	Low
<p>Tawny Frogmouth <i>Podargus strigoides</i> Known from the site. Night-flying</p>	<p>Observed at Bannister and Pomeroy.</p> <p>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 in timbered lowlands, and would generally occur below blade height.</p>	Low
<p>White-bellied Sea-Eagle <i>Haliaeetus leucogaster</i> Known from the area Soars on air currents, hovers low over prey, makes angled power dives, travels large distances overland.</p>	<p>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.</p>	Low
<p>Peregrine Falcon <i>Falco peregrinus</i> Known from the area Chases prey and dives at high speed Glides on air currents</p>	<p>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, or represent quality habitat for this species.</p>	Low
<p>Painted Snipe <i>Rostratula benghalensis</i> Migratory Potential habitat adjacent to site</p>	<p>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 in local lagoons. There are no local records.</p> <p>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.</p>	Low

Species and risk factors	Behaviour and ecology	Risk
<p>Latham's Snipe Japanese Snipe <i>Gallinago hardwickii</i></p> <p>Migratory Potential habitat adjacent to site</p>	<p>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).</p> <p>Habitat may be present in local lagoons. 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 site and be at risk of collision with wind turbines.</p>	Low
<p>White Ibis <i>Threskiornis molucca</i></p> <p>Known from the area May fly in groups, can be nomadic or migratory Night-flying</p>	<p>Can occur 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).</p> <p>Australian White Ibises and other waterbird species demonstrate crepuscular peaks of abundance (Hamilton <i>et al.</i> 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).</p> <p>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).</p> <p>Ibis and other waterbirds may travel large distances between local water bodies and those in Canberra. They probably use riparian corridors.</p>	Low
<p>Australian Wood Duck and other ducks <i>Checonetta jubata</i></p> <p>Known from the area Swift flight, possibly with poor manoeuvrability</p>	<p>Observed at Pomeroy and Gurrundah, above 30m.</p> <p>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 dams and drainage lines and therefore generally away from where turbines are proposed.</p>	Low
<p>White-faced Heron <i>Ardea novaehollandiae</i></p> <p>Known from the area May form winter flocks Tendency to perch on high trees or posts.</p>	<p>Observed at Pomeroy, above 30m.</p> <p>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.</p>	Low

Species and risk factors	Behaviour and ecology	Risk
<p>Satin Flycatcher <i>Myiagra cyanoleuca</i> Migrant, breeding likely to occur within the area.</p>	<p>Typically a species of densely vegetative gullies in tall forests (Pizzey and Knight 2003). 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.</p> <p>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.</p> <p>The Satin Flycatcher favours heavily vegetated gullies in forests and taller woodlands when breeding (Pizzey 1985). This species may breed in the study area,</p>	Low
<p>Rainbow Bee-eater <i>Merops ornatus</i> Known from site Migrant, suitable foraging habitat onsite.</p>	<p>Identified at Pomeroy and Gurrundah.</p> <p>A species of open woodlands and riverbanks. Foraging would 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 and there are few records of this conspicuous species from the area, it is unlikely that the site is on a migration pathway.</p>	Low.
<p>Great Egret <i>Ardea alba</i> and Cattle Egret <i>Ardea ibis</i> Migratory / dispersive, suitable habitat nearby.</p>	<p>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 also likely that long-distance movements would follow wetland corridors and thereby avoid the site.</p>	Low.

F.2 Conclusion

From the above assessment, no species was categorised as having high risk rating. Species categorised as having a moderate or low-moderate risk rating include:

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

For raptors, the risk is related primarily to foraging. There is potential to reduce this risk by managing the availability of prey beneath turbines onsite. The species which would be controlled in cleared areas beneath turbines include rabbits and lambs. Lambing near turbines would only be restricted if monitoring indicates increased collisions are attributable to the presence of lambs. No native species would be included in such a control program.

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 considered a non-mitigatable risk. The presence of the turbines may act to deter individuals from the immediate danger area. Furthermore, woodland to the east of Pomeroy and Gurrundah may be a more preferred movement pathway.

A level of risk remains that mortalities will occur. Monitoring is required to ensure that mortality levels do not reach unacceptable levels without action being taken. Appropriate actions may include:

- Controlling prey populations around turbines (as discussed above);
- Modifying habitat around turbines (removing water sources);
- Turning particular turbines off at certain times of the year (known migration times).

APPENDIX G: MATTERS OF NATIONAL SIGNIFICANCE REPORT

Environmental Reporting Tool

You are here: [Environment Home](#) > [ERIN](#) > [ERT](#)

20 June 2007 16:54

Database Report

This report includes places of national environmental significance that are registered in the Department of the Environment and Water Resources' databases, for the selected area. The information presented here has been provided by a range of groups across Australia, and the accuracy and resolution varies.

Search Type: Area
Buffer: 50 km
Coordinates: -34.50485,149.41428, -34.73261,149.41428,
 -34.73261,149.49718, -34.5048,149.49718



Report Contents: [Summary](#) >> [Details](#) >> [Caveat](#) >> [Acknowledgment](#)

Biodiversity

Threatened Species:	28
Migratory Species:	15
Listed Marine Species:	13
Invasive Species:	14
Whales and Other Cetaceans:	None
Threatened Ecological Communities:	2

Heritage

World Heritage Properties:	None
Australian Heritage Sites:	21

Wetlands

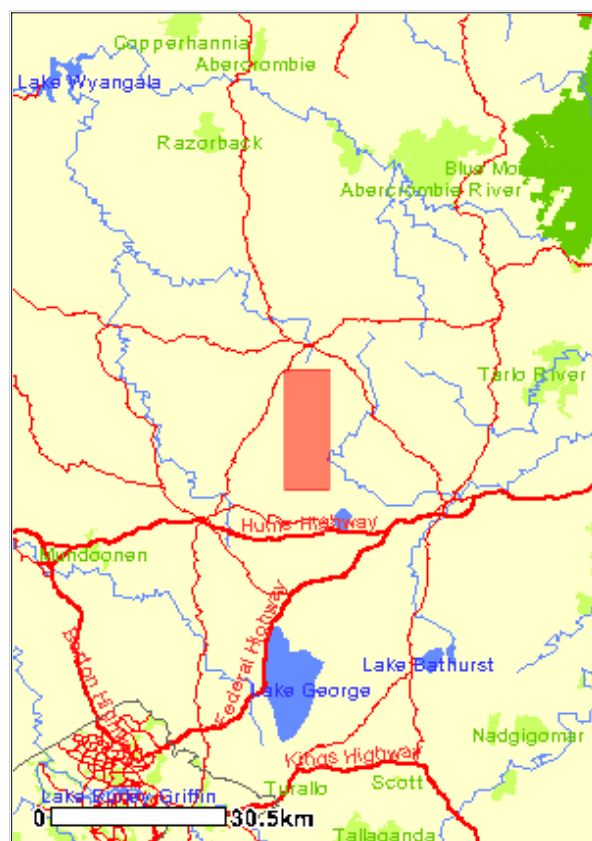
Ramsar sites: (Internationally important)	1
Nationally Important Wetlands:	2

National Pollutant Inventory

Reporting Facilities:	5
Airsheds:	1
Catchments:	3

Protected Areas

Reserves and Conservation Areas:	4
Regional Forest Agreements:	1



This map may contain data which are
 © Commonwealth of Australia (Geoscience Australia)
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Biodiversity

Threatened Species [[Dataset Information](#)] Status Comments

Birds

<u><i>Lathamus discolor</i></u> Swift Parrot	Endangered	Species or species habitat may occur within area
<u><i>Polytelis swainsonii</i></u> Superb Parrot	Vulnerable	Breeding likely to occur within area
<u><i>Rostratula australis</i></u> Australian Painted Snipe	Vulnerable	Species or species habitat may occur within area
<u><i>Xanthomyza phrygia</i></u> Regent Honeyeater	Endangered	Species or species habitat likely to occur within area

Frogs

<u><i>Litoria castanea</i></u> Yellow-spotted Tree Frog, Yellow-spotted Bell Frog	Endangered	Species or species habitat likely to occur within area
<u><i>Litoria littlejohni</i></u> Littlejohn's Tree Frog, Heath Frog	Vulnerable	Species or species habitat may occur within area

Insects

<u><i>Synemon plana</i></u> Golden Sun Moth	Critically Endangered	Species or species habitat likely to occur within area
----------------------------------------------------------------	-----------------------	--------------------------------------------------------

Mammals

<u><i>Chalinolobus dwyeri</i></u> Large-eared Pied Bat, Large Pied Bat	Vulnerable	Species or species habitat may occur within area
<u><i>Dasyurus maculatus maculatus (SE mainland population)</i></u> Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population)	Endangered	Species or species habitat may occur within area
<u><i>Nyctophilus timoriensis (South-eastern form)</i></u> Eastern Long-eared Bat	Vulnerable	Species or species habitat may occur within area
<u><i>Petrogale penicillata</i></u> Brush-tailed Rock-wallaby	Vulnerable	Species or species habitat may occur within area
<u><i>Pteropus poliocephalus</i></u> Grey-headed Flying-fox	Vulnerable	Species or species habitat may occur within area

Ray-finned fishes

<u><i>Maccullochella peelii peelii</i></u> Murray Cod, Cod, Goodoo	Vulnerable	Species or species habitat may occur within area
<u><i>Macquaria australasica</i></u> Macquarie Perch	Endangered	Species or species habitat may occur within area

Reptiles

<u><i>Aprasia parapulchella</i></u> Pink-tailed Worm-lizard	Vulnerable	Species or species habitat likely to occur within area
<u><i>Delma impar</i></u> Striped Legless Lizard	Vulnerable	Species or species habitat likely to occur within area
<u><i>Hoplocephalus bungaroides</i></u> Broad-headed Snake	Vulnerable	Species or species habitat likely to occur within area

Plants

<u><i>Ammobium craspedioides</i></u> Yass Daisy	Vulnerable	Species or species habitat likely to occur within area
--------------------------------------------------------------------	------------	--------------------------------------------------------

<u><i>Amphibromus fluitans</i></u> River Swamp Wallaby-grass	Vulnerable	Species or species habitat may occur within area
<u><i>Caladenia tessellata</i></u> Thick-lipped Spider-orchid, Daddy Long-legs	Vulnerable	Species or species habitat likely to occur within area
<u><i>Diuris aequalis</i></u> Buttercup Doubletail	Vulnerable	Species or species habitat likely to occur within area
<u><i>Diuris sheaffiana</i></u> Tricolour Diuris	Vulnerable	Species or species habitat may occur within area
<u><i>Dodonaea procumbens</i></u> Trailing Hop-bush	Vulnerable	Species or species habitat likely to occur within area
<u><i>Kunzea cabbagei</i></u>	Vulnerable	Species or species habitat likely to occur within area
<u><i>Lepidium hyssopifolium</i></u> Basalt Pepper-cress	Endangered	Species or species habitat likely to occur within area
<u><i>Leucochrysum albicans</i> var. <i>tricolor</i></u> Hoary Sunray	Endangered	Species or species habitat likely to occur within area
<u><i>Rutidosia leptorrhynchoides</i></u> Button Wrinklewort	Endangered	Species or species habitat likely to occur within area
<u><i>Thesium australe</i></u> Austral Toadflax, Toadflax	Vulnerable	Species or species habitat likely to occur within area
Migratory Species [Dataset Information]	Status	Comments

Migratory Terrestrial Species

Birds

<u><i>Haliaeetus leucogaster</i></u> White-bellied Sea-Eagle	Migratory	Species or species habitat likely to occur within area
<u><i>Hirundapus caudacutus</i></u> White-throated Needletail	Migratory	Species or species habitat may occur within area
<u><i>Merops ornatus</i></u> Rainbow Bee-eater	Migratory	Species or species habitat may occur within area
<u><i>Monarcha melanopsis</i></u> Black-faced Monarch	Migratory	Breeding may occur within area
<u><i>Myiagra cyanoleuca</i></u> Satin Flycatcher	Migratory	Breeding likely to occur within area
<u><i>Rhipidura rufifrons</i></u> Rufous Fantail	Migratory	Breeding may occur within area
<u><i>Xanthomyza phrygia</i></u> Regent Honeyeater	Migratory	Species or species habitat likely to occur within area

Migratory Wetland Species

Birds

<u><i>Ardea alba</i></u> Great Egret, White Egret	Migratory	Species or species habitat may occur within area
<u><i>Ardea ibis</i></u> Cattle Egret	Migratory	Species or species habitat may occur within area
<u><i>Charadrius bicinctus</i></u> Double-banded Plover	Migratory	Species or species habitat likely to occur within area

Gallinago hardwickii Latham's Snipe, Japanese Snipe	Migratory	Species or species habitat may occur within area
Rostratula benghalensis s. lat. Painted Snipe	Migratory	Species or species habitat may occur within area
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift	Migratory	Species or species habitat may occur within area
Ardea alba Great Egret, White Egret	Migratory	Species or species habitat may occur within area
Ardea ibis Cattle Egret	Migratory	Species or species habitat may occur within area
Listed Marine Species [Dataset Information]	Status	Comments
Birds		
Apus pacificus Fork-tailed Swift	Listed - overfly marine area	Species or species habitat may occur within area
Ardea alba Great Egret, White Egret	Listed - overfly marine area	Species or species habitat may occur within area
Ardea ibis Cattle Egret	Listed - overfly marine area	Species or species habitat may occur within area
Charadrius bicinctus Double-banded Plover	Listed - overfly marine area	Species or species habitat likely to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe	Listed - overfly marine area	Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle	Listed	Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail	Listed - overfly marine area	Species or species habitat may occur within area
Lathamus discolor Swift Parrot	Listed - overfly marine area	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater	Listed - overfly marine area	Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch	Listed - overfly marine area	Breeding may occur within area
Myiagra cyanoleuca Satin Flycatcher	Listed - overfly marine area	Breeding likely to occur within area
Rhipidura rufifrons Rufous Fantail	Listed - overfly marine area	Breeding may occur within area
Rostratula benghalensis s. lat. Painted Snipe	Listed - overfly marine area	Species or species habitat may occur within area
Invasive Species [Dataset Information]	Status	Comments

Selected Invasive Species: Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resources Audit, 2001.

Mammals

<u>Capra hircus</u> Goat	Feral	Species or species habitat may occur within area
<u>Felis catus</u> Cat, House Cat, Domestic Cat	Feral	Species or species habitat likely to occur within area
<u>Oryctolagus cuniculus</u> Rabbit, European Rabbit	Feral	Species or species habitat likely to occur within area
<u>Sus scrofa</u> Pig	Feral	Species or species habitat likely to occur within area
<u>Vulpes vulpes</u> Red Fox, Fox	Feral	Species or species habitat likely to occur within area

Plants

<u>Asparagus asparagoides</u> Bridal Creeper, Smilax	WoNS	Species or species habitat may occur within area
<u>Genista sp. X Genista monspessulana</u> Broom	Invasive	Species or species habitat may occur within area
<u>Lycium ferocissimum</u> African Boxthorn, Boxthorn	Invasive	Species or species habitat may occur within area
<u>Nassella neesiana</u> Chilean Needle-grass	WoNS	Species or species habitat may occur within area
<u>Nassella trichotoma</u> Serrated Tussock	WoNS	Species or species habitat may occur within area
<u>Pinus radiata</u> Monterey Pine, Radiata Pine	Invasive	Species or species habitat may occur within area
<u>Rubus fruticosus agg.</u> Blackberry	WoNS	Species or species habitat likely to occur within area
<u>Salix spp. except S.babylonica, S.X calodendron & S.X reichardtiji</u> Willows except Weeping Willow, Pussy Willow and sterile Pussy Willow	WoNS	Species or species habitat may occur within area
<u>Ulex europaeus</u> Gorse, Furze	WoNS	Species or species habitat may occur within area

Threatened Ecological Communities [
[Dataset Information](#)]

Status

Comments

[Natural Temperate Grassland of the Southern Tablelands of NSW and the Australian Capital Territory](#)

Endangered

Community likely to occur within area

[White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland](#)

Critically Endangered

Community likely to occur within area

Heritage

Australian Heritage Sites [
[Dataset Information](#)]
Note that not all Indigenous sites may be listed.

Historic

[Burrungurroolung Garden NSW](#)

[Burrungurroolung and Stables NSW](#)

[Collingwood Homestead NSW](#)

[Danganelly Farmhouse NSW](#)

[Frankfield Homestead Group NSW](#)[Goulburn Post Office NSW](#)[Lake Bathurst Public School \(former\) NSW](#)[Lockyersleigh NSW](#)[Norwood NSW](#)[Rossi Bridge NSW](#)[St James Chapel on Kippilaw NSW](#)[Tarago Railway Station NSW](#)[Tirranna - Gibson Family Cemetery NSW](#)[Tirranna, Garden, Farm Complex and Cemetery. NSW](#)[Towrang Bridge and Culverts NSW](#)[Towrang Convict Stockade & Magazine NSW](#)[Wollogorang Garden NSW](#)**Natural**[Fossil Leaf Beds Specimen NSW](#)[Lake George Quaternary Site NSW](#)[Mundoonen Nature Reserve NSW](#)[Tarlo River National Park \(1991 boundary\) NSW](#)

Wetlands

Wetlands of International Importance (Ramsar sites) [[Dataset Information](#)][FIVEBOUGH AND TUCKERBIL SWAMPS](#)

Within same catchment as Ramsar site


Nationally Important Wetland Sites [[Dataset Information](#)][Lake Bathurst, NSW](#)[Lake George, NSW](#)




National Pollutant Inventory

[NPI Location Report](#)Reporting Facility [[Dataset Information](#)]


Top Substance

Source

Substance emissions are ranked on a scale of 1-100: 1=lowest; 100=highest. Rankings are shown as: 


=0-25;  =26-50;  =51-75;  =76-100.

[Aboray Pty Ltd \(Hill and Co Goulburn Depot, Goulburn NSW \)](#)

Cumene
(1-methylethylbenzene)
 [Low]


Petroleum product storage and wholesaling.

[Caltex Petroleum Distributors Pty Ltd \(Caltex Goulburn Depot, Goulburn NSW \)](#)

Cumene
(1-methylethylbenzene)
 [Low]


Petroleum product wholesaling.

[Goulburn Mulwaree Council \(Goulburn Wastewater Treatment System, Goulburn NSW \)](#)

Total Phosphorus
 [Low]


Sewage treatment and effluent irrigation for agricultural use

[Goulburn Wool Scour Pty Limited \(Goulburn Wool Scour, Goulburn NSW \)](#)

Oxides of Nitrogen
 [Low]

wool scouring - washing shorn wool

[Southern Meats Pty Ltd \(Southern Meats Goulburn Abattoir, Goulburn NSW \)](#)

Ammonia (total)
 [Low]

Animal slaughter, rendering, livestock processing for export.

Airshed [Dataset Information]	Substances	Sources
Canberra, ACT	57	24
Catchment [Dataset Information]	Substances	Sources
Hawkesbury-Nepean River, NSW	2	10
Murray-Darling Basin, CW	2	10
Shoalhaven River, NSW	2	11

Other

Reserves and Conservation Areas [[Dataset Information](#)]

Abercrombie River National Park, NSW

Mundoonen Nature Reserve, NSW

Razorback Nature Reserve, NSW

Tarlo River National Park, NSW

Regional Forest Agreements [[Dataset Information](#)]

Note that all RFA areas including those still under consideration have been included.

Southern RFA, New South Wales

Caveat

The information presented here has been drawn from a range of sources, compiled for a variety of purposes. Details of the coverage of each dataset are included in the metadata [[Dataset Information](#)] links above.

Acknowledgment

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- [New South Wales National Parks and Wildlife Service](#)
- [Department of Sustainability and Environment, Victoria](#)
- [Department of Primary Industries, Water and Environment, Tasmania](#)
- [Department of Environment and Heritage, South Australia Planning SA](#)
- [Parks and Wildlife Commission of the Northern Territory](#)
- [Environmental Protection Agency, Queensland](#)
- [Birds Australia](#)
- [Australian Bird and Bat Banding Scheme](#)
- [Australian National Wildlife Collection](#)
- Natural history museums of Australia
- [Queensland Herbarium](#)
- [National Herbarium of NSW](#)
- [Royal Botanic Gardens and National Herbarium of Victoria](#)
- [Tasmanian Herbarium](#)
- [State Herbarium of South Australia](#)
- [Northern Territory Herbarium](#)
- [Western Australian Herbarium](#)
- [Australian National Herbarium, Atherton and Canberra](#)
- [University of New England](#)
- Other groups and individuals

[ANUCLiM Version 1.8, Centre for Resource and Environmental Studies, Australian National University](#) was used extensively for the production of draft maps of species distribution. The Department is extremely

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APPENDIX H: PHOTOGRAPHS

H.1 Kialla



H.2 Bannister



H.3 Pomeroy



H.4 Gurrundah

