5.3 VEGETATION MAPPING

5.3.1 Existing Vegetation Mapping

Two existing vegetation mapping datasets were reviewed for the Study Area; NPWS (2002) and Gellie (2005). The mapping undertaken by NPWS (2002) was based on a desktop assessment of broad geological types, average annual temperature and average annual rainfall, followed by a series of plot based surveys in different vegetation units. The Gellie (2005) mapping was based on analysis of existing plot data. Both mapping projects focussed on areas of woodland and mapped these areas relatively accurately.

The resolution of both datasets was appropriate for the current study, allowing initial stratification of the Study Area to be undertaken for ERM's flora and fauna surveys. However, the mapping does not distinguish between differing conditions and does not identify the areas of derived native grassland that occur throughout the Study Area. These areas are unmapped in both vegetation datasets. The two vegetation datasets also use different nomenclature, neither of which are directly related to BVTs. As a result, ERM ground truthed all the vegetation in the Study Area and identified vegetation communities in accordance with BVTs to be consistent with the BBAM.

NPWS (2002) identified five vegetation communities scattered through the Study Area:

- Blakelys Red Gum - Yellow Box Grassy Woodland;
- Themeda - Bothriochloa Grassland/Open Woodland;
- Red Stringybark Dry Shrub Forest;
- Red Stringybark - Joycea tussock grass dry shrub open forest; and
- Tableland Woodland/forest.

Gellie (2005) identified three vegetation communities scattered through the Study Area.

- Northern Slopes Dry Grass Woodland;
- Tableland Dry Grassy Woodland; and
- Northern Tablelands and Slopes Dry Shrub-Grass Forest.

The above vegetation communities have been matched with an equivalent BVT, based on the vegetation community descriptions in the literature and ground truthing in the Study Area. The relationships between the vegetation communities and the BVTs are shown in *Table 5.5*.

Table 5.5 Vegetation Community Associations

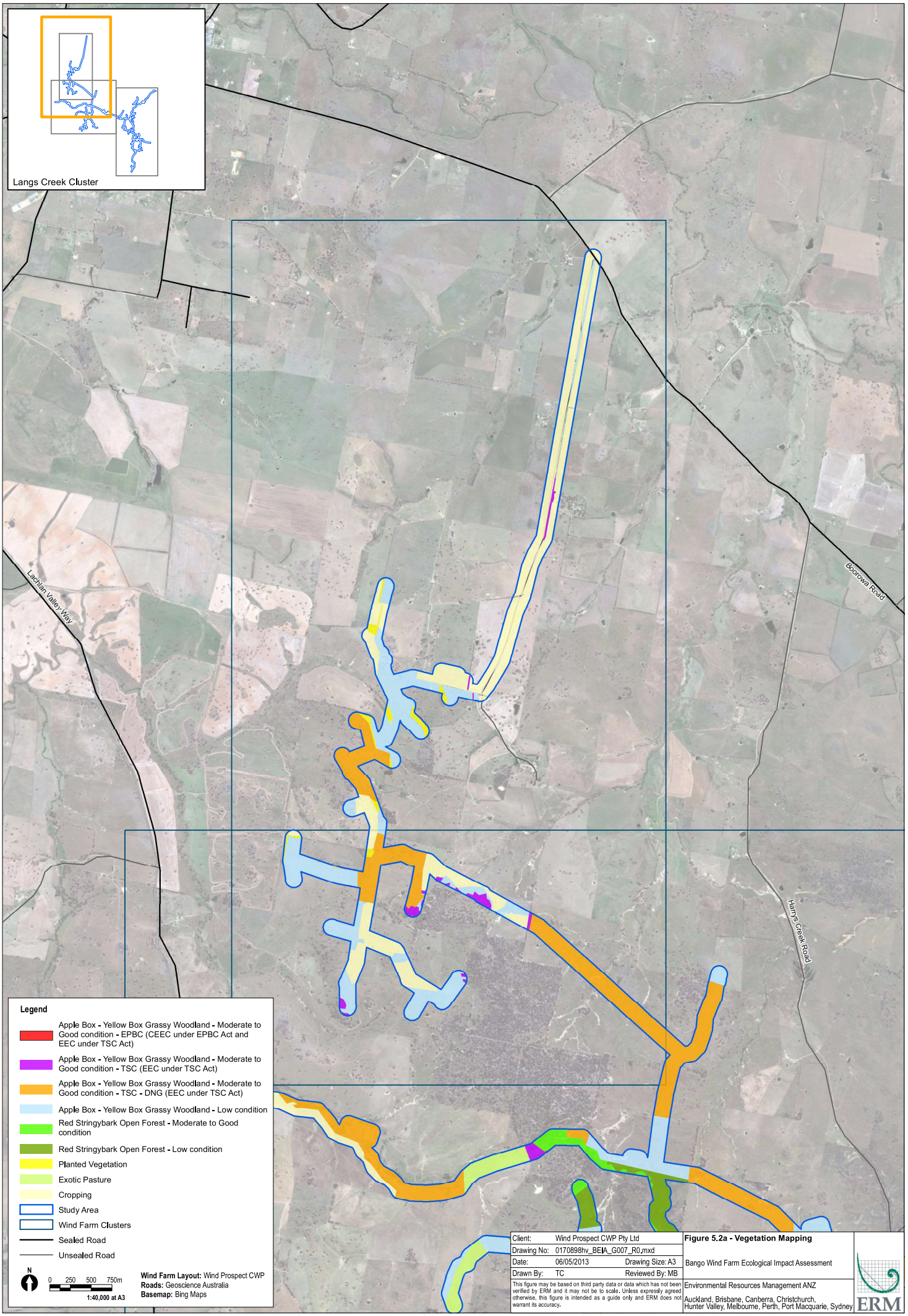
Vegetation Community	BioMetric Vegetation Type	Biometric Vegetation Type ID
Native Vegetation of the Boorowa Shire (NPWS 2002)		
• Blakelys Red Gum - Yellow Box Grassy Woodland • Themeda - Bothriochloa Grassland/Open Woodland	Apple Box - Yellow Box dry grassy woodland of the South Eastern Highlands	LA103
• Red Stringybark Dry Shrub Forest • Red Stringybark - Joycea tussock grass dry shrub open forest • Tableland Woodland/forest	Red Stringybark - Scribbly Gum - Red Box - Long-leaved Box shrub - tussock grass open forest the NSW South Western Slopes Bioregion	LA182
Native Vegetation of the Southern Forests (Gellie 2005)		
• Northern Slopes Dry Grass Woodland • Tableland Dry Grassy Woodland	Apple Box - Yellow Box dry grassy woodland of the South Eastern Highlands	LA103
• Northern Tablelands and Slopes Dry Shrub-Grass Forest	Red Stringybark - Scribbly Gum - Red Box - Long-leaved Box shrub - tussock grass open forest the NSW South Western Slopes Bioregion	LA182

5.3.2 *Vegetation Mapping Results*

Vegetation mapping undertaken by ERM identified five vegetation communities in the Study Area, including two BVTs. The five communities recorded within the Study Area were:

- Apple Box - Yellow Box dry grassy woodland of the South Eastern Highlands (Apple Box – Yellow Box Grassy Woodland);
- Red Stringybark - Scribbly Gum - Red Box - Long-leaved Box shrub - tussock grass open forest the NSW South Western Slopes Bioregion (Red Stringybark Open Forest);
- Exotic Pasture;
- Cropping; and
- Planted Vegetation (native and exotic).

The BVTs have been divided into different condition classes in accordance with the definitions provided in *Table 4.2*. The distribution of these vegetation communities is shown in *Figure 5.2*. The floristic composition and structure of each of these communities is described in *Section 5.3.3*.


Langs Creek Cluster
Lachlan Valley Way
Boorowa Road
Harms Creek Road
Legend
Apple Box - Yellow Box Grassy Woodland - Moderate to Good condition - EPBC (CEEC under EPBC Act and EEC under TSC Act)
Apple Box - Yellow Box Grassy Woodland - Moderate to Good condition - TSC (EEC under TSC Act)
Apple Box - Yellow Box Grassy Woodland - Moderate to Good condition - TSC - DNG (EEC under TSC Act)
Apple Box - Yellow Box Grassy Woodland - Low condition
Red Stringybark Open Forest - Moderate to Good condition
Red Stringybark Open Forest - Low condition
Planted Vegetation
Exotic Pasture
Cropping
Study Area
Wind Farm Clusters
Sealed Road
Unsealed Road
N
0 250 500 750m
1:40,000 at A3
Wind Farm Layout: Wind Prospect CWP
Roads: Geoscience Australia
Basemap: Bing Maps
Client: Wind Prospect CWP Pty Ltd
Drawing No: 0170898hv_BEIA_G007_R0.mxd
Date: 06/05/2013 Drawing Size: A3
Drawn By: TC Reviewed By: MB
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
Figure 5.2a - Vegetation Mapping
Bango Wind Farm Ecological Impact Assessment
Environmental Resources Management ANZ
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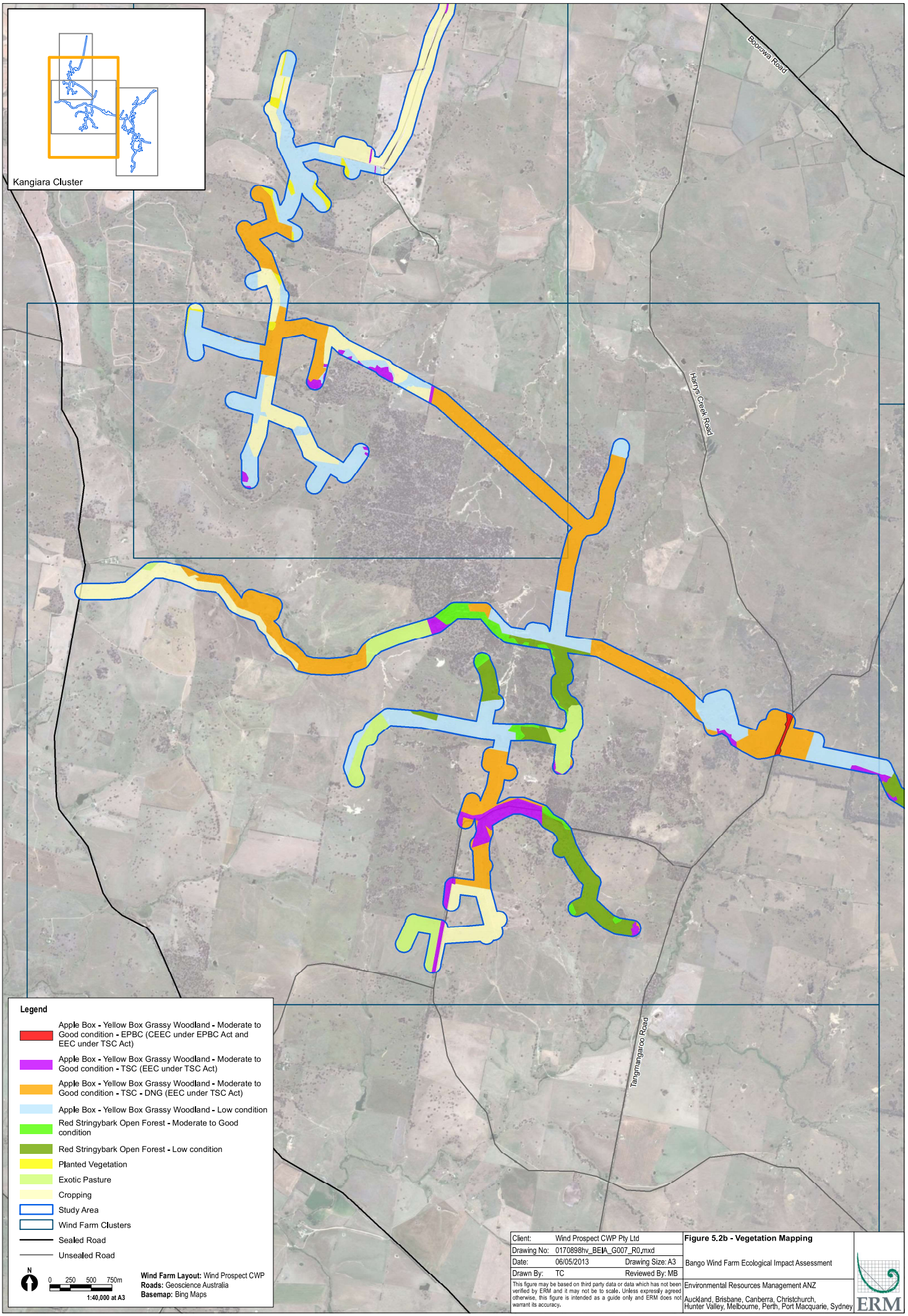
ERM


Kangiara Cluster
Boorowa Road
Harrys Creek Road
Tangmangaroo Road
Legend
Apple Box - Yellow Box Grassy Woodland - Moderate to Good condition - EPBC (CEEC under EPBC Act and EEC under TSC Act)
Apple Box - Yellow Box Grassy Woodland - Moderate to Good condition - TSC (EEC under TSC Act)
Apple Box - Yellow Box Grassy Woodland - Moderate to Good condition - TSC - DNG (EEC under TSC Act)
Apple Box - Yellow Box Grassy Woodland - Low condition
Red Stringybark Open Forest - Moderate to Good condition
Red Stringybark Open Forest - Low condition
Planted Vegetation
Exotic Pasture
Cropping
Study Area
Wind Farm Clusters
Sealed Road
Unsealed Road
N
0 250 500 750m
1:40,000 at A3
Wind Farm Layout: Wind Prospect CWP
Roads: Geoscience Australia
Basemap: Bing Maps
Client: Wind Prospect CWP Pty Ltd
Drawing No: 0170898hv_BEIA_G007_R0.mxd
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Reviewed By: MB
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Figure 5.2b - Vegetation Mapping
Bango Wind Farm Ecological Impact Assessment
Environmental Resources Management ANZ
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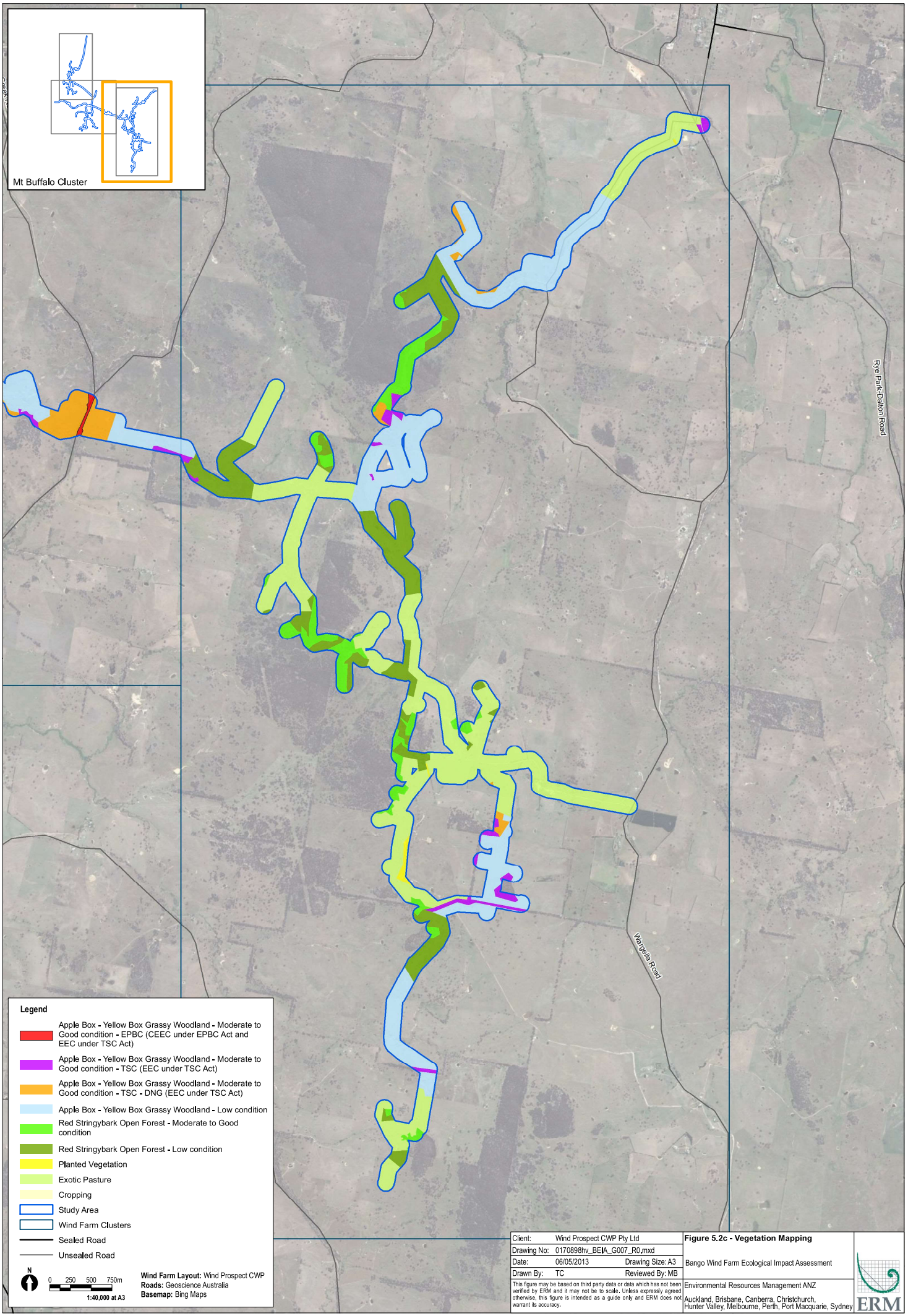
ERM


Mt Buffalo Cluster
Rye Park-Dalton Road
Wargeila Road
Legend
Apple Box - Yellow Box Grassy Woodland - Moderate to Good condition - EPBC (CEEC under EPBC Act and EEC under TSC Act)
Apple Box - Yellow Box Grassy Woodland - Moderate to Good condition - TSC (EEC under TSC Act)
Apple Box - Yellow Box Grassy Woodland - Moderate to Good condition - TSC - DNG (EEC under TSC Act)
Apple Box - Yellow Box Grassy Woodland - Low condition
Red Stringybark Open Forest - Moderate to Good condition
Red Stringybark Open Forest - Low condition
Planted Vegetation
Exotic Pasture
Cropping
Study Area
Wind Farm Clusters
Sealed Road
Unsealed Road
N
0 250 500 750m
1:40,000 at A3
Wind Farm Layout: Wind Prospect CWP
Roads: Geoscience Australia
Basemap: Bing Maps
Client: Wind Prospect CWP Pty Ltd
Drawing No: 0170898hv_BEIA_G007_R0.mxd
Date: 06/05/2013 Drawing Size: A3
Drawn By: TC Reviewed By: MB
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
Figure 5.2c - Vegetation Mapping
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ERM

5.3.3 Vegetation Community Descriptions

Apple Box – Yellow Box Grassy Woodland

The Apple Box – Yellow Box Grassy Woodland in the Study Area comprises a canopy dominated by Yellow Box (*Eucalyptus melliodora*). The main associated canopy species are Apple Box (*E. bridgesiana*) and Blakelys Red Gum (*E. blakelyi*). A mid-storey was not recorded in this vegetation type. The groundcover is dominated by native grasses such as Snowgrass (*Poa sieberiana*), Weeping Grass (*Microlaena stipoides*) and several species of Speargrass (*Austrostipa* sp.) and Wallaby Grass (*Rytidosperma spp.*).

In the Study Area, Apple Box – Yellow Box Grassy Woodland occurs on lower slopes and gullies (refer *Figure 5.2*). It is associated with the more fertile soils in the Study Area and, as these areas are conducive to agriculture, large areas of Apple Box – Yellow Box Grassy Woodland have been cleared and its distribution in the Study Area is patchy. It occurs as isolated remnants in paddocks and as narrow linear strips along public roads and paper roads. Apple Box – Yellow Box Grassy Woodland has a similar patchy distribution across the Locality.

The condition of Apple Box – Yellow Box Grassy Woodland varies across the Study Area from areas of intact grassy woodland to those comprising only a native grassy groundcover. The most intact occurrences comprise a canopy of mature Eucalypts of two or more species and a diverse groundcover of native grasses and herbs. These occurrences are restricted to narrow linear strips along public road reserves. Other relatively intact areas comprise a canopy of mature Eucalypts and a groundcover dominated by native grasses with very few native herbs. Occurrences of Apple Box – Yellow Box Grassy Woodland that are more degraded comprise stands of Yellow Box over a groundcover dominated by exotic pasture species.

Apple Box – Yellow Box Grassy Woodland also occurs as DNG, ie grassland areas where the majority of woody vegetation has been cleared, however, greater than 50% of the ground cover comprises indigenous grasses and forbs. The more intact areas of derived native grassland are dominated by native grasses, particularly Speargrass (*Austrostipa* sp.) and Wallaby Grass (*Rytidosperma spp.*) with scattered native herbs. Areas of derived native grassland that are more degraded comprise patches of Speargrass (*Austrostipa* sp.) and Wallaby Grass (*Rytidosperma spp.*) interspersed with patches of exotic pasture and very few native herbs.

The majority of the above occurrences of Apple Box – Yellow Box Grassy Woodland meet the criteria for listing as an EEC under the TSC Act (refer *Section 5.1.2* and *Figure 5.2*). A small proportion also meets the criteria for listing as a CEEC under the EPBC Act (refer *Section 5.1.2* and *Figure 5.2*).

Four condition classes are mapped for this BVT, as shown in *Table 5.6.*

Table 5.6 Condition Classes

Condition Class	Description	Area in Study Area (ha)	TEC
Apple Box – Yellow Box Grassy Woodland - Mod_Good-EPBC	Native over-storey percent foliage cover greater than 25% of the lower benchmark value; OR more than 50% of groundcover vegetation is indigenous species; AND Meets the definition for listing under the EPBC Act.	2.27	CEEC under the EPBC Act EEC under the TSC Act
Apple Box – Yellow Box Grassy Woodland - Mod_Good-TSC (See Photograph 5.1)	Native over-storey percent foliage cover greater than 25% of the lower benchmark value; AND Meets the definition for listing under the TSC Act.	65.27	EEC under the TSC Act
Apple Box – Yellow Box Grassy Woodland - Mod_Good-TSC-DNG (See Photograph 5.2)	More than 50% of groundcover vegetation is indigenous species; AND The majority of the woody vegetation has been cleared; AND Meets the definition for listing under the TSC Act.	313.00	EEC under the TSC Act
Apple Box – Yellow Box Grassy Woodland – Low	Native over-storey percent foliage cover less than 25% of the lower benchmark value; AND Less than 50% of groundcover vegetation is indigenous species.	469.57	-

Photograph 5.1 Yellow Box Grassy Woodland - Mod_Good-TSC

Photograph 5.2 Yellow Box Grassy Woodland - Mod_Good-TSC-DNG

Red Stringybark Open Forest

The Red Stringybark Open Forest comprises a canopy dominated by Red Stringybark (*Eucalyptus macrorhynca*) and *E. rossii* (Scribbly Gum). The mid-storey is sparse and comprises scattered low native shrubs such as Hoary Guinea-flower (*Hibbertia obtusifolia*), Urn Heath (*Melichrus urceolatus*) and Daphne Heath (*Brachyloma daphnoides*). The groundcover is sparse, comprising scattered Snowgrass and native herbs such as Twining Fringe Lily (*Thysanotus patersonii*), Tall Bluebell (*Wahlenbergia stricta* subsp. *stricta*) and a number of native orchids including the Waxlip Orchid (*Glossodia major*), Slender Sun Orchid (*Thelymitra pauciflora*), Pink Finger Orchid (*Caladenia carnea*) and Swan Greenhood (*Pterostylis cycnocephala*). In areas in which the canopy has been partially or completely removed, the groundcover is dominated by native grasses such as Speargrasses and Wallaby Grasses with patches of Kangaroo Grass (*Themeda australis*) and Nodding Blue Lily (*Stypandra glauca*).

Red Stringybark Open Forest is associated with skeletal soils and occurs on dry hills and crests of hills (refer *Figure 5.2*). In the Study Area, it is patchy and restricted to these landscape types.

The stands of Red Stringybark Open Forest that occur on crests of hills in the Study Area are generally undisturbed and comprise an intact canopy, mid-storey and groundcover of native species. Other occurrences have undergone clearing and comprise a canopy of scattered remnant Red Stringybark over a groundcover of native grasses. This vegetation type also occurs as DNG, dominated by Speargrasses and Wallaby Grasses with occasional Red Stringybark.

This BVT is not commensurate with any EECs or CEECs listed under the EPBC Act or the TSC Act.

Two condition classes are mapped for this BVT, as shown in *Table 5.7.*

Table 5.7 Condition Classes

Condition Class	Description	Area in Study Area (ha)	TEC
Red Stringybark Open Forest - Mod_Good (See Photograph 5.3)	Native over-storey percent foliage cover greater than 25% of the lower benchmark value; OR more than 50% of groundcover vegetation is indigenous species.	99.24	-
Red Stringybark Open Forest – Low	cover less than 25% of the lower benchmark value; AND Less than 50% of groundcover vegetation is indigenous species.	238.72	-

Photograph 5.3 Red Stringybark Open Forest - Mod_Good

Exotic Pasture

Exotic pasture comprises areas of grassland with greater than 75% exotic species and all or most of the indigenous vegetation has been removed (Benson 1996). Areas of pasture are widespread across the Study Area (refer *Figure 5.2*), particularly on lower slopes and gullies where the soil is generally more fertile. These areas have undergone pasture improvement and are dominated by exotic pasture species. They are predominantly used for cattle and sheep grazing. Common species in areas of exotic pasture include Clover species (*Trifolium* sp.), Sheep Sorrel (*Acetosella vulgaris*), Barley Grasses (*Hordeum* sp.), Rye Grass (*Lolium* sp.) and Brome species (*Bromus* sp.). Weed species such as Paterson's Curse (*Echium plantagineum*) and Scotch Thistle (*Onopordum acanthium*) are largely restricted to areas of exostic pasture. Where native species persist in areas of exotic pasture, they comprise scattered Speargrasses and Wallaby Grasses. Exotic pasture covers 415.38 ha of the Study Area.

Cropping

Cropping refers to areas that have previously or are currently undergoing intensive ploughing and cultivation of crops. Common crops in the area are wheat, oats, canola and triticale. These areas can include isolated native trees occurring as individuals or small stands of up to five trees. The native mid-storey and groundcover have been completely cleared and, due to the intensive nature of the ground disturbance, a native understorey is unlikely to regenerate naturally. Cropping covers 261.33 ha of the Study Area.

Planted Vegetation

Areas of planted vegetation include both native and exotic plantings and have been planted as wind breaks and erosion control measures. As such, planted vegetation generally occurs in linear narrow corridors. Exotic plantings almost exclusively comprise Pine Trees (*Pinus radiata*). Native plantings include both indigenous and non-indigenous species and comprise a mix of *Eucalyptus* and *Acacia* species. Areas of planted native vegetation are usually fenced off from livestock and as such, an understorey of native grasses occurs. Planted vegetation covers 15.37 ha of the Study Area.

5.3.4 Endangered Ecological Communities

The majority of the Apple Box – Yellow Box Grassy Woodland in the Study Area meets the description for White Box Yellow Box Blakely's Red Gum Woodland (Box-Gum Woodland), which is an EEC under the TSC Act (refer *Figure 5.2*). This includes 380.54 ha in the Study Area and 45.52 ha in the permanent Development Footprint.

The EEC is characterised by the presence of one or more of the following species: White Box (*Eucalyptus albens*), Yellow Box and Blakely's Red Gum. The EEC includes modified and degraded sites as follows:

- sites where the main canopy species are present, ranging from an open woodland formation to a forest structure and the groundcover is predominantly composed of exotic species; and
- sites where the canopy species have been removed and only the grassy groundlayer and some herbs remain (OEH 2012b).

The occurrences of Apple Box – Yellow Box Grassy Woodland in the Study Area were assessed against the *White Box Yellow Box Blakely's Red Gum Woodland Identification Guidelines* (NPWS undated) and the NSW Scientific Committee Final Determination (OEH 2011a). The majority of Apple Box – Yellow Box Grassy Woodland in the Study Area meets the criteria for Box-Gum Woodland listed under the TSC Act. This includes the areas that comprise a canopy of mature Eucalypts of two or more species and a diverse groundcover of native grasses and herbs, areas comprising a canopy of mature Eucalypts and a groundcover dominated by native grasses, stands of Yellow Box over a groundcover dominated by exotic pasture species and grasslands derived from Apple Box – Yellow Box Grassy Woodland.

A small proportion of the Apple Box – Yellow Box Grassy Woodland also meets the description for White Box - Yellow Box - Blakely's Red Gum grassy woodlands and derived native grasslands (Box-Gum Grassy Woodlands and Derived Native Grasslands), which is a CEEC under the EPBC Act (refer *Figure 5.2*). A total of 2.27 ha of the CEEC occurs in the Study Area, of which 0.26 ha occurs in the permanent Development Footprint. This is discussed in *Chapter 8*.

5.4 FLORA

5.4.1 General Description

Field investigations identified 127 flora taxa in the Study Area, 97 (76%) of which were indigenous and 30 (24%) of which are introduced (refer *Annex C*). Many of these species are characteristic of the open forests, grassy woodlands, derived native grasslands and pasture in the Locality. The most frequently occurring canopy species were Red Stringybark and Yellow Box and the most frequently occurring native groundcover species were Speargrasses and Wallaby Grasses. The exotic species recorded are common in areas of improved pasture.

5.4.2 Threatened Flora

One threatened flora species was recorded in the Locality during field surveys: Yass Daisy (*Ammobium craspedioides*) which is listed as Vulnerable under both the EPBC Act and TSC Act. A population comprising over 200 individuals was recorded approximately 750 m to the west of the Study Area in the Mt Buffalo Cluster (refer *Figure 5.3*).

A Likelihood of Occurrence Assessment was undertaken for the remaining species and 10 species are considered to be likely or have the potential to occur in the Study Area (refer to *Annex E*). The remaining species are considered unlikely to occur due to a lack of the species' preferred habitat within the Study Area (refer to *Annex E*).

5.4.3 Exotic Flora

Numerous exotic species occur in the Study Area, two of which are listed as Declared Noxious Weeds under the NW Act in both Boorowa and Yass Valley LGAs, as shown in *Table 5.8*. There are five declaration classes under the NW Act, each describing the type of threat the weed poses, its extent, potential to spread and control requirements. Species declared as Class 4 weeds pose a potentially serious threat to primary production, the environment or human health, are widely distributed and are likely to spread in the area or to another area. Their growth must be managed in a manner that reduces its numbers spread and incidence and continuously inhibits its reproduction (Department of Primary Industries (DPI) 2013).

Table 5.8 **Declared Noxious Weeds in the Study Area**

Scientific Name	Common Name	Declaration Class	Location
Echium sp.	Paterson's Curse	4	Scattered in grazed / ploughed paddocks
Onopordum acanthium	Scotch Thistle	4	Scattered in grazed / ploughed paddocks

Langs Creek Cluster

Lachlan Valley Way

Boorowa Road

Harrys Creek Road

Legend

- Superb Parrot
- Brown Treecreeper
- Varied Sittella
- Scarlet Robin
- Wedge-tailed Eagle
- Diamond Firetail
- Grey-crowned Babbler
- Speckled Warbler
- Little Eagle
- Rainbow Bee-eater
- Yellow-bellied Sheathtail Bat
- Eastern bentwing Bat
- Squirrel Glider
- Yass Daisy
- Golden Sun Moth
- Wedge-tailed Eagle Nest
- Study Area
- Wind Turbines Layout 1
- Wind Turbines Layout 2
- Overhead Electrical Lines
- Access Tracks
- Substation Options
- Site Compounds
- Wind Farm Clusters
- Sealed Road
- Unsealed Road

N

0 250 500 750m

1:40,000 at A3

Wind Farm Layout: Wind Prospect CWP
Roads: Geoscience Australia
Basemap: Bing Maps

Client:	Wind Prospect CWP Pty Ltd		
Drawing No:	0170898hv_BEIA_G008_R0.mxd		
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Drawn By:	TC	Reviewed By: MB	

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Figure 5.3a - Threatened Flora and Fauna Observations

Bango Wind Farm Ecological Impact Assessment

Environmental Resources Management ANZ

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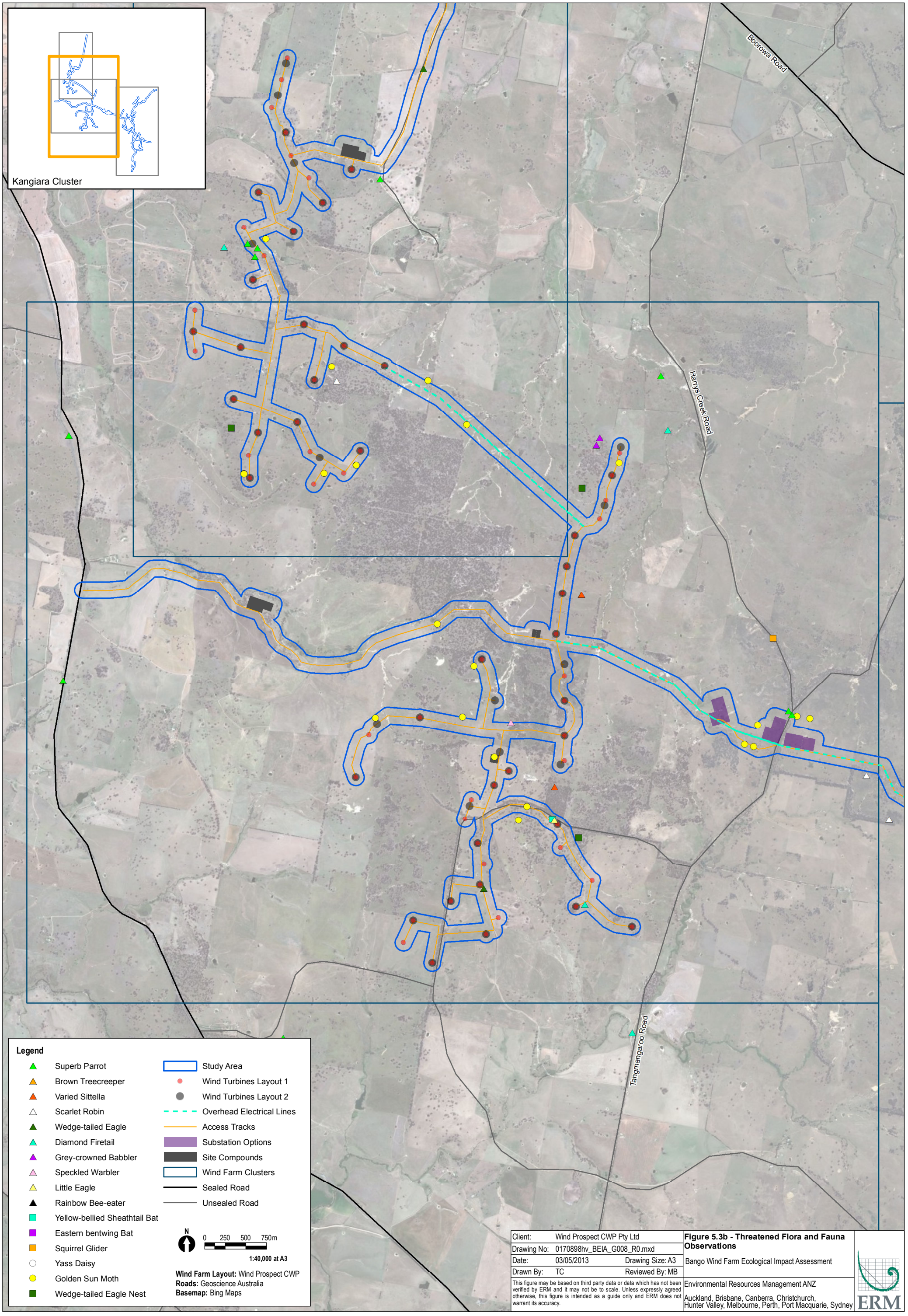
Kangiara Cluster
Boorowa Road
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Tangmangaroo Road
Legend
Superb Parrot
Brown Treecreeper
Varied Sittella
Scarlet Robin
Wedge-tailed Eagle
Diamond Firetail
Grey-crowned Babbler
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Rainbow Bee-eater
Yellow-bellied Sheathtail Bat
Eastern bentwing Bat
Squirrel Glider
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Figure 5.3b - Threatened Flora and Fauna Observations
Bango Wind Farm Ecological Impact Assessment
Environmental Resources Management ANZ
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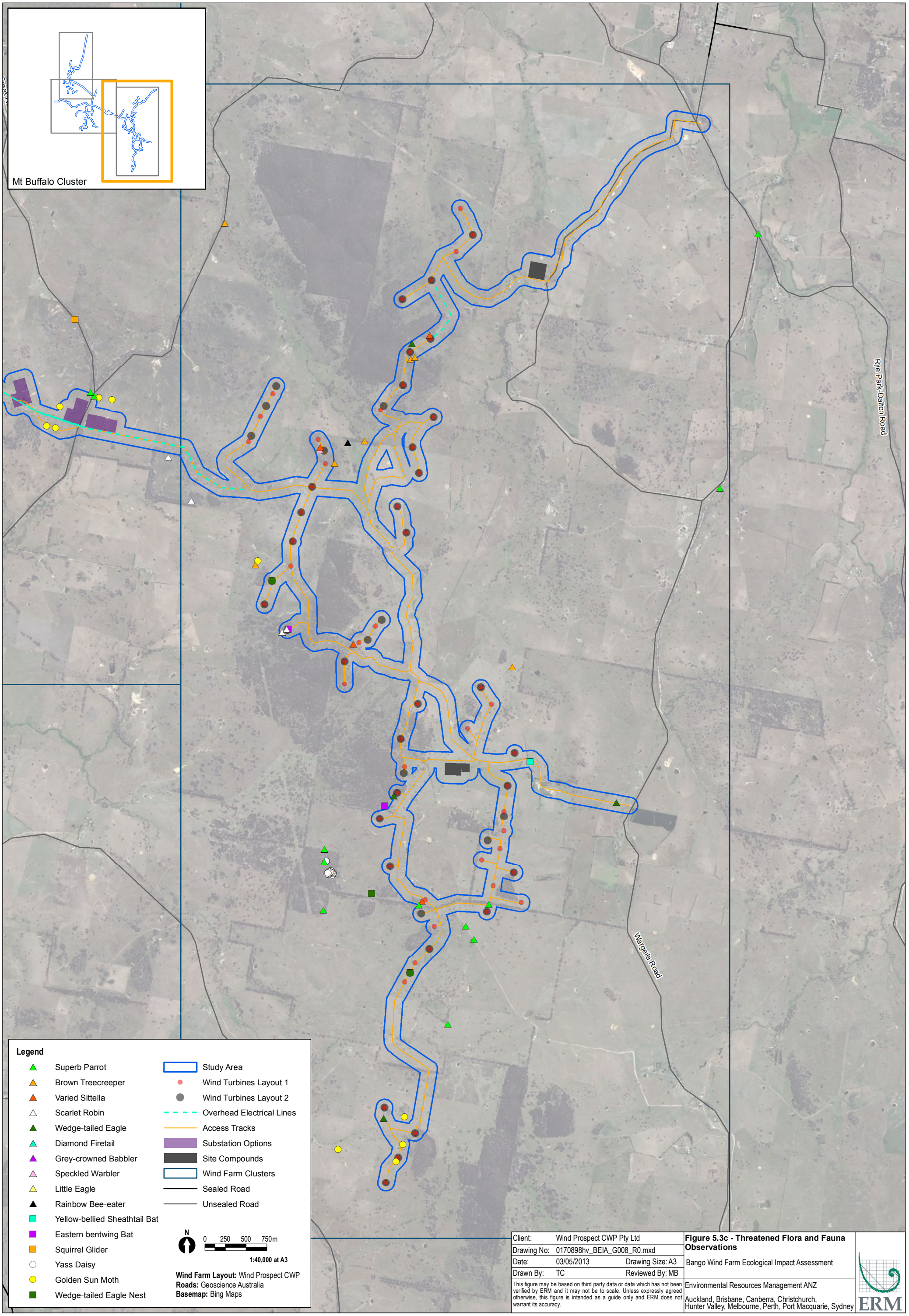
ERM


Mt Buffalo Cluster
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Grey-crowned Babbler
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Figure 5.3c - Threatened Flora and Fauna Observations
Bango Wind Farm Ecological Impact Assessment
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5.5 *FAUNA HABITAT*

Fauna habitat types in the Study Area comprise native woodlands, native grasslands, exotic grasslands and aquatic habitats. Within these habitat types, a variety of fauna habitat features exist, including hollow bearing trees, paddock trees, tussock grasslands, disused mines, farms dams and creek lines.

During the survey period approximately 313 ha of Native Grassland, 166.78 ha of Native Woodland and 708.29 ha of Exotic Grassland habitats were recorded within the Study Area (*Table 5.9*), habitat types and features within these habiat types are discussed in the following sections.

Table 5.9 Fauna Habitats Recorded in Study Area

Habitat type	Area in Study Area (ha)	Condition
Native Grassland	313	Moderate to good, has been impacted by grazing insome places.
Native Woodland	166.78	Moderate to good in places
Exotic Grassland	708.29	Moderate to degraded in places
Total	1188.07	
Native Grassland habitat is made up of BVT Box Gum Woodland Moderate to Good DNG		
Native Woodland is made up of BVT's Box Gum Woodland Mod –Good and Red Stringybark Open Forest Mod – Good		
Exotic Grassland consists of BVT's, Box Gum Woodland-Low and Red Stringybark Open Forest-Low		

5.5.1 *Native Woodlands*

Native woodland habitat is commensurate with the following BVT condition classes:

- Apple Box – Yellow Box Grassy Woodland - Mod_Good-EPBC;
- Apple Box – Yellow Box Grassy Woodland - Mod_Good-TSC; and
- Red Stringybark Open Forest - Mod_Good.

Within the Study Area, woodland habitat generally occurs in small scattered patches and linear corridors along roadsides. Some of the woodland patches in the Study Area are part of larger tracts of woodland that extend beyond the Study Area. These larger tracts occur in the Kangiara and Mt Buffalo clusters.

Habitat features in areas of Apple Box – Yellow Box Grassy Woodland include foraging, breeding and shelter resources such as a variety of nectar and / or seed producing native species, hollow bearing trees, grassy groundcover, fallen logs, leaf litter and occasional small areas of exposed rock (see *Photograph 5.4*). Some patches of Apple Box – Yellow Box Grassy Woodland have a degraded understorey and features such as a native grassy groundcover and leaf litter are reduced.

Areas of Red Stringybark Open Forest also include a variety of nectar and / or seed producing native species, hollow bearing trees, fallen logs and leaf litter. These areas also comprise a sparse shrub layer and areas of exposed rock are abundant.

Areas of planted native vegetation also provide habitat resources for native species as they comprise nectar and / or seed producing plants for foraging and shelter. These areas also comprise stepping stones between areas of native woodland habitat.

Photograph 5.4 Remnant Apple Box – Yellow Box Grassy Woodland

5.5.2 Native Grasslands

Native grassland habitat is commensurate with the following BVT condition classes:

- Apple Box – Yellow Box Grassy Woodland - Mod_Good-TSC-DNG; and
- Apple Box – Yellow Box Grassy Woodland – Low; and

- Red Stringybark Open Forest - Low.

Grassland habitat is widespread in the Study Area, covering the majority of lower slopes and valleys. Areas of Apple Box – Yellow Box Grassy Woodland - Mod_Good-TSC-DNG comprise the most intact native grassland habitats, with a high proportion of native grasses and some native herbs providing foraging resources (see *Photograph 5.5*). Tussock forming native grasses also occur, providing shelter for a variety of native species. The Apple Box – Yellow Box Grassy Woodland – Low and Red Stringybark Open Forest – Low have a reduced native grass component, however, they still comprise a foraging and shelter resource.

Other habitat features in native grasslands comprise scattered paddock trees with hollows, scattered fallen logs and areas of exposed rock.

Photograph 5.5 Native Grassland Habitat

5.5.3 Exotic Grasslands

Exotic grasslands are commensurate with the areas mapped as exotic pasture and cropping. The native and exotic grasses and herbs that occur in the exotic pasture areas provide a foraging resource for native species. When areas of cropping are seeding, this provides an abundant foraging resource for native species (see *Photograph 5.6*). Scattered hollow bearing trees and some areas of exposed rock also occur in these areas.

Photograph 5.6 Exotic Grassland Habitats (Cropping)

5.5.4 Hollow bearing trees

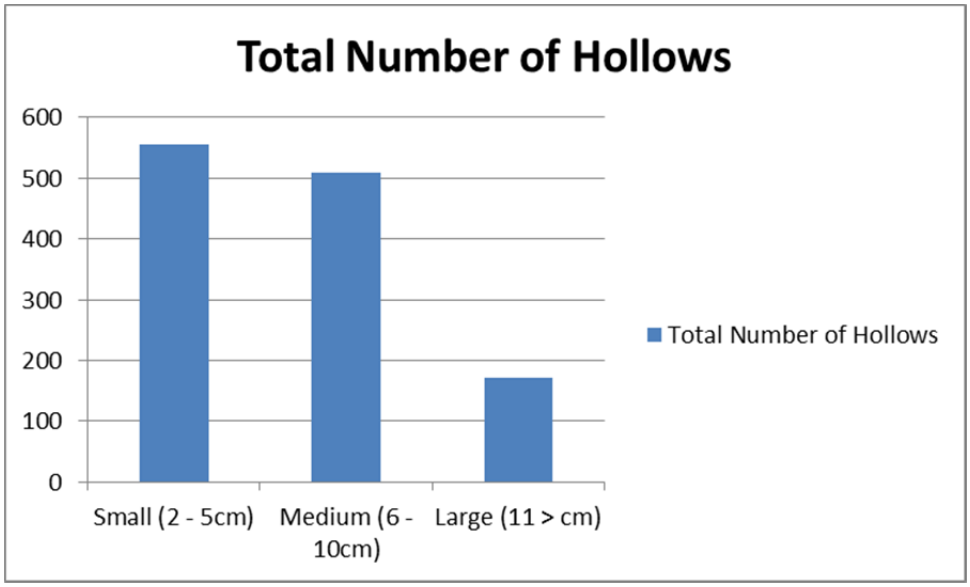
Hollow bearing trees within the Study Area are found in remnant woodland and on pastoral land as scattered paddock trees. The total area surveyed for hollow bearing trees was approximately 4981 ha. A total of 449 hollow bearing trees were identified within 500 m of proposed turbine locations (refer *Figure 5.5*). A total of 1237 hollows were recorded, made up of 556 Small hollows, 509 medium hollows and 172 large hollows. The hollow bearing tree density in the area surveyed equates to an overall value of approximately 0.09 hollow bearing trees per hectare. However, the density of hollow bearing trees in undisturbed woodland was closer to 7–17 hollow-bearing trees per hectare (OEH 2012).

The dominant hollow bearing tree species were Scribbly Gum, Red Stringybark, Yellow Box and Blakely's Red Gum. Hollow bearing trees provide important roosting habitat for arboreal mammals such as Possums and Squirrel Gliders, as well as insectivorous bats, Superb Parrots, and large forest owls. A breakdown of the data collected is shown in *Table 5.10*. The distribution of the total number of hollows in their respective size classes is represented in *Figure 5.5*.

Table 5.10 Breakdown of Tree Hollow Data

Size Class	Small (2 - 5cm)	Medium (6 - 10cm)	Large (11 > cm)
Total number of hollows	556	509	172
Average height of hollow (m)	5.4	4.1	2.4
Height range min (m)	2	3	2
Height range max (m)	11	9	9

Figure 5.4 Distribution of Hollows recorded by Size Classes



5.5.5 Exposed rock

Areas of exposed rock occur on hill tops and slopes and within paddocks in the Study Area. The majority of the exposed rock consisted of granite outcrops on the hills and slopes. These rocks provide habitat for reptile species, such as Cunningham's Skink (*Egernia cunninghami*) as shown in *Photograph 5.7.* The majority of the properties surveyed during the survey period had isolated outcrops of rocks. Most of the woodland slopes were rocky and the presence of the rock has dictated the landuse in these areas. Many of the hills and slopes that had been cleared for grazing have substantial rock areas and shallow soils and are not suitable for cropping. Habitat for the Pink-tailed Worm-lizard in these areas is limited due to the quality of the habitat which has been impacted by the historical landuse in these areas. The area has a long farming history and as such, many of the areas of rocky habitat have been heavily grazed over long periods of time.

Photograph 5.7 Cunningham's Skink (Egernia cunninghamii) on rock outcrop

5.5.6 Farm dams

Many farm dams occur within the Study Area. The majority of these are small and have limited to no fringing vegetation, however, they provide habitat for water bird species including the Eurasian Coot (*Fulica atra*), Grey Teal (*Anas gracilis*) and Australasian Grebe (*Tachybaptus novaehollandiae*), and are a drinking water source for a variety of native species. The majority of the farm dams investigated during the field survey have a long history of being used for stock watering and as such, limited habitat remains to support threatened amphibian species such as the Growling Grass Frog.

5.5.7 Creek lines

Creeklines and drainage lines were observed and investigated during the surveys. These streams are predominantly ephemeral in nature and may provide habitat for amphibian species such as the Striped Marsh Frog (*Limnodynastes peronii*) and Spotted Grass Frog (*Limnodynastes tasmaniensis*). The areas investigated on the higher slopes were steep drainage lines. These areas are ephemeral with rocky substrate as bed, and any small pondages of water quickly dried up during the survey period. The creek line in the lower area along Tangmangaroo Road had more permanent pools with a sandy substrate on the bed, vegetation in the riparian area was a mixture of native and exotic species. The flow in this creek was very slow and by the end of the survey period flow had decreased substantially. Due to the ephemeral nature of the creeks and the lack of key habitat features within the Study Area it is unlikely that these areas would provide suitable habitat to support the Booroolong Frog (*Litoria booroolongensis*).

5.5.8 Tussock grasslands

Tussock grasslands provide important habitat for reptile species including the Striped Legless Lizard, as well as the Golden Sun Moth. Tussock forming grass species in the Study Area include Kangaroo Grass (*Themeda australis*), Speargrasses, Poa Tussocks (*Poa sp.*), and Wallaby Grasses. Areas of native grass within the Study Area are derived from Apple Box – Yellow Box Grassy Woodland and Red Stringybark Open Forest.

5.5.9 Disused Mines

Two disused mines were identified in the Study Area. Both of these mines were located on the Taree property and appeared to be shallow and collapsed (*Photograph 5.8*). The mines were probably established in the 1950s and have been unused for the better part of 40 years (Malcolm Curthoy pers. comm 2012). As such, one of the mines entrances was collapsed and another was a vertical entrance that had filled with water. The mines were investigated for signs of occupation by fauna species. Stagwatching and Anabat detectors were deployed in proximity to the mine entrances. Very little activity was recorded from these sites. Such low activity would indicate that the disused mines were not being utilised as roosts for fauna species at the time of the surveys. From these investigations it was concluded unlikely that these mines would provide suitable roost sites for cave dependant bat species such as the Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis).*

Photograph 5.8 Disused Mine (Taree property)

5.5.10 *Superb Parrot Habitat Enhancement Sites*

Greening Australia Capital Region has assisted several landholders within the Study Area to establish Superb Parrot habitat enhancement sites. Enhancement included revegetation, remnant protection, or patch enhancement and restricted grazing. Three landholders within the Study Area currently have Superb Parrot habitat enhancement sites on their properties and ten additional sites within 6 km of the Study Area have also been established by Greening Australia Capital Region.

5.6 *INVERTEBRATES*

Targeted surveys were undertaken for the Golden Sun Moth (GSM), which is listed as Critically Endangered under the EPBC Act and Endangered under the TSC Act. A total of 103 male GSM and one female GSM (see *Photograph 5.9*) were recorded at 22 sites during the survey period, as shown in *Figure 5.3.* The highest number of GSM observed at a given site was 23 individuals, with the majority of sites having 10 or fewer GSM.

Photograph 5.9 Female GSM recorded in the Study Area

5.7 *FROGS*

Frog searches were undertaken in areas of observed habitat and microhabitat both on foot and by vehicle, and frogs were regularly captured in pitfall traps. The target species for the surveys were the Boorroolong Frog (*Litoria booroolongensis*) and the Growling Grass Frog (*Litoria raniformis*). A total of 132 frogs from seven species were recorded during field surveys. This includes 124 frogs captured in pitfall traps, and eight frogs observed during nocturnal frog searches. None of the target threatened frog species were observed during field surveys. *Table 5.11* lists the species recorded during the field surveys. The most commonly recorded species was the Spotted Grass Frog (*Limnodynastes tasmaniensis*), followed by the Smooth Toadlet (*Uperoleia laevigata*) and Eastern Pobblebonk (*Limnodynastes dumerilii*) (see *Photograph 5.10*). The least common species recorded was the Peron's Tree Frog (*Littoria peronii*).

Table 5.11 Frog species recorded

Scientific Name	Common Name	TSC Status	EPBC Status
Crinia parinsignifera	Beeping Froglet	-	-
Crinia Signifera	Common Eastern Froglet	-	-
Limnodynastes dumerilii	Eastern Pobblebonk	-	-
Limnodynastes peroni	Striped Marsh Frog	-	-
Limnodynastes tasmaniensis	Spotted Grass Frog	-	-
Littoria peronii	Peron's Tree Frog	-	-
Uperoleia laevigata	Smooth Toadlet	-	-

Photograph 5.10 Eastern Pobblebonk (Limnodynastes dumerilii)

5.8 REPTILES

A total of 12 reptile species were recorded. Trapping recorded a total of 38 individuals from five species, with seven additional species observed during surveys (*Table 5.12*). The most commonly trapped species in pitfall traps was the Southern Rainbow Skink (*Carlia tetradactyla*). The majority of these captures were from the Taffs Hill pitfall arrays. The Patternless Delma (*Delma inornata*) was also captured at the Taff's Hill pitfall arrays (see *Photograph 5.11*). One Lace Monitor (*Varanus varius*) was also recorded by a remote camera (see *Photograph 5.12*). No threatened reptiles were observed during field surveys.

Table 5.12 Reptiles recorded

Scientific Name	Common Name	EPBC Status	TSC Status
Carlia tetradactyla	Southern Rainbow skink	-	-
Delma inornata	Patternless Delma	-	-
Lampropholis Delicata	Dark-flecked Garden Sunskink	-	-
Morethia boulengeri	South-eastern Morethia Skink	-	-
Egernia cunninghamii	Cunningham's Skink	-	-
Ctenotus taeniolatus	Copper-tailed Skink	-	-
Pogona barbata	Eastern Bearded Dragon	-	-
Pseudechis porphyriacus	Red-bellied Black Snake	-	-
Pseudonaja textilis	Eastern Brown Snake	-	-
Tiliqua rugosa	Shingleback	-	-
Tiliqua scincoides	Blue Tongue Skink	-	-
Varanus varius	Lace Monitor	-	-

Photograph 5.11 Patternless Delma (Delma inornata)

Photograph 5.12 Lace Monitor recorded using remote camera

5.9 BIRDS

Field surveys identified a total of 108 species of birds, 104 of which were native Australian birds. The BUS identified over 1300 individuals. Bird surveys conducted in woodland or adjacent to woodland areas recorded 99 species of bird. A full list of the species recorded is included in *Annex C.*

5.9.1 Threatened Birds

Eight threatened species and one migratory bird species, Rainbow Bee-eater (*Merops ornatus*) (see *Photograph 5.13*) were identified within the Study Area (refer to *Table 5.13* and *Figure 5.3*). The Diamond Firetail (*Stagonopleura guttata*) and Superb Parrot were the most commonly encountered threatened species. Superb Parrot was observed at numerous locations across the Study Area during the breeding season, however, it was not recorded after the end of the breeding season. The Diamond Firetail was regularly observed in small flocks in low roadside vegetation, particularly along Harry's Creek Road and Tangmangaroo Road, and also in the eastern parts of the Study Area. A group of eight or more Grey-crowned Babblers (*Pomatostomus temporalis temporalis*) were observed on a property within the Langs Creek Cluster on a western facing hill in an open area with scattered woodland. The Varied Sittella (*Daphoenositta chrysoptera*) and Brown Treecreeper (*Climacteris picumnus victoriae*) were observed in both woodland habitats as well as in paddock trees adjacent to woodland. The Scarlet Robin (*Petroica boodang*) was only observed in woodland areas.

Table 5.13 Threatened and Migratory Bird Species recorded in the Study Area

Scientific Name	Common Name	EPBC Act	TSC Act
Chthonicola sagittata	Speckled Warbler	-	V
Circus assimilis	Spotted Harrier	-	V
Climacteris picumnus victoriae	Brown Tree-creeper	-	V
Daphoenositta chrysoptera	Varied Sitella	-	V
Merops ornatus	Rainbow Bee-eater	Mi	-
Pomatostomus temporalis temporalis	Grey-crowned Babbler	-	V
Petroica boodang	Scarlet Robin	-	V
Polytelis swainsonii	Superb Parrot	V	V
Stagonopleura guttata	Diamond Firetail	-	V

Status: V – Vulnerable, Mi - Migratory

Photograph 5.13 Rainbow Bee-eater (Merops ornatus) recorded in the Study Area

5.9.2 Bird Utilisation Surveys

This section details the results of the BUS undertaken from November 2012 to February 2013. The comprehensive results of the BUS are provided in Annex D.

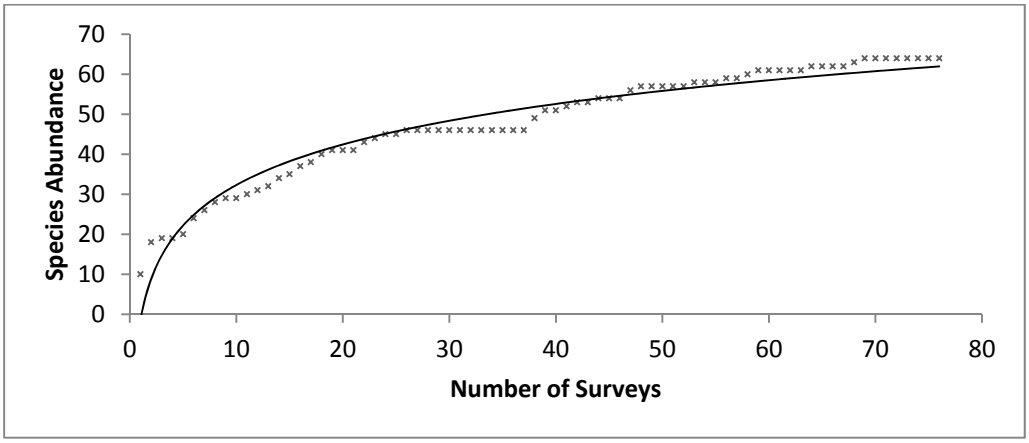
A total of 1335 birds were recorded from 76 surveys at 20 different sites. There were 68 different species identified, with the most abundant being the Australian Magpie (*Corvus coronoides*) (79), Crimson Rosella (*Platycercus elegans*) (49), Sulphur-crested Cockatoo (*Cacatua galerita*) (44) and the Superb Parrot (*Polytelis swainsonii*) (41). The Superb Parrot is listed as Vulnerable under the EPBC Act and the TSC Act.

Other threatened species recorded during the BUS were Brown Treecreeper *(Climacteris picumnus)* (Vulnerable under the TSC Act), Spotted Harrier (*Circus assimilis*) (Vulnerable under the TSC Act), Diamond Firetail (*Stagonopleura guttata*) Vulnerable under the TSC Act and the Rainbow Bee-eater (*Merops ornatus*) Migratory under the EPBC Act.

The majority of birds observed during the BUSs were flying moderate to short distances between trees, perching or moving on to the next tree or group of trees. Peak activity was generally recorded in the mornings or late afternoon surveys or on arrival to site when birds were flushed from the immediate area into the surrounding trees. Flocks of birds such as Eastern Rosellas (*Platycercus eximius*), Crimson Rosellas and Sulphur Crested Cockatoos were observed moving across the landscape generally following the contour of the ground. Birds were rarely observed to fly directly above the ridge tops.

A species accumulation curve illustrates that the number of species recorded rose rapidly within the first 10 surveys conducted and then began to taper (Refer to *Figure 5.6*). After completion of the 76 surveys the number of new species recorded declined, however, had not fully reached asymptote.

Figure 5.5 Species Accumulation Curves for All Species Recorded



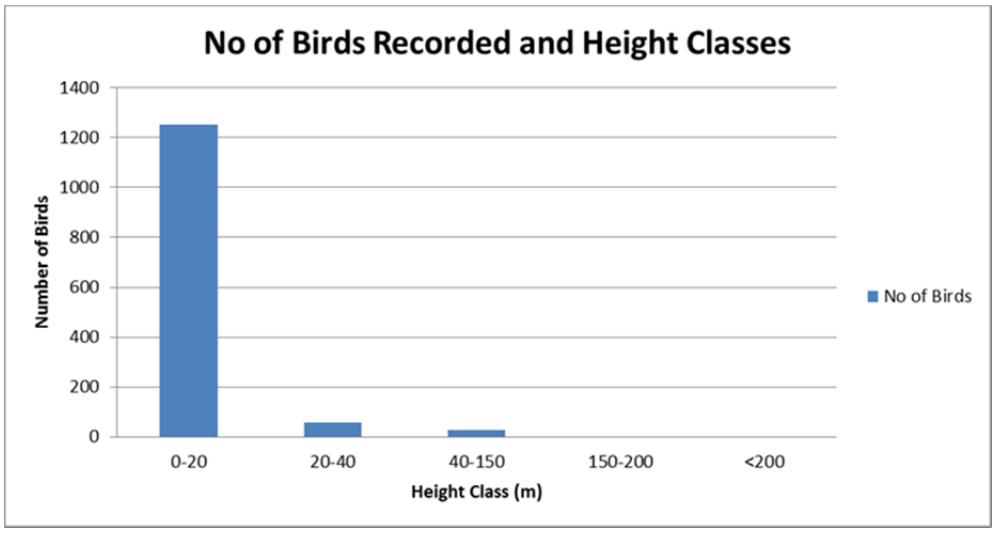
Height Categories of Species Recorded

Birds were recorded flying at five height classes, 0 – 20 m, 20 – 40 m, 40 – 150 m, and greater than 200 m. A total of 1250 birds were recorded flying at 0 – 20 m, 59 were recorded flying at 20 – 40 m, 26 were recorded flying at 40 – 150 m, none were recorded flying at 150 – 200 m or greater than 200 m during the surveys.

A total of 57 different bird species were recorded flying at 0 – 20 m, sixteen different bird species were observed flying at 40 -150 m, ten different species were recorded flying at 20 – 40 m and nine species were recorded flying at 40 – 150 m during the BUS surveys *Figure 5.7.*

Of the birds recorded in large numbers, very few exhibited direct movement through the landscape as would be expected of some true migratory species. The Wedge-tailed Eagles and other raptors were typically observed circling and soaring rather than direct movements.

Figure 5.6 Number of birds recorded at respective height classes



Threatened Species Recorded

A total of 164 individual threatened birds from six different species were recorded from 16 of the 20 survey sites. One of of the threatened species was recorded flying in the 20 – 40 m height class, the other two were recorded at the 40 -150 m height class. A breakdown of the data collected for the threatened species recorded at respective height classes is shown in *Table 5.14*. This table illustrates that the most abundant threatened species recorded was the Superb Parrot (148). A total of 147 Superb Parrots were recorded flying at 0 – 20 m, one Superb Parrot was recorded 20 – 40 m. The Little eagle and Spotted Harrier were both recorded at the 40 – 150 m height class as would be expected for these raptors. The Diamond Firetail and Brown Treecreeper were both observed in the 0 – 20 m height class as woodland birds it would be very rare to record either of these species at above the 20 m height class in the terrain where the surveys were undertaken. Superb Parrots were typically observed moving to or from areas to forage. Foraging areas tended to be those used for cropping grain. After the month of January the Superb Parrot was rarely recorded within the Study Area. This coincided with the harvesting of grain and the end of the breeding season for the Superb Parrot.

Table 5.14 Height Classes recorded of threatened species

		Height Classes				
Threatened species	Individuals recorded	0-20 (m)	20-40 (m)	40-150 (m)	150-200 (m)	<200 (m)
Superb Parrot	148	147	1	-	-	-
Brown Treecreeper	2	2	-	-	-	-
Spotted Harrier	1	-	-	1	-	-
Diamond Firetail	1	1	-	-	-	-
Rainbow Bee-eater	11	11	-	-	-	-
Little Eagle	1	-	-	1	-	-

5.10 OTHER BIRDS

The Wedge-tailed Eagle can be seen perched on trees or poles or soaring overhead to altitudes of up to 2000 m. Wedge-tailed Eagles build their nest in a prominent location with a good view of the surrounding countryside. It may be built in either a live or dead tree, but usually the tallest one in the territory. The density of active nests depends on the abundance of prey and other resources. In most years, nests are usually 2.5 km - 4 km apart. If conditions are particularly good, the distances apart may be less than 1 km because the birds require smaller areas to find sufficient food (Australian Museum 2012).

The Wedge-tailed Eagle has been previously recorded within the Locality with records of this species west and south of Boorowa, north and south of Rye Park Road (OEH 2013). During the field surveys this species was recorded in six locations (*Figure 5.3*) during bird census surveys, BUS and opportunistic observations. Six nest sites were recorded within the Study Area and have been mapped in *Figure 5.3*. One of these nests was recorded as active at the time of the September survey; it is not clear whether the other nests were active or inactive during the survey period.

5.11 BATS

A total of 13 species of microbat were detected using Anabat detectors (refer *Table 5.15* and *Figure 5.3*). A total of 546 recognisable passes were analysed from four Anabat units over the survey period. A further three microbat species were identified by capture as a result of harp trapping, including Lesser Long-eared Bat (*Nyctophilus geoffroyii*) as shown in *Photograph 5.14*, the Little Forest Bat (*Vespadelus vulturnus*) and the Southern Forest Bat (*Vespadelus regulus*),

Table 5.15 Bat species recorded

Species	Common Name	Status TSC Act	Status EPBC Act	Observation Type
Austronomus australis (syn. *Tadarida australis)*	White-striped Freetail Bat	-	-	U
Chalinolobus gouldii	Gould's Wattled Bat	-	-	U
Chalinolobus morio	Chocolate Wattled Bat	-	-	U
Miniopterus schreibersii oceanensis	Eeastern bentwing Bat	V	-	U
Mormopterus sp	Freetail Bat	-	-	U
Mormopterus sp 2	Eastern Freetail Bat	-	-	U
Mormopterus sp 4	Southern Freetail Bat	-	-	U
Nyctophilus geoffroyii	Lesser Long-eared Bat	-	-	U, T
Nyctophilus sp	Long Eared Bat	-	-	U
Saccolaimus flaviventris	Yellow-bellied Sheathtail Bat	V	-	U
Vespadelus darlingtoni	Large Forest Bat	-	-	U
Vespadelus regulus	Southern Forest Bat	-	-	U, T
Vespadelus vulturnus	Little Forest Bat	-	-	U, T

Status, V = Vulnerable

Observation Type, U = Ultrasonic, T = Trapped

Photograph 5.14 Lesser Long-eared Bat captured in the Study Area

5.11.1 *Threatened Bats*

Of the 13 species of microbat identified, two are listed as Vulnerable under the TSC Act: the Eastern Bentwing Bat (*Miniopterus schreibersii oceanensis*) and the Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*). The Eastern Bentwing Bat was recorded as a definite identification on an Anabat unit on 23 October 2012, and again as a probable identification on 22 October 2012 (*Figure 5.3*). Both recordings were taken from units placed on the Mt Buffalo property in Red Stringybark dominated woodland or on the edge of Red Stringybark dominated woodland. This species has a preference for using caves and abandoned mines as roosts.

The Yellow-bellied Sheathtail Bat was recorded as a definite identification on an Anabat unit on the 21 November 2012, which was placed on a stag on the edge of a creekline on the Taffs Hill property. The vegetation at this location consisted of scattered trees on derived native grassland. The primary land use in this area was grazing of both sheep and cattle. This species was also recorded as a probable identification on on 22 February 2013. This unit was placed on a small stag on a hill where the vegetation comprises scattered trees and cleared pasture. The primary land use in this area was grazing.

5.12 *MAMMALS (EXCLUDING BATS)*

A total of nine native mammal species were identified during spotlighting, trapping, camera trapping and as incidental observations (refer *Table 5.16*). This includes four macropod species, three arboreal species, the Short-beaked Echidna (*Tachyglossus aculeatus*) and the Yellow-footed Antechinus (*Antechinus flavipes*). An additional five exotic mammal species were observed, including the European Hare (*Lepus europaeus*), Brown Hare (*Lepus capensis*), Rabbit (*Oryctolagus cuniculus*), Pig (*Sus scrofa*) and European Red Fox (*Vulpes vulpes*) as shown in *Photograph 5.15*.

Table 5.16 Mammals recorded

Scientific Name	Common Name	TSC Status	EPBC Status
Antechinus flavipes	Yellow-footed Antechinus	-	-
Lepus europaeus	European Hare*	-	-
Macropus giganteus	Eastern Grey Kangaroo	-	-
Macropus robustus	Common Wallaroo	-	-
Macropus rufogriseus	Red-necked Wallaby	-	-
Oryctolagus cuniculus	Rabbit*	-	-
Petaurus norfolcensis	Squirrel Glider	V	-
Pseudocheirus peregrinus	Common Ringtail Possum	-	-
Sus scrofa	Pig*	-	-
Tachyglossus aculeatus	Short-beaked Echidna	-	-
Trichosurus vulpecula	Common Brushtail Possum	-	-
Vulpes vulpes	European Red Fox*	-	-
Wallabia bicolor	Swamp Wallaby	-	-

V = Vulnerable, * = Introduced species

Photograph 5.15 European Red Fox captured on a remote camera

5.12.1 Threatened Mammals

One threatened mammal species was recorded, the Squirrel Glider (Vulnerable, TSC Act). The individual was recorded during spotlighting in February 2013, as shown in *Photograph 5.16*. The Squirrel Glider was in mature Apple Box – Yellow Box Grassy Woodland adjacent Tangmangaroo Road (see *Figure 5.3*). The immediate area contained few tree hollows; however was only a few hundred metres from an area with many hollow bearing trees. Targeted trapping in the Study Area did not capture any additional Squirrel Gliders.

Photograph 5.16 Squirrel Glider observed in the Locality

5.13 THREATENED SPECIES LIKELIHOOD OF OCCURRENCE ASSESSMENT

The results of the threatened species Likelihood of Occurrence Assessment are provided in full within *Annex E*.

A summary of the results are provided in a series of tables below (*Table 5.17, Table 5.18, Table 5.19* and *Table 5.20*). The threatened species that are Known, Likely or have the Potential to occur within the Study Area have been assessed under the NSW TSC Act Assessment of Significance (7 part test) in *Section 6.6* and *Annex F*. Species and communities listed under the EPBC Act which have been determined as Known, Likely or Potential to occur within the Study Area through the Likelihood of Occurrence Assessment have also been assessed under the Commonwealth *Significant Impact Assessment Guidelines 1.1 Matters of NES*, the results of which are presented in *Chapter 7* and *Annex J*.

Table 5.17 Likelihood of Occurrence Summary: Ecological Communities

Community Species Name	TSC Act Status	EPBC Act Status	Likelihood
White Box, Yellow Box, Blakely's Red Gum Grassy Woodland and Derived Native Grassland	E	CE	Known
Tableland Basalt Forest in the Sydney Basin and South East Highlands Bioregions	E		Unlikely – suitable habitat does not occur

1. CE = Critically Endangered; E= Endangered

Table 5.18 Likelihood of Occurrence Summary: Subject Species

Common Name	Species Name	TSC Act Status	EPBC Act Status	Likelihood
Plants				
Yass Daisy	*Ammobium craspedioides*	V	V	Likely
Crimson Spider Orchid	*Caladenia concolor*	E	E	Potential
Doubletail Buttercup	*Diuris aequalis*	E	V	Potential
Hoary Sunray	*Leucochrysum albicans var. tricolor*		E	Potential
Silky Swainson-pea	*Swainsona sericea*	V		Potential
Invertebrates				
Golden Sun Moth	*Synemon plana*	E	CE	Known
Frogs				
Booroolong Frog	*Litoria booroolongensis*	E	E	Unlikely - due to the lack of swamps, Lignum/Typha and River Red Gum swamps or billabongs along floodplains and river valleys throughout the Study Area.

Common Name	Species Name	TSC Act Status	EPBC Act Status	Likelihood
Growling Grass Frog	*Litoria raniformis*	V	E	Unlikely - due to the ephemeral nature of the creeks and streams throughout the Study Area.
Birds				
Regent Honeyeater	*Anthochaera phrygia*	CE	E	Likely
Gang-gang Cockatoo	*Callocephalon fimbriatum*	V		Potential
Glossy Black-cockatoo	Calyptorhynchus lathami	V		Potential
Spotted Harrier	*Circus assimilis*	V		Known
Brown Treecreeper	*Climacteris picumnus victoriae*	V		Known
Varied Sittella	*Daphoenositta chrysoptera*	V		Known
White-fronted Chat	*Epthianura albifrons*	V		Potential
Little Lorikeet	*Glossopsitta pusilla*	V		Potential
Painted Honeyeater	*Grantiella picta*	V		Potential
Little Eagle	*Hieraaetus morphnoides*	V		Known
Swift Parrot	*Lathamus discolor*	E	E	Potential
Square-tailed Kite	*Lophoictinia isura*	V		Potential
Hooded Robin	*Melanodryas cucullata cucullatta*	V		Potential
Black-chinned Honeyeater	*Melithreptus gularis gularis*	V		Likely
Turquoise Parrot	*Neophema pulchella*	V		Potential
Barking Owl	*Ninox connivens*	V		Potential
Powerful Owl	*Ninox strenua*	V		Potential
Scarlet Robin	*Petroica boodang*	V		Known
Flame Robin	*Petroica phoenicea*	V		Likely
Superb Parrot	*Polytelis swainsonii*	V	V	Known
Grey-crowned Babbler	*Pomatostomus temporalis temporalis*	V		Known
Speckled Warbler	*Pyrrholaemus sagittatus*	V		Known

Common Name	Species Name	TSC Act Status	EPBC Act Status	Likelihood
Diamond Firetail	*Stagonopleura guttata*	V		Known
Mammals				
Koala	*Phascolarctos cinereus*	V	V	Potential
Eastern Pygmy Possum	*Cercartetus nanus*	V		Unlikely - no suitable habitat exists.
Spotted-tailed Quoll	*Dasyurus maculatus*	V	E	Unlikely - woodland is highly fragmented.
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	V		Unlikely - few areas have trees taller than 20 m.
Eastern Bentwing-bat	*Miniopterus schreibersii oceanensis*	V		Known
Greater Long-eared Bat	*Nyctophilus corbeni*	V	V	Unlikely - No records have been identified within 20 km of the Study Area
Yellow Bellied Sheathtail-bat	*Saccolaimus flaviventris*	V		Known
Greater Broad-nosed bat	*Scoteanax rueppellii*	V		Unlikely - No records within within the Locality
Squirrel Glider	*Petaurus norfolcensis*	V		Known

1. CE = Critically Endangered, E = Endangered, V = Vulnerable

Table 5.19 Likelihood of Occurrence Summary: Other Entities

Species/Community Status	Likelihood of Occurrence	Assessment of impact required?
Plants		
Robertson's Gum *Eucalyptus robertsonii subsp. Hemisphaerica* TSC Act - V EPBC Act - V	Potential – suitable habitat present in woodlands on the site.	Yes
Aromatic Peppercress *Lepidium hyssopifolium* TSC Act - E EPBC Act - E	Potential - suitable habitat present in woodlands and secondary grassland.	Yes
Tarengo Leek Orchid *Prasophyllum petilum* TSC Act - E EPBC Act - E	Potential – recorded within the Locality, sub-optimal habitat exists within the Study Area.	Yes
Dwarf Kerrawang *Rulingia prostrate* TSC Act - E EPBC Act - E	Unlikely – suitable habitat absent from the Study Area.	No

Species/Community Status	Likelihood of Occurrence	Assessment of impact required?
Mountain Swainson Pea *Swainsona recta* TSC Act - E EPBC - E	Potential - suitable habitat present in woodlands with an undisturbed understory.	Yes
Black Gum *Eucalyptus aggregata* TSC Act - V -	Unlikely – suitable habitat does not occur. The site does not support any of the associated cold-adapted Eucalypts and is at a lower altitude than other known populations.	Yes

Species/Community Status	Likelihood of Occurrence	Assessment of impact required?
Button Wrinklewort *Rutidosis leptorrhynchoides* TSC Act - E EPBC Act – E	Potential - suitable habitat present in woodlands with an undisturbed understory and secondary grassland. Areas of suitable habitat were surveyed during the flowering season for the species.	Yes
Reptiles		
Pink-tailed Worm-lizard *Aprasia parapulchella* TSC Act - V EPBC Act - V	Unlikely – limited areas of suitable habitat occur.	No
Striped Legless Lizard *Delma impar* TSC Act - V EPBC Act - V	Potential limited areas of suitable habitat occur.	Yes
Grassland Earless Dragon *Tympanocryptis pinguicolla* TSC Act - E EPBC Act - E	Unlikely - areas of derived native grassland dominated by *Austrodanthonia* and *Themeda australis* occur within the Study Area however in a disturbed and fragmented state.	No
Little Whip Snake *Suta flagellum* TSC Act - V	Unlikely - areas of Derived native grassland exist and sub prime habitat exists on slopes. Site has been heavily grazed and habitat fragmented.	No
Rosenberg's Goanna *Varanus rosenbergi* TSC vAct - V	Potential - habitat occurs only in small fragmented patches.	Yes
Birds		
Australasian Bittern *Botaurus poiciloptilus* TSC Act - E EPBC Act – E	Unlikely – due to absence of densely vegetated wetlands within the Study Area and lack of records in the Locality.	No
Australian Painted Snipe *Rostratula australis* TSC Act - E EPBC Act - V, Mi	Unlikely – suitable habitat does not occur within the Study Area and no previous records exist for the Locality.	No
CE = Critically Endangered, E = Endangered, V = Vulnerable, Mi = Migratory		

Table 5.20 Likelihood of Occurrence Assessment Results: Additional Species Identified in Database Searches

Species/Community Status	Likelihood of Occurrence	Assessment of impact required?
Plants		
Eucalyptus canobolensis Silver-leaf Candlebark TSC Act - V EPBC Act - E	Unlikely - Optimal or sub optimal habitat absent from the Study Area.	No
Pelargonium sp. Striatellum (G.W. Carr 10345) Omeo Stork's Bill TSC Act - E EPBC Act – E	Unlikely – Optimal or sub optimal habitat absent from the Study Area.	No

Species/Community Status	Likelihood of Occurrence	Assessment of impact required?
Fish		
Maccullochella peelii peelii Murray Cod, Cod, Goodoo EPBC Act - V	Unlikely – No optimal or sub optimal habitat present.	No
Macquaria australasica Macquarie Perch FM Act - E EPBC Act – E	Unlikely – No optimal or sub optimal habitat present.	No
Ecological Communities		
EPBC Act listing: Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South eastern Australia Natural Temperate Grassland of the Southern Tablelands of NSW and the Australian Capital Territory TSC Act listing: Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions TSC Act – E EPBC Act - E	Unlikely – suitable habitat does not occur. Not mapped or recorded in the Study Area.	No
Natural Temperate Grassland of the Southern Tablelands of NSW and the Australian Capital Territory EPBC Act - CE	Unlikely – suitable habitat does not occur. Not mapped or recorded in the Study Area.	No
Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions TSC Act - E	Unlikely – suitable habitat does not occur. Not mapped or recorded in the Study Area.	No

Status: CE = Critically Endangered, E = Endangered, V = Vulnerable

5.14 RESULTS SUMMARY

Five vegetation communities were recorded in the Study Area, including two BVTs that occur in varying condition. The remaining vegetation communities largely comprise exotic species and do not meet the description of any BVTs. The majority of the Apple Box – Yellow Box Grassy Woodland meets the description for the Box-Gum Woodland EEC listing under the TSC Act and a small proportion also meets the description for the Box-Gum Grassy Woodlands and Derived Native Grasslands CEEC listing under the EPBC Act.

A total of 127 flora species were recorded in the Study Area. Nine threatened flora species listed under the EPBC Act and / or the TSC Act were considered likely to, or have the potential to, occur in the Study Area. Of these, none were recorded in the Study Area, however, one was recorded in the Locality (see *Table 5.20*).

A total of four fauna habitat types were recorded in the Study Area including native woodlands, native grasslands, exotic grasslands and aquatic habitats. Within these habitat types, a variety of fauna habitat resources were identified, including hollow bearing trees, paddock trees, tussock grasslands, disused mines, farms dams and creek lines.

A total of 152 fauna species were recorded in the Study Area. Thirty two threatened fauna species were considered likely to, or have the potential to, occur in the Study Area. This includes one invertebrate, one frog, three reptiles, 23 birds and four mammals. Of these, a total of 15 were recorded within the Study Area including one invertebrate, ten birds and three mammals (see *Table 5.20*). One migratory species listed under the EPBC Act was recorded in the Study Area (see *Table 5.20*).

A summary list of the threatened species recorded is shown in *Table 5.20*. This information combined with the known records of threatened species and potential for a species to occur within the Study Area has formed the basis for the impact evaluation in *Chapter 6* of this report.

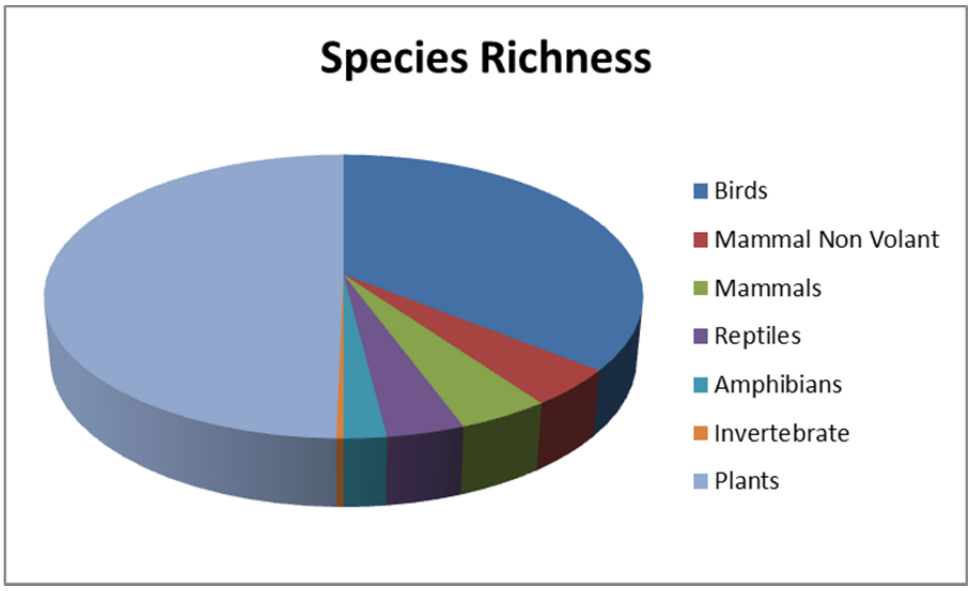
Table 5.21 Summary of Threatened Species Recorded

Taxon	Scientific Name	Common Name	Status TSC Act	Status EPBC Act
Plant	*Ammobium craspedioides*	Yass Daisy	V	V
Invertebrate	*Synemon plana*	Golden Sun Moth	E	CE
Bird	*Chthonicola sagittata*	Speckled Warbler	V	-
Bird	*Circus assimilis*	Little Eagle	V	-
Bird	*Climacteris picumnus*	Brown Treecreeper	V	-
Bird	*Daphoenositta chrysoptera*	Varied Sittella	V	
Bird	*Merops ornatus*	Rainbow Bee-eater	-	Mi
Bird	*Petroica boodang*	Scarlet Robin	V	-
Bird	*Polytelis swainsonii*	Superb Parrot	V	V
Bird	*Pomatostomus temporalis*	Grey-crowned Babbler	V	-
Bird	*Stagonopleura guttata*	Diamond Firetail	V	-
Mammal	*Miniopterus schreibersii oceanensis*	Eeastern bentwing Bat	V	-
Mammal	*Petaurus norfolcensis*	Squirrel Glider	V	-
Mammal	*Saccolaimus flaviventris*	Yellow-bellied Sheathtail Bat	V	-

Status: CE = Critically Endangered, E = Endangered, V = Vulnerable, Mi = Migratory

The surveys and observations carried out over the Study Area recorded a total of 280 different species. A species richness chart (*Figure 5.8*), based on the number of different species recorded over the survey period has been constructed to show the relative species richness within the Study Area during the survey period. The graph shows that plants were the most commonly recorded group with birds, mammals (flying), non-volant mammals, reptiles relatively equal in species richness with amphibians and invertebrates being recorded the least. Note that this information does not take into account the number of records per individual species and survey limitations may have impacted on the detection of some species.

Figure 5.7 Species Richness Chart



6 IMPACT EVALUATION

This section provides an evaluation of the potential impacts associated with the proposed Project. It discusses the components of the Project which are likely to lead to ecological impacts, the avoidance and mitigation measures which have been put in place to minimise the Project's residual impacts, and the nature and extent of potential impacts associated with each stage of the Project. Assessments of Significance against Section 5A of the EP&A Act (also known as the seven part test) were undertaken for 39 species and one ecological community, as discussed in *Section 6.6* and presented in full in *Annex F*. Offset calculations and proposed measures are discussed in the final section of this chapter, although it is acknowledged that the provision of offsets can not be considered in the determination of project-related impacts.

6.1 PROPOSED DEVELOPMENT

The Project is comprised of a number of components which would impact on the ecological features of the Study Area. An overview of the components is provided in *Table 6.1* and detailed descriptions are provided in the following sections.

Table 6.1 Project components

Project Component	Approximate Dimensions
Permanent	
WTG footings (maximum footprint)	25 m x 25 m
WTG assembly / crane hardstand areas	25 m x 60 m
Collector substation (CS)	150 m x 150 m
Site compounds *(the extent of permanent section retained within temporary compound)*	75 m x 75 m
On-site access: new roads	6 m x 83 km
Overhead transmission lines / easement [4]	30 m x 0.86 km
(Typical pole spacing as per **Table 3.3** of **Section 2.4.4**)	(1 x 33 kV)
	45 m x 7.82 km
	(2 x 33 kV)
	75 m x 0.65 km
	(2 x 33 kV, 1 x 132 kV)
Switching station (SS)	220 m x 160 m
Wind monitoring masts	1 m x 1 m
	(5 per mast)

[4] The final constructed easement width is up to 75 m for the internal overhead transmission lines, depending on their configuration. The maximum easement widths for each transmission line section have been assessed in detail and used in the calculation of the Development Footprint impact area. The actual impact area has been estimated to be 5% of this total area given the low level of impacts associated with installing the overhead transmission lines and the sparse vegetation cover along the selected routes.

Project Component	Approximate Dimensions
Temporary (during construction)	
Earthworks alongside permanent infrastructure (roads / hardstands) [5]	12 m x 83 km (est.)
Underground transmission lines[6]	3 m x 61 km
Concrete /asphalt batching plant	50 m by 100 m
Rock crushing facility	50 m by 100 m
Site compound and office	150 m by 200 m

6.1.1 Wind Turbine Generators (WTGs)

Up to 122 WTGs are proposed to be constructed as part of the Project. Each WTG requires a 25 m x 25 m concrete footing and a 25 m x 60 m WTG assembly / crane hardstand area. The hardstand is required as a crane pad to construct each turbine on site and will remain in situ after construction to allow for future maintenance or possible removal of each turbine. The supporting structure is comprised of a reducing cylindrical tower of up to 120 m, with an approximate diameter at the base of 4.5 m and 3 m at the top. Rotors will be three-bladed with diameters between 74 m and 144 m and a swept area of 4,300 to 16,286 square metres (m^2). The lowest possible swept height would be 25 m, however, it is more likely to be greater than 30 m, depending on the turbine model.

Installation of the WTGs would involve the excavation of approximately 750 m^3 of ground material to a depth of approximately 2.5 m (based on a 21 m diameter circular foundation). Approximately 200 m^3 would, if suitable, be used as backfill around the wind turbine base. Remaining excavation material will be used for the on-site road infrastructure, where necessary. The majority of the WTGs are proposed in areas of pasture, cropping and DNG. Some WTGs would also require clearing of woodland vegetation.

[5] Construction of the on-site access road network will require earth works that are beyond the limits of the permanent road impact within the Study Area. This is required to level areas of steep gradient to a design suitable for safely transporting Project components into position. Civil engineering designs have been prepared for both Layout Options based on available contour and geotechnical data, to include impacts associated with permanent road, hardstand and turning head areas in addition to the area considered the extent of the earthworks.

[6] Underground transmission lines are a temporary impact and where feasible will be installed either within or adjacent to on-site access roads and earthworks. The trenches for the cables are backfilled with excavated material and covered with topsoil post installation. Suitable rehabilitation measures will be implemented.

6.1.2 Collector Substation

The CS will occupy an area approximately 150 by 150 m and will be surrounded by a 3 m high security fence, surmounted by strands of barbed or razor wire. The transformer(s) within the CS may contain upwards of 50,000 L of oil. The 2.25 ha area for the CS includes a provision for a 20 m Asset Protection Zone. A facilities building will be constructed at the same location as the CS. The proposed CS location occurs in areas of pasture, cropping or DNG.

6.1.3 Switching Station

The SS will occupy an area approximately 160 by 220 m and will be surrounded by a 3 m high security fence, surmounted by strands of barbed or razor wire. The 3.52 ha area includes a provision for a 20 m Asset Protection Zone. The proposed SS location occurs in areas of pasture, cropping or DNG.

6.1.4 Site Access Works

Site access requires site entry roads and onsite access roads. All entrances to the PAA from the existing arterial roads will be designed to allow long vehicles to safely exit from or re-enter the road whilst minimising the disruption to traffic.

Other access consists of new on-site access roads of up to 6 m between wind turbines, also comprising hardstand and turning head areas. The on-site access roads will follow existing farm tracks, where practicable, that traverse the ridgelines and plateaus. All roads leading from the arterial roads and all on-site access roads are likely to require a full or partial upgrade to accommodate the construction traffic loads, as well as for maintenance purposes during operation.

Construction of the on-site access road network will require earth works to level areas of steep gradient to a design suitable for safely transporting Project components into position. Access roads are largely proposed through areas of pasture, cropping and DNG, however, some sections also pass through woodland areas.

6.1.5 Transmission Lines

The electrical and control cables from the Langs Creek, Kangiara and Mt Buffalo Clusters will comprise a mix of underground and overhead transmission lines and will connect directly into the CS.

Underground routes will generally be between the WTGs and follow the route of the internal on-site access roads. Installation would involve the cutting or excavation of trenches to a depth of up to 0.45 m wide and 1.2 m deep for the laying of the underground transmission lines.

Approximately 9 km of overhead transmission line will be required to connect the WTGs to the CS and SS. The final constructed easement width is up to 75 m for the internal overhead transmission lines, depending on their configuration. The actual impact area has been estimated to be 5% of this total area given the low level of impacts associated with installing the overhead transmission lines and the sparse vegetation cover along the selected routes. Overhead transmission lines are largely proposed through areas of pasture, cropping and DNG, however, some sections also pass through woodland. A section of the overhead transmission line passes through Box-Gum Woodland and would require clearing of native vegetation.

6.2 *POTENTIAL IMPACTS OF PROJECT*

There are a range of potential impacts associated with wind farm developments including direct and indirect impacts, as discussed in the following sub-sections.

6.2.1 *Habitat Loss*

Habitat loss is a direct consequence of earthworks and construction activities which is classified in this report as either temporary loss or permanent loss. Habitat loss is the direct impact which is most easy to quantify, based upon the Development Footprint of the Project, involving all aspects of the Project components. The Development Footprint is made up of the components discussed in *Section 6.1*. In order to minimise the impacts on vegetation and habitat the proponent has applied a range of safeguards through avoidance and mitigation measures outlined in *Section 6.3* and *Section 6.4*.

The habitat loss associated with the Project is quantified in *Section 6.5*.

6.2.2 *Collision-related mortality*

Operational wind farms pose a collision risk to birds and bats where rotor strike can cause injury and/or death, as well as alienation of habitat through avoidance of WTGs. Fatalities and injuries are usually caused by a collision with the moving blades (blade strike), or with turbine infrastructure, such as guy lines and powerlines. Lighting on wind farm turbines may also increase the likelihood of blade strike to insectivourous bat species by attracting insects to within the RSA, thus causing bats to forage within this area and interact with the rotors.

Impacts on Birds

The main potential impacts on bird species from an operational wind farm are:

- direct mortality associated with rotor collisions and collisions with other associated infrastructure including towers, guy wires and transmission lines; and

- indirect impacts relating to habitat loss through the effects of installation of wind farm facilities.

Rotor strike is reasonably well studied in Europe and the Americas where flocking seasonal migratory birds are common, whereas literature relating to rotor strike in Australia is relatively scarce. Alienation of habitat is also a key consideration which is related to rotor strike, as it indicates a measure of "avoidance" of WTGs by birds and bats. The avoidance rate for birds in Australia is generally considered to be in the order of 95% to 99% (Smales 2005a). This avoidance effect essentially leads to a loss of habitat within the footprint of the proposed development.

Collision risk depends on a wide range of factors as summarised below:

- high collision rates have been recorded at several large wind farms located in areas where large concentrations of birds are present (e.g. Altamont Pass in California, USA, Tarifa, and Navarra in Spain). High collision rates are particularly evident for large soaring raptors, near areas used by large numbers of roosting or foraging birds, migratory flyways or local fly paths or areas with high bird use. No large concentrations of birds were recorded in the Study Area and the area is not known to form part of any significant migratory routes for large numbers of birds;

- turbines constructed linearly in long strings result in more collision mortality than turbines that are constructed in clusters. The turbine layout for the proposed wind farm generally consists of clusters of turbines along ridgelines and scattered high points. The large size of individual turbines and subsequent large spacing between each turbine limits the potential impacts of the precincts with linear layouts;

- large birds with poor manoeuvrability (such as larger waterbirds) are generally at greater risk of collision with wind turbines. Species that habitually fly at dawn, dusk or at night are also less likely to detect and avoid turbines. There were no records of significant numbers of large waterbirds in the Study Area. Wedge-tailed Eagles were the only large bird with poor manoeuvrability identified in the Study Area and this species is considered to be common within the Locality and the broader NSW region; and

- bird collision risk may vary on a seasonal basis due to bird migration or breeding. This is true for the Superb Parrot which occurs in the Study Area in high densities during the breeding season (spring – summer) and migrates northward during winter as evidenced by the data in this study.

Studies on the interactions between wind farms, birds and bats have been undertaken across the world for decades. In the United States it is estimated that between 100 million to over a billion birds are killed annually by collisions with wind farms (NWCC 2001).

In Australia studies tend to focus on the impacts to threatened species. A report produced for the Department of Environment and Heritage in 2005 carried out modelling to guage the cumulative impacts of wind farm developments on the Swift Parrot, across its range in south eastern Australia. The modelling used provides a measure of the potential risk at different rates at which birds might avoid collisions (Smales 2005a). The report concluded that the number of Swift Parrots that the model predicts might be killed on average per annum at each wind farm, according to three avoidance rates modelled a cumulative total of between 0.08 and 0.13 Swift Parrots per year are predicted to be killed by collisions at all of the sites the population is likely to encounter within its natural range. This equates to slightly more or less than a single parrot killed every ten years (Smales 2005a). Therefore, the cumulative impacts of collision with turbines on the overall population of Swift Parrots as predicted by the modelling for all current and presently proposed wind farms as of 2005 within the species' range are very small (Smales 2005a).

In North America and Europe most bird collisions at wind farms are attributed to migrating birds. Many Northern hemisphere species are distinctly migratory, however most Australian species are nomadic, moving long distances in response to rainfall and drought at a continental scale. The data collected in this study indicates that birds flying at RSA height were dominated by common inland species such as Galah and Crimson Rosella. Given the abundance and wide distribution of the species recorded flying and RSA height, population scale impacts are not considered likely within the Study Area.

Impacts on Bats

Limited data is available on wind farm impacts on bats in Australia. Several hypotheses have been suggested in an attempt to determine how and why bats are killed by wind turbines (BL&A 2001a). These include:

- sensory failure where bats are unable to visually or acoustically detect moving turbine blades (non-echo locating bats are less able to avoid collision);

- roost attraction where bats may mistake turbines for a roost;

- acoustic attraction where bats are attracted to sounds generated by turbines;

- insect concentration such that bats are attracted to lit areas such as wind farms because of higher insect activity;

- food resources, in that wind farms tend to be built in areas where insects are concentrated (e.g., hilltops and ridges), thus in prime foraging habitat for bats. Open spaces around turbines may also create favourable foraging habitats; and

- decompression – sudden changes in air pressure created by turbine turbulence which can cause barotraumas in some species (BL&A 2011).

In Australia, bats display some migratory behaviour but migrations are local and not considered to cover significant distances (BL&A 2011). The Eastern Bentwing-bat migrates annually to maternity caves, where the females breed and hibernate. Males remain dispersed throughout suitable habitat, and females emerge following the breeding period, to disperse across the landscape. The nearest known breeding colony of the threatened Eastern Bentwing-bat is at Church Cave, over 60 km south of the Study Area. Due to the distance from the maternity site, and the fragmentation of suitable habitat in the Study Area, it is not expected that significant numbers of individuals congregate in the Study Area at any stage. Therefore the proportion of Eastern Bentwing-bat that would be at risk of rotor collision impacts in the Study Area is relatively low.

The only mortality rate data in the public domain in Australia is that from Woolnorth wind farm of 1.86 bats per turbine per year, published by Hydro-Tasmania. This rate range is comparable to that recorded for most North American and European Wind farms (BL&A 2011).

6.2.3 Barotrauma

The decompression hypothesis proposes that many bats are killed by barotrauma that is caused by rapid air-pressure reduction near moving turbine blades (Baerwald 2008). Barotrauma involves tissue damage to air-containing structures caused by rapid or excessive pressure changes, pulmonary barotrauma is lung damage due to expansion of air in the lungs that is not accommodated by exhalation (Baerwald 2008). As with any airfoil, moving wind- turbine blades create zones of low pressure as the air flows over them. Animals entering these low pressure areas may suffer barotrauma (Baerwald 2008).

Species most at risk of barotrauma within the Study Area are species of microbats. Eight species of microbats are nationally listed as threatened and are protected under the EPBC Act 1999. Sixteen species are listed as threatened under the NSW TSC Act (ABS Undated). Two of these have been recorded within the Study Area. All reported fatalities of bats from wind

turbines, in Australia and overseas, have been microbats (ABS Undated). Where reliable data are available, the bat deaths reported range from 1.6 per turbine per year to over 90 bats per turbine per year (ABS Undated).

Within the Study Area, the microbat species most at risk of mortaility due to the effects of barotrauma are the Eastern Bentwing Bat and the Yellow-bellied Sheathtail Bat, both of which were positively identified from the field surveys. Both of these species are relatively high flying and prefer to forage above canopy height. Both of these species have high dispersion rates, with the Yellow bellied Sheathtail Bat having a migratory pattern moving from wintering ares in the north to summer habitat areas in the south. The Eastern Bentwing has been recorded to forage up to 25 km from a roost site.

6.2.4 Alienation of habitat

The alienation of habitat involves changes in behaviour of species. Species may respond to the introduction of wind turbine infrastructure by avoiding breeding or foraging resources and habitat utilisation such as avoidance of areas where turbines are located due to the unfamiliar object being perceived as a potential threat.

Careful planning to avoid the placement of turbine clusters in or near areas of high habitat values will minimise the risk of the alienation of habitat to key threatened woodland species such as the Brown Treecreeper, and Scarlet Robin. The potential impacts to the Superb Parrot are not yet known and hard to predict as this species' movement patterns and use of the Study Area are not fully understood.

6.3 AVOIDANCE OF IMPACTS

When first announced in February 2011 the Project consisted of up to 200 wind turbines and ancillary structures spread over 30 different properties. The 330 kV overhead transmission line 5 km north of Yass was being considered as the power export connection point. The Project therefore extended over a much larger area, from Boorowa to just north of Yass during the initial design phase. Information regarding biodiversity and other factors has been considered during the design process and has resulted in a significant reduction in the extent of the wind farm and a re-design of the wind turbine layout to arrive at the two configurations presented in this report.

The initial Project design took into account broad scale ecological features, with WTGs and associated infrastructure generally sited to avoid areas of remnant woodland vegetation and riparian areas. The ecological surveys have informed micro-siting of turbines and infrastructure to take into account site-specific environmental issues and minimise on-ground ecological impacts. Factors considered include:

- areas of native vegetation, particularly those that are in good condition and / or meet the description of an EEC or CEEC;
- habitat features for native fauna, including hollow bearing trees, exposed rock and native tussock grassland; and
- wildlife corridors.

This approach resulted in the removal of WTGs and project-related infrastructure at several locations across the PAA. The key adjustments made specifically to account for biodiversity values are outlined in *Table 6.2*.

Table 6.2 Avoidance measures adopted into the Project Design

Project Feature	Original Location	Adjusted Location	Reason
Main access road to the Kangiara Cluster	Tangmangaroo Road, starting at the intersection with the Lachlan Valley Way and continuing to the intersection with Harrys Creek Rd	Removed. Access is now proposed directly off the Lachlan Valley Way.	To avoid removal or modification of intact roadside stands of Box-Gum Woodland along Tangmangaroo Road. The stands provide habitat for threatened species, including the Squirrel Glider, which was recorded in this area.
Substations	Within Box Gum Woodland DNG in the Kangiara Cluster	Moved to nearby grassland with a lower percent coverage of native species	To avoid removal of Box Gum Woodland DNG and potential GSM habitat.
Six WTGs and associated access tracks	Within the Environmental Stewardship Block on 'Glanmire'	Removed	To avoid removal or modification of an area of Box Gum Woodland that is being managed under the Environmental Stewardship Program.
One WTG	Adjacent to a stand of Box-Gum Woodland in the Kangiara Cluster	Removed	To avoid areas adjacent to Box Gum Woodland that have a high potential of being within the flight path of the Superb Parrot.
Turbines and access tracks	Within a remnant of Red Stringybark Open Forest in the Mt Buffalo cluster	Moved to the edge of remnant woodland and nearby grassland	To avoid removal and fragmentation of remnant native woodland.

6.4 MITIGATION MEASURES

This section describes the mitigation measures which are proposed in order to minimise the impacts of the Project on ecology as a result of construction and operation of the Project. The mitigation measures are defined separately for the construction phase and the operational phases of the Project. There is some overlap in these mitigation measures.

6.4.1 *Construction Phase*

Measures to reduce general impacts to ecological features associated with construction activities have been considered during the ecological assessment in order to avoid and minimise impacts to biodiversity wherever feasuible. Management of construction related impacts will be facilitated through the development and implementation of a Construction Environmental Management Plan (CEMP), outlining the roles and responsibilities of parties in implementing the mitigation actions. General mitigation measures to address envirommental issues during the Project construction phase are presented within the relevant sections of the EA. This section describes the mitigation measures which are specific to biodiversity values of the Study Area.

The proposed biodiversity mitigation measures for the construction phase of the Project are outlined in *Table 6.3*.

6.4.2 *Operational Phase*

Management of impacts to ecological features associated with the operational phase will be facilitated through the development and implementation of an Operational Environmental Management Plan (OEMP). General mitigation measures to address envirommental issues during the Project operational phase are presented within the relevant sections of the EA. This section describes the mitigation measures which are specific to biodiversity values of the Study Area for operation only.

The proposed biodiversity mitigation measures for the operational phase of the Project are outlined in *Table 6.4*.

Table 6.3 Proposed Mitigation Measures – Construction Phase

Issue	Description	Approach	Management Actions	Responsible Party
Weeds	The spread of weeds is a high risk with any large scale development that extends over a large geographic area.	Minimise spread	Stringent weed management measures will be defined within the CEMP and will be implemented during construction to prevent and managed weed invasion. Management measures will include (but not be limited to): • where a specific weed risk has been identified, all machinery, equipment and vehicles are to be washed down before entry and egress of the Project site; • piling of soil that may contain seeds of exotic species at least 50 m away from creeks, drainage lines and other areas of native vegetation, to prevent spread into adjacent areas during rainfall or wind events; • topsoil recovery will be undertaken in areas that have a high proportion of native vegetation and few weeds in the ground layer of vegetation; • all construction staff and sub-contractors educated on noxious weeds present at the Project site and ways to prevent spread; • where practical, topsoil that is limited in weeds to be harvested to salvage the native soil seed bank and reintroduced into disturbed areas. Otherwise, revegetate with locally native endemic species characteristic of the cleared vegetation type; • control of perennial weed grasses within the disturbance zone for 3 to 5 years after construction; • where practical, and in consultation with host landowners, manage stock access during periods of revegetation; and • imported soil and rubble to be certified as free of weeds and weed seeds.	Proponent in consultation with ecologist and associated landowners

Issue	Description	Approach	Management Actions	Responsible Party
Loss of biodiversity	Biodiversity loss is anticipated as a direct result of clearance for construction activities.	Minimise Impact	Development of a CEMP that will ensure vegetation clearing is minimised as far as practical during construction. This will be aimed to minimise impacts to threatened species known or predicted to occur within the Study Area. Management measures will include: • all site staff are to be inducted on the procedures of the CEMP in relation to flora and fauna; • the area to be cleared at the site will be clearly demarcated using flagging or fencing, and mapped on construction plans, to prevent breaches of the construction boundary; • laydown or temporary disturbance areas will be located in already disturbed areas to avoid any unnecessary clearing of native vegetation and habitat; • vehicles will remain on formed roads or tracks designed specifically for the purposes of the wind farm construction where possible; • care will to be taken when working near wooded areas to prevent damage to adjacent tree roots and indirect impact to habitat areas; • trenches will be excavated at least 15 m away from the base of trees where possible to prevent root damage; • where practical, suitable fencing to be erected along trenches to prevent fauna falling in; • habitat features such as logs, large rocks and fallen hollows within the proposed clearance footprint will be relocated to adjacent areas to supplement habitat where possible; • any individual hollows removed will be replaced with artificial hollows within adajacent suitable habitat. • pre-clearance protocol to be designed to identify how hollow-bearing fauna will be surveyed for and managed during clearing;	Proponent in consultation with ecologist, OEH and DSEWPC

Issue	Description	Approach	Management Actions	Responsible Party
			• Environmental Compliance Manager or field officer qualified in the handling of fauna to be present on-site during clearing to capture and re-release fauna (where appropriate); • regular checking of trenches by the Environmental Compliance Manager to ensure any captured fauna are released according to the CEMP *(Note: this will not be carried out during the operation phase)*; • pre-clearance surveys undertaken to determine if roosts, nests or dens are present in any trees proposed for clearing; • native vegetation that is removed will be chipped and mulched for on-site use where practical; • where practical, native vegetation greater than 3 m in height to be retained during transmission line construction; and • rehabilitation of internal access roads that are not required following construction to be undertaken.	
Loss of biodiversity	In order to account for the residual impacts of the Project which can not be avoided or minimised, offsets are proposed.	Offset impacts	An appropriate offset package will be secured within 12 months of commencing construction to compensate for the loss of habitat within the Study Area as outlined within the EA. Final calculation of the offset area will be carried out during the pre-construction phase once turbine selection has taken place and the final Development Footprint is confirmed.	Proponent in consultation with ecologist, OEH, SEWPaC and associated land owners
Habitat Loss – Golden Sun Moth	Based on the infrastructure layout, which is considered to be a worst case scenario in terms of extent, 82.48 ha of GSM habitat will be removed (with an additional 18.4 ha disturbed and rehabilitated after construction).	Minimise impact	The CEMP will include specific measures to adress loss of habitat for Golden Sun Moth. Management will include measures such as:	Proponent in consultation with ecologist, OEH and DSEWPC

Issue	Description	Approach	Management Actions	Responsible Party
			• movement through and disturbance to mapped GSM habitat will be minimised during the flying period, from November to January, if possible; • areas of habitat will be delineated by barrier tape (or similar) to clearly demarcate these areas and limit risk of vehicles traversing through habitat accidently; and • all vehicle movements will be contained to roads and tracks where possible.	
Habitat Loss – Box-Gum Woodland	Based on the infrastructure layout, which is considered to be a worst case scenario in terms of extent, 0.26 ha of Box-Gum Grassy Woodland (which meets the description of the EEC and CEEC) will be removed.	Minimise and manage impacts	The CEMP will include specific measures to address loss of habitat for Box-Gum Grassy Woodland and Derived Native Grassland. Management will include measures such as: • impacts will be minimised by siting the transmission lines and easements in areas that are already cleared for existing driveways and access gates where possible; • where hollow bearing trees are removed the material will be placed in adjacent habitat; • any hollows removed should be replaced with artificial hollows within adajacent suitable habitat; • clearing will be restricted to the canopy and mid-storey; and • remaining Box-Gum Grassy Woodland areas (including areas of DNG) will be delineated by barrier tape (or similar) to clearly demarcate these areas and limit the risk of vehicles or machinery causing damage to these areas.	Proponent in consultation with ecologist, OEH and DSEWPC

Issue	Description	Approach	Management Actions	Responsible Party
Fauna Mortality	Vegetation clearance and vehicle activity have the potential to cause mortality of fauna.	Pre-clearance protocol	The CEMP will define the pre-clearance protocol involving nocturnal surveys to evaluate the presence of any fauna within identified hollow bearing trees. When identified a qualified ecologist experienced in tree clearance should be present when hollow bearing trees are being removed to mitigate any impacts to fauna. Fencing will be erected along open trenches to prevent fauna falling into open cavities. Trench monitoring will be undertaken to rescue trapped fauna and the frequency and details of monitoring will be outlined in the CEMP. The CEMP will define management measures to reduce fauna mortality on roads and access tracks including speed limits and appropriate signage.	Proponent in consultation with ecologist, OEH and DSEWPC
Erosion, Runoff and Dust	The Project has the potential to influence erosion, runoff and dust within the Study Area. A range of mitigation measures are proposed to manage these impacts.	Manage impacts	Erosion and sediment control measures will be included in the CEMP to limit runoff to adjacent habitat areas and watercourses. Details will include devices to be installed, monitoring requirements and corrective actions. Management measures will include: • all erosion and sedimentation control devices regularly checked, cleared and repaired, particularly after periods of heavy rainfall; • rehabilitation and stabilisation methods to limit erosive and dust generation potential of earth areas exposed that are not required for permanent infrastructure; • disturbed soil surfaces should be stabilised as soon as practical after works have ceased in the area; • stockpiles will be covered to prevent the loss of material during high wind and rain events, and appropriate sediment barrier fencing will be used in areas to inhibit the flow of sediment into surrounding areas; and • stock pile locations will consider shelter from the wind where practical.	Proponent in consultation with erosion and sediment specialist

Issue	Description	Approach	Management Actions	Responsible Party
Hazardous Materials	Hazardous materials such as oils will be used during the construction and operational phases of the proposed action.	Prevent spills and manage risk	Storage of hazardous materials will be in designated areas specifically designed and constructed for containment. Emergency spill response procedures, including the location of spill kits, will be outlined in the project CEMP. Hazardous materials will be handled and stored according to regulatory requirements and Australian Standards AS1940.	Proponent in consultation with OEH / EPA

Table 6.4 Proposed Mitigation Measures – Operational Phase

Issue	Description	Approach	Management Actions	Responsible Party
Turbine Collisions or Barotrauma	Turbine collisions and barotrauma have been identified as a potential ongoing impact during the operation of the wind farm. A bird and bat monitoring program is proposed to manage this impact.	Bird and Bat Monitoring	A specific Bird and Bat Monitoring Plan will be developed with the objective of minimising the impacts of the operational wind farm on threatened bird species. The Bird and Bat Monitoring Plan will outline the required monitoring measures, key thresholds for determining permissible impacts and corrective actions that are required in order to achieve the objectives of the plan. The plan will also outline the roles and responsibilities for the proponent, operator and agencies in implementing, assessing and enforcing the plan. The plan will be developed in consultation with DSEWPC and OEH to ensure the plan meets the requirements of each agency. The frequency of report strike data will be determined during the preparation of the monitoring programme. The adaptive management measures that could be implemented should strike thresholds be reached, will be negotiated with OEH and SEWPaC when significant strike rates are detected. Bird and bat strike monitoring will be undertaken with consideration for the monitoring guidelines provided by the Australian Wind Energy Association (Brett Lane & Associates 2005).	Proponent in consultation with ecologist, OEH and DSEWPC
Hazardous Materials	Hazardous materials such as oils will be used during the construction and operational phases of the proposed action.	Prevent spills and manage risk	Storage of hazardous materials will be in designated areas specifically designed and constructed for containment. Emergency spill response procedures, including the location of spill kits, will be outlined in the project Operational Management Plan. Hazardous materials will be handled and stored according to regulatory requirements and Australian Standards AS1940.	Proponent in consultation with OEH / EPA

6.5 *RESIDUAL IMPACTS*

This section quantifies the direct residual impacts that are anticipated to occur as a result of the Project, following consideration of the avoidance and mitigation measures implemented for the Project. Indirect impacts which could not be quantified are discussed further in the Assessments of Significance (*Section 6.6*).

6.5.1 *Habitat Loss*

Vegetation clearance

Vegetation clearance will be required for the construction of the Project. Permanent vegetation relates to all areas associated with the permanent footprint of the Project including WTGs, access tracks, substations and overhead powerlines. Temporary impact relates to the area surrounding the permanent footprint which is required for construction. Mitigation measures will include revegetation, spreading mulched or cleared vegetation and spreading native grass seed with local species to enable the temporary impact area to return to a natural state.

The Development Footprint covers a total area of 251.18 ha. The Permanent Impact area covers 135.41 ha. The Temporary Impact area includes 115.77 ha that will be rehabilitated upon completion of construction.

Of the total Development Footprint, 122.48 ha comprises exotic pasture, cropping, planted vegetation or bare ground. The remaining 128.70 ha comprises native vegetation, as shown in *Table 6.3*. *Table 6.3* shows the breakdown of areas for both permanent and temporary impacts.

Table 6.5 Area of Each BVT in Development Footprint

BVT	Area in Study Area (ha)	Total Area in Development Footprint (ha)[1]	Permanent Impact Area (ha)	Temporary Impact Area (ha)
Box Gum Woodland - Mod_Good-EPBC	2.27	0.26	0.26	-
Box Gum Woodland - Mod_Good-TSC	65.27	3.08	2.57	0.51
Box Gum Woodland - Mod_Good-TSC-DNG	313.00	49.16	42.69	6.47
Box Gum Woodland - Low	469.57	48.94	38.11	10.83
Red Stringybark Open Forest - Mod_Good	99.24	5.28	3.75	1.53
Red Stringybark Open Forest - Low	238.72	21.98	17.39	4.59
Total	**1188.07**	**128.7**	**104.77**	**23.93**

1. The area of each BVT within the Development Footprint was calculated based on the area of Layout Option 1.

As shown in *Table 6.3,* vegetation removal will include 6.58 ha of woodland / open forest (comprising Box Gum Woodland - Mod_Good-EPBC, Box Gum Woodland - Mod_Good-TSC and Red Stringybark Open Forest - Mod_Good) and 49.16 ha of DNG. This includes 0.26 ha of Box-Gum Woodland that meets the description for the CEEC as listed under the EPBC Act and 45.52 ha of Box-Gum Woodland that meets the description for the EEC as listed under the TSC Act. The remaining area comprises Red Stringybark Open Forest. The remaining areas comprise native vegetation in low condition, ie the majority of the canopy has been removed and the groundcover comprises less than 50% native vegetation.

Vegetation removal results in a direct reduction in the extent of native vegetation types and flora and fauna habitat in the Study Area. The native vegetation in the Study Area is already highly fragmented; in particular Box-Gum Woodland comprises a highly cleared BVT, with an estimated 95% cleared in the Lachlan CMA (OEH 2012a). An estimated 25% of Red Stringybark Open Forest has been cleared in the Lachlan CMA (OEH 2012a).

In addition to the direct impact of removal of native vegetation, indirect impacts to adjacent and nearby native vegetation can result from vegetation removal. This includes the operation of edge effects, whereby a vegetation community's susceptibility to factors such as weed invasion and erosion are increased due to its increased exposure to surrounding disturbed environments. The vegetation community becomes less resilient and able to undergo natural regeneration.

As the Development Footprint comprises small and linear components spread over a large area, the effects of vegetation removal are minimal in comparison to large developments in small areas. The majority of the Project infrastructure has been sited to avoid areas of woodland and open forest, with the results of the ecological field surveys being considered throughout the iterative design process. This has resulted in avoidance of most areas of intact Box-Gum Woodland and habitat for threatened species. As such the connectivity of the Study Area to the surrounding Locality is unlikely to be impacted. The Study Area does not form part of a larger tract of woodland or open forest. The majority of vegetation to be removed comprises derived native grassland, exotic pasture or cropping, with only a small proportion of native woodland / open forest.

As the majority of vegetation to be removed is in a degraded condition, its removal would not impact on the viability of ecological communities or native flora species in the Study Area. It is unlikely to impact seed dispersal, animal movements or remove habitat features that are essential to species survival. The threatened species that are likely to be impacted by vegetation removal are discussed in *Section 6.4.*

A number of mitigation measures will be implemented during both the construction and operation phases to further reduce the impacts of the Project, as described in *Section 6.4.*

Fauna Habitats

The residual impacts on fauna habitats include the direct removal of habitat, fragmentation of habitats, and habitat becoming alienated for some species. Fauna habitat types recorded in the Study Area comprise of native woodlands, native grasslands, exotic grasslands and aquatic habitats. Within these habitat types, a variety of fauna habitat features exist, including hollow bearing trees, paddock trees, tussock grasslands, disused mines, farms dams, rocky outcrops and creek lines.

Approximately 313 ha of native grassland has been identified within the Study Area, this habitat type has the potential to provide habitat for threatened species such as the Striped Legless Lizard and the Pink-tailed Worm-lizard, where there are features such as rocky outcrops. Of the 313 ha identified within the Study Area, 49.16 ha has been recorded within the Development Footprint and of that, approximately 42.69 ha will be permanently removed for the placement of WTGs, construction of access tracks, substations and overhead powerlines. Approximately 6.47 ha of this habitat type will be reinstated after construction of the wind farm.

Approximately 166.78 ha of native woodland have been identified within the Study Area. This habitat type supports a range of threatened species such as woodland bird species, reptiles and mammal species. Key features recorded within this habitat type include hollow bearing trees and also rocky outcrops. Of the 166.78 ha of native woodland identified within the Study Area, 8.62 ha has been identified within the project footprint. Of the 8.62 ha within the project footprint approximately 6.58 ha will be permanently impacted upon for the placement of WTG's, crane pads access tracks and powerline easments. A further 2.04 ha will be reinstated following the finalization of the project.

Exotic grassland was the most commonly recorded habitat type with 708.29 ha being recorded throughout the Study Area. This habitat type was generally in poor condition as a result of past and current land management practices such as grazing. Important features within these areas are paddock trees which provide important breeding habitat for bird species such as the Superb Parrot and the Wedge-tailed Eagle. Other features restricted mainly to the slopes and ridges include rocky outcrops which provide some refuge for reptile species. Of the 708.29 ha identified within the Study Area a total of 70.92 ha has been recorded within the development footprint and of that 55.5 ha will be permanently impacted upon for the placement of WTG's, crane pads, accdess tracks, substations and construction compounds. Of the 55.5 ha 15.42 ha will be reinstated following construction of the wind farm.

Table 6.4 shows the breakdown of areas of habitat types that will be impacted permanently and temporarily.

Table 6.6 Fauna Habitats Impacted

Habitat type	Area in Study Area (ha)	Total Area in Development Footprint (ha)[1]	Permanent Impact Area (ha)	Temporary Impact Area (ha)
Native Grassland	313	49.16	42.69	6.47
Native woodland	166.78	8.62	6.58	2.04
Exotic Grassland	708.29	70.92	55.5	15.42
Total	1188.07	128.7	104.77	23.93

1. The area of each habitat type within the Development Footprint was calculated based on the area of Layout Option 1.

Approximately 449 hollow bearing trees that are predominately paddock trees have been mapped within 500 m of turbine infrastructure (see *Table 6.7*) as part of targeted Superb Parrot habitat mapping. Of the 449 trees recorded the project has the potential to impact upon 15 of those through the construction of access tracks, crane pads, construction compounds and powerline easements.

Careful planning taking the environmental values of the Study Area into consideration has resulted in the citing of the WTG's, access tracks, substation footprints and construction compounds to avoid woodland remnants and hollow bearing paddock trees where possible, that have the potential to provide shelter and or breeding habitat thus reducing the impacts of fragmentation of woodland. The potential loss of rocky habitats is generally associated with the construction pads on the upper slopes throughout the Study Area. Where possible, loss of rocky habitat will be avoided through inspection of areas at the final design stage.

Mitigation measures to minimise the impacts on fauna habitats include replacement of cleared habitat features such as rocks, hollows and timber into adjacent areas, retention of large hollow bearing trees, and replacement of hollows with artificial hollows with adjacent habitat and revegetation of impact area to return to a natural state. *Table 6.7* outlines the quantitative impacts to individual species and or species groups.

Table 6.7 Fauna Habitat Impacts

Species	Impact	Habitat Type	Total in Study Area (ha)	Total Impacted Area (ha)
Superb Parrot	Habitat removal	Box Gum Woodland Stringybark Woodland, Hollow Bearing Trees	166.78 – 449 (HBT)	6.58 - 15(HBT)
Powerful Owl, Barking Owl	Habitat removal	Box Gum Woodland, Red stringy bark open forest, Hollow Bearing Trees	166.78 - 449(HBT)	6.58 - 15(HBT)
Woodland Birds	Habitat removal	Box Gum Woodland, Red stringy bark open forest, Hollow Bearing Trees	166.78 – 449 (HBT)	6.58 – 15 (HBT)

Species	Impact	Habitat Type	Total in Study Area (ha)	Total Impacted Area (ha)
Regent Honeyeater, Swift Parrot	Habitat removal (Foraging only)	Box Gum Woodland, Red Stringybark Open Forest	166.78	6.58
Turquoise Parrot, Gang-gang Cockatoo	Habitat removal Hollow Bearing trees	Box Gum Woodland, Red Stringybark Open Forest	166.78 – 449 (HBT)	6.58 – 15 (HBT)
White-fronted Chat	Habitat removal	Natural Temperate Grassland and grassland derived from Box-Gum Woodland	313	42.69
Squirrel Glider	Habitat removal, Fragmentation	Box Gum Woodland, Hollow Bearing Trees	2.26	0.26
Koala	Habitat removal, Fragmentation	Box Gum Woodland, Red stringy bark open forest	166.78	6.58
Striped Legless Lizard	Habitat removal, disturbance	Open Box Gum Woodland, Native grassland	313	42.69
Pink-tailed Worm lizard	Habitat removal, disturbance	Open Box Gum Woodland, Native grassland.	313	42.69
Rosenbergs goanna	Habitat removal, disturbance	Woodland Habitats including Box Gum Woodland, Red Stringybark Open Forest.	166.78	6.58
Spotted Harrier Little Eagle Square-tail Kite	Habitat removal, Blade strike	Woodland Habitats including Box Gum Woodland, Red Stringybark Open Forest.	166.78	6.58
Golden Sun Moth	Habitat removal	DNG, Low condition Box Gum Woodland	782.57	98.1
Bats	Habitat removal, Blade Strike	Hollow Bearing Trees	166.78 - 449 (HBT)	6.58 – 15 (HBT)

HBT = Hollow Bearing tree

The proximity of infrastructure to key habitat features, such as hollow-bearing trees, rocky outcrops or water bodies would impact on fauna during construction. Fauna may also be impacted by disturbance during the operational phase of a wind farm. Noise, light flicker and vibration may have impacts during sensitive periods, such as the breeding season for some species, or lead to alienation of habitat. The extent of impact depends on turbine design, wind farm layout as well as ecological characteristics of particular species.

Wildlife Corridors

The wind turbies and infrastructure have been located to avoid the removal of large tracts of forest or woodland that would be associated with key wildlife corridors within the Study Area and Locality.

Overhead transmission line easements have the potential to impact on wildlife corridor connectivity by fragmeting tracts of forest or woodland. Potential fragmentation or isolation of these habitats has been largely avoided for the majority of the alignment by utilising cleared areas or existing easements wherever possible.

Aquatic Habitats

The majority of the creeklines and drainage areas throughout the Study Area are ephemeral in nature. Infrastructure such as access tracks have largely been sited to avoid waterways. Crossings of creeks and streams would affect riparian and aquatic habitats during the construction phase, and would result in stream bank and stream bed disturbance. Crossings that impede fish passage are a danger and can result in a major loss of breeding and foraging habitat by fragrementation.

Where creek crossings would be required for road construction and an existing crossing would be upgraded, the removal of riparian vegetation at creek crossings would be largely limited to road construction and upgrades of existing roads. Impacts to riparian and aquatic vegetation would be minimised by reducing disturbance of areas at creek crossings and siting of crossings to avoid mature and native riparian vegetation. Additionally, mitigation measures can be undertaken to address these risks. Best practice erosion and sediment controls would be implemented during creek works, including silt fencing and avoidance of works during rain or high flows. The selection of the type of crossing and construction methods would comply with relevant DI&I (Fisheries) guidelines, to ensure that potential impacts would be minimised. Instream habitat would be left in place or relocated nearby within the same creek system.

6.5.2 Collision Risk

The impact of collision risk on bird species has been quantified by carrying out a bird risk collision model. The model has been based on data recorded by the BUS surveys and this information forms stage one of the bird risk collision analysis.

RSA Height

RSA height refers to the area containing Rotor Swept Area (RSA), ie the area between the tips of the rotor blades of a WTG. For analysis of the data collected durng the BUS, a minimum height of the rotor blade above the ground of 20 m was adopted, with the highest point of the blade being up to

150 m. WPCWP indicated that 25 m would represent a worst case scenario and the final height is more likely to be greater than 30 m. The analysis presented in this report is therefore a conservative 'worst-case' approach.

Sixteen different bird species were observed flying at RSA height during the BUS surveys. A total of 85 individual birds were recorded flying at and above RSA height, which is 6.4% of the number of birds recorded (*Table 6.6*). The remaining 93.6% of birds recorded were flying below the RSA height. A species accumulation curve was created (*Figure 6.1*) for species recorded flying at and above RSA height. This illustrates a pronounced asymptote indicating that the surveys had reached a point where no more new species were being recorded flying at RSA height.

Figure 6.2 illustrates the abundance of birds recorded Flying at RSA height and at how many different sites they were recorded. The species which were most abundant flying at RSA height were the Sulphur Crested Cockatoo (29) Australian Raven (13) and Australian Magpie (8). The Wedge-tailed Eagle (*Aquila Audax*) was recorded at four different sites. This species was recorded across the Study Area and is not likely to be restricted to particular habitat types. Typically they were observed singly or in pairs. The majority of the other abundant species were recorded at only one or two sites, however were recorded in flocks.

Table 6.8 Bird Species Data

Data	Numbers	%
Birds at RSA	85	6.4
Birds Below RSA	1250	93.6
Birds Above RSA	0	0
Total	1335	

Figure 6.1 Species Accumulation Curves for Species Recorded at RSA Height

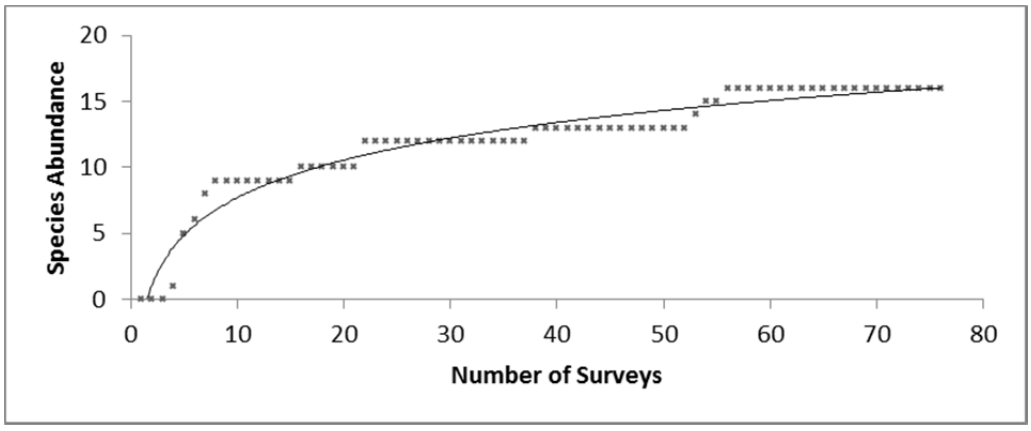
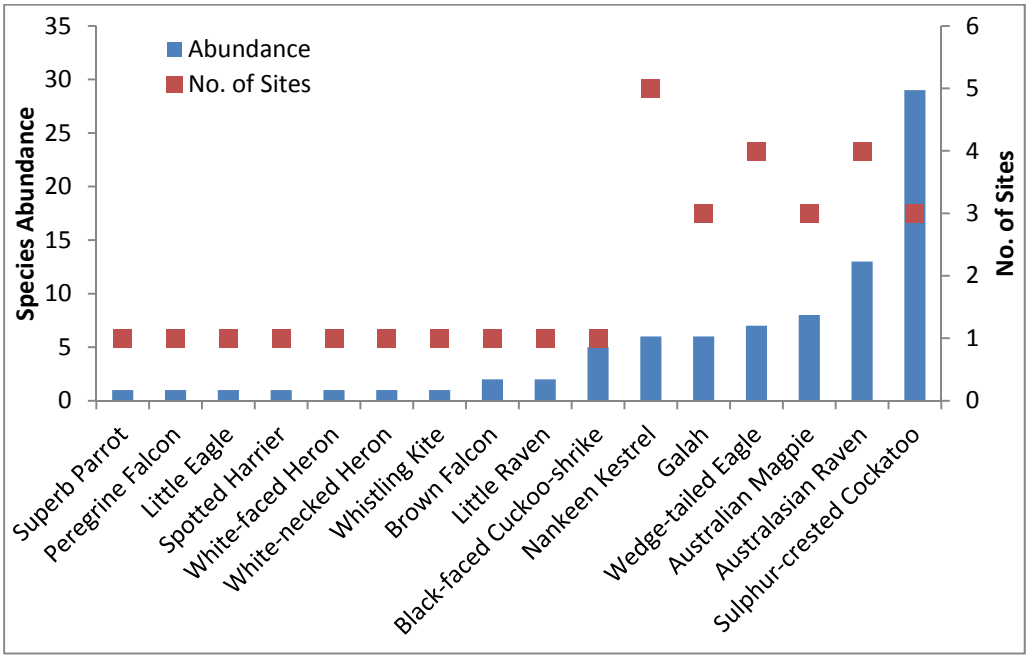


Figure 6.2 ***Abundance of Species Flying at RSA Height and the Frequency Species are Recorded at Each Site***



Threatened Species Recorded

A breakdown of the data collected for the threatened species recorded is shown in *Table 6.7*. This table illustrates that the most abundant threatened species recorded was the Superb Parrot (148) from a total of eight different BUS sites. One Superb Parrot was recorded at RSA height during the surveys which is 0.7 % of the total number recorded. *Table 6.7* also shows that 147 (99.3%) of the Superb Parrots recorded during the BUSs were flying below RSA height. A total of 164 individual threatened birds from six different species were recorded from 16 of the 20 survey sites. Three (1.8%) of the threatened species were recorded flying at RSA height. A total of 161 birds (98%) of those identified were recorded at below RSA height. Superb Parrots were typically observed moving to or from areas to forage. Foraging areas tended to be those used for cropping grain. After the month of January the Superb Parrot was rarely recorded within the Study Area. This coincided with the harvesting of grain and the end of the breeding season for the Superb Parrot.

Table 6.9 Threatened Species Data Analysis

Threatened species	Individuals recorded	Number of Sites	Individuals at RSA height	% at RSA height	Number of Sites recorded at RSA height	Individuals below RSA	% below RSA height	Number of Sites recorded below RSA height
Superb Parrot	148	8	1	0.7	1	147	99.3	8
Brown Treecreeper	2	1	0	0	0	2	100	1
Spotted Harrier	1	1	1	100	1	0	0	0
Diamond Firetail	1	1	0	0	0	1	100	1
Rainbow Bee-eater	11	4	0	0	0	11	100	4
Little Eagle	1	1	1	0	1	0	0	0
Total	164	16	3	1.8	3	161	98.2	14

Collision Risk Model

Collision risk was estimated for the threatened species recorded within the Study Area. This assessment was carried out on those threatened species identified flying at RSA height using data collected from the BUS. Some bird species were not included in the assessment because all individuals recorded during the BUS were below the RSA height during the surveys and thus the risk cannot be determined by the adopted calculations. The bird species assessed include the Superb Parrot, Spotted Harrier, Little Eagle and Wedge-tailed Eagle.

In this assessment the Collision Risk Model (CRM) developed for Scottish National Heritage is used to calculate the collision risk (see *Annex G* for detailed methodology adopted). CRM has been generally accepted to estimate bird collision risk in impact assessment of bird for various wind farm development projects. In addition, we have estimated the risk in two different situations. The first situation is that birds fly as if the wind turbine structures and rotors were not there and take no avoiding action (ie death). In reality most birds do take avoiding action and therefore the collision risk is usually adjusted by the avoidance factor. The avoidance rate accounts for the behaviour of birds avoiding collision with a WTG, and is a standard element in the calculation of collision risk (Smales 2005).

Two avoidance factors were used in the CRM for the Project. A conservative avoidance rate of 95% was applied as the baseline. A less conservative 99% avoidance rate was also applied, which is the avoidance factor which has been applied to numerous CRMs in Australia, including those developed for migratory parrot assessments for DSEWPC (i.e. Smales 2005).

The following presents the results of individual assessment for each species, followed by an overall assessment of the impact. The calculations of collisions are detailed in *Annex I. Table 6.8* below presents the summary results of the number of collisions predicted in each season for each species.

Table 6.10 Number of Bird Collisions Predicted (Number per Month) within the Study Area

Species	Number of Collisions per month at 95 % and 99 % avoidance rates							
	November		December		January		February	
Avoidance Factor	95 %	99 %	95 %	99 %	95 %	99 %	95 %	99 %
Superb Parrot	0.027	0.0055	0	0	0	0	0	0
Little Eagle	0.028	0.0057	0	0	0	0	0	0
Spotted Harrier	0	0	0.024	0.0048	0	0	0	0
Wedge-tailed Eagle	0.046	0.0092	0.012	0.0024	0.22	0.044	0.14	0.028

Superb Parrot

Within the Study Area the Superb Parrot were sighted in November and December only during the surveys and only one individual was recorded at RSA height during this time. The number of collisions predicted was 0.55 birds in November under no avoidance situation. After applying the 95% avoidance factor, the number of collisions predicted is 0.027, with the more realistic avoidance rate of 99 % this fell to 0.0055 birds for the month of November based on the data collected. The number predicted under the 99% avoidance rate is considered negligible when compared with the total number of individuals recorded during the surveys (~0.004% of 148 individuals). The impact of collision to this bird species is therefore not considered adverse.

Little Eagle

Within the Study Area the Little Eagle was sighted once in November during the surveys and was recorded at RSA height. The number of collisions predicted was 0.57 birds in November under no avoidance situation. After applying the 95% avoidance factor, the number of collisions predicted is 0.028, with the more realistic avoidance rate of 99 % this fell to 0.0057 birds for the month of November based on the data collected. The number predicted under the 99% avoidance rate is considered negligible when compared with the total number of individuals recorded during the surveys (~0.57% of 1 individual). The impact of collision to this bird species is therefore not considered adverse.

Spotted Harrier

Within the Study Area the Spotted Harrier was sighted once in November at RSA height. The number of collisions predicted was 0.48 birds in November under no avoidance situation. After applying the 95% avoidance factor, the number of collisions predicted is 0.024, with the more realistic avoidance rate of 99 % this fell to 0.0049 birds for the month of November based on the data collected. The number predicted under the 99% avoidance rate is considered negligible when compared with the total number of individuals recorded during the surveys (~0.49 % of 1 individual). The impact of collision to this bird species is therefore not considered adverse.

Wedge-tailed Eagle

Within the Study Area the Wedge-tailed Eagle was sighted in November, December, January and February at RSA height. The number of collisions predicted was 0.95 birds in November, 0.24 in December, 4.40 in January and 2.83 in February under no avoidance situation. After applying the 95% avoidance factor, the number of collisions predicted is 0.046 birds in November, 0.012 in December, 0.22 in January and 0.14 in February. With the more realistic avoidance rate of 99 % this fell to 0.0093 birds for the month of November, 0.0024 in December, and 0.044 in January and 0.028 in February based on the data collected. The number predicted under the 99% avoidance rate is considered negligible when compared with the total number of individuals recorded during the surveys (~0.28 % of 1 individual). The impact of collision to this bird species is therefore not considered adverse..

6.6 ASSESSMENT OF SIGNIFICANCE

This section provides and Assessment of Significance of threatened species and communities considered Known, Likely or potential to occur within the Study Area, as identified in the Likelihood of Occurrence Assessment in *Section 5.13*.

6.6.1 Threatened Species

A Likelihood of Occurrence Assessment was undertaken which grouped threatened ecological communities and threatened species into four likelihood categories, as outlined in *Section 5.10*.

The species listed in *Table 6.9* were classified as known within the Study Area, as likely to occur within the Study Area or with the potential to occur within the Study Area. Assessments of Significance under Section 5A of the EP&A Act (seven part tests) were undertaken for these species.

Table 6.11 Threatened Species Assessed under the TSC Act

Scientific Name	Common Name	TSC Act	EPBC Act
EECs			
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	EEC	CEEC
Flora			
Ammobium craspedioides	Yass Daisy	V	V
Caladenia concolor	Crimson Spider Orchid	E	E
Diuris aequalis	Doubletail Buttercup	E	V
Eucalyptus robertsonii subsp. Hemisphaerica	Robertson's Gum	V	V
Lepidium hyssopifolium	Aromatic Peppercress	E	E
Leucochrysum albicans var. tricolor	Hoary Sunray	-	E
Prasophyllum petilum	Tarengo Leek Orchid	E	E

Scientific Name	Common Name	TSC Act	EPBC Act
Rutidosis leptorrhynchoides	Button Wrinklewort	E	E
Swainsona recta	Mountain Swainson Pea	E	E
Swainsona sericea	Silky Swainson-pea	E	-
Invertebrates			
Synemon plana	Golden Sun Moth	E	CE
Reptiles			
Aprasia parapulchella	Pink-tailed Worm-lizard	V	V
Delma impar	Striped Legless Lizard	V	V
Varanus rosenbergi	Rosenberg's Goanna	V	-
Birds			
Anthochaera phrygia	Regent Honeyeater	CE	E
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	-
Circus assimilis	Spotted Harrier	V	-
Chthonicola sagittatus	Speckled Warbler	V	-
Climacteris picumnus victoriae	Brown Treecreeper - eastern subspecies	V	-
Daphoenositta chrysoptera	Varied Sittella	V	-
Epthianura albifrons	White-fronted Chat	V	-
Glossopsitta pusilla	Little Lorikeet	V	-
Grantiella picta	Painted Honeyeater	V	-
Hieraaetus morphnoides	Little Eagle	V	-
Lathamus discolour	Swift Parrot	E	E
Lophoictinia isura	Square-tailed Kite	V	-
Melanodryas cucullata cucullata	Hooded Robin - south-eastern form	V	-
Melithreptus gularis gularis	Black-chinned Honeyeater - eastern subspecies	V	-
Neophema pulchella	Turquoise Parrot	V	-
Ninox connivens	Barking Owl	V	-
Ninox strenua	Powerful Owl	V	-
Petroica boodang	Scarlet Robin	V	-
Petroica phoenicea	Flame Robin	V	-
Polytelis swainsonii	Superb Parrot	V	V
Pomatostomus temporalis temporalis	Grey-crowned Babbler - eastern subspecies	V	-
Stagonopleura guttata	Diamond Firetail	V	-
Mammals			
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	-
Petaurus norfolcensis	Squirrel Glider	V	-
Phascolarctos cinereus	Koala	V	V
Pteropus poliocephalus	Grey-headed Flying-fox	V	V
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-

CE = Critically Endangered, CEEC = Critically Endangered Ecological Community, E = Endangered, V = Vulnerable

Assessments of Significance were undertaken for one EEC and 39 threatened species including:

- ten threatened plants;
- one threatened moth;
- three threatened reptiles;

- twenty one birds; and
- four mammals (including two bats).

The Project will result in direct and indirect impacts to all the threatened species and the EEC due to direct clearing of vegetation, removal and modification of habitat, the risk of collision with rotors and barotrauma. However, as a result of the application of avoidance and mitigation measures, the Project is unlikely to result in a significant impact to any of the species or the EEC. A summary of the results of the seven part tests for each species or group of species is provided below.

Box-Gum Woodland

Box-Gum Woodland occurs throughout the Study Area in varying conditions. The Project will involve clearing of a small area of intact woodland and larger areas of DNG. This will reduce the extent of the EEC, however, as the majority of the intact Box-Gum Woodland will be retained in the Study Area, the Project is unlikely to have a significant impact on the EEC.

Plants

The threatened plants were not recorded in the Study Area during field surveys, however, potential habitat for all ten threatened plants occurs. Areas of potential habitat will be removed or modified as part of the Project, the majority of which comprises grassland habitat. Areas of similar habitat occur throughout the Study Area and Locality and the removal of this habitat is unlikely to significantly impact these species. As the Development Footprint is narrow and linear, it is unlikely to affect fragmentation, seed dispersal and vegetative reproduction to the extent that it will significantly impact these species, should they occur in the Development Footprint.

Golden Sun Moth

This species was recorded during field surveys in native grassland areas throughout the Study Area. The proposal would result in the removal of habitat and also result in the fragmentation of existing habitat. To mitigate these impacts a Flora and Fauna Management Plan would be implemented outlining measures to minimise disturbance to mapped GSM habitat, to conduct works outside of the flying period and delineating habitat by barrier tape to limit the risk of vehicles traversing through habitat accidently. The preservation of key sites would further mitigate any impacts to this species. With the mitigation measures implemented it is unlikely that the proposal would result in a significant impact on the Golden Sun Moth.

Lizards

None of these species were recorded during field surveys, however, the Study Area may provide potential habitat for these species. Potential impacts to these reptiles include removal of habitat. A portion of woodland habitat that is preferred habitat for Rosenberg's Goanna would be removed as part of the project. This is unlikely to increases the levels of fragmentation within the Study Area as it is already highly fragmented. The project has avoided impacts on large tracts of woodland by the relocation of turbines and infrastructure to minimise impacts on woodland and associated grasslands. Furthermore, the demarcation of key habitat areas for the Striped Legless Lizard and Pink-tailed Worm-lizard would ensure these habitats be preserved and improved. Through the implementation of mitigation measures to avoid disturbance to areas of key habitat for these species, it is unlikely that the Project would have a significant impact on these species.

Woodland Birds

The proposal would not significantly impact on the Brown Treecreeper, Diamond Firetail, Varied Sittella Flame Robin, Scarlet Robin, Grey-crowned Babbler, Speckled Warbler or Hooded Robin. Habitat loss for these species would constitute removal of a small amount of woodland and forest. Hollow-bearing trees and fallen timber would be retained where possible to mitigate impacts. Furthermore, habitat loss would be offset by preserving and improving large areas of woodland that are in moderate to good condition.

Swift Parrot and Regent Honeyeater

The Project is unlikely to have a significant impact on the Regent Honeyeater or the Swift Parrot. The project would result in the removal of a small portion of the total habitat available to these species. The resources available within the Study Area would be regarded as sub optimal and this is shown by the lack of records of these species within the Locality. The Study Area does not represent an area of optimal breeding habitat for either of these species as both of these species have well known breeding areas. The presence of either of these species within the Study Area would be regarded as a stopover and would generally be in small numbers. Therefore the collision risk with a turbine rotor to these species would be considered very low.

Little Lorikeet and Black-chinned Honeyeater

The proposal would not significantly impact on the Little Lorikeet or Black-chinned Honeyeater. Habitat loss for these species would constitute removal of a small amount of woodland and forest. Hollow-bearing trees and fallen timber would be retained where possible to mitigate impacts. As these species are very mobile, the impact of habitat fragmentation would not significantly impact these species. Furthermore, habitat loss would be offset by preserving and improving large areas of woodland that are in moderate to good condition.

Turquoise Parrot and Gang-gang Cockatoo

The proposal would not significantly impact on the Turquoise Parrot or Gang-gang Cockatoo. Habitat loss for these species would constitute removal of a small amount of woodland and forest. Hollow-bearing trees and fallen timber would be retained where possible to mitigate impacts. The Study Area does not constitute as known breeding habitat for either of these species and as such no known breeding habitat would be removed or modified. These species both have foraging habitats that rely on terrestrial resources. As these species move from resource to resource they are unlikely to fly at RSA height and would therefore be at little risk of collision with a wind turbine. Both of these species are very mobile thus the impact of habitat fragmentation would not significantly impact these species. Furthermore, habitat loss would be offset by preserving and improving large areas of woodland that are in moderate to good condition.

White-fronted Chat

The Project is unlikely to have a significant impact on the White-fronted Chat. The Project would involve the removal of a small amount of habitat that is available to the White-fronted Chat within the Study Area. To offset potential impacts to this species mitigation measures will be adopted to minimise the impacts of vegetation removal. Habitat loss would be offset by preserving and improving large areas of woodland that are in moderate to good condition.

Superb Parrot

The Project would result in the removal of a small portion of foraging and breeding habitat for this species. Field surveys recorded this species throughout the Study Area, thus showing that the resources within the Study Area are important for the survival of this species. This species was recorded once flying at RSA height during the BUS which took place over the species breeding season. The Superb Parrot was observed mostly flying at below RSA height, thus is generally unlikely to be at risk of a collision with a turbine. Habitat removal would be very minor in comparison to the resources available to these species. The Project would impact on potential breeding habitat, however, it would be generally regarded to be below a threshold which would be considered as a significant impact. It is concluded that the Project would not result in a significant impact to the Superb Parrot, however, this species is considered to be a local key species and would be monitored as part of a bird and bat monitoring program.

Raptors

Whilst the Project would reduce vegetated habitat for nesting by 8.62 ha for these three raptors, much of the vegetation on the steep slopes and paddock trees throughout the site would be retained. Potential Little Eagle nesting habitat on the higher slopes is unlikely to be impacted as much of the taller trees in these locations would be retained. The Spotted Harrier is unlikely to be impacted by turbine collision as they generally fly below RSA height. The Square-tailed Kite and Little Eagle could be impacted by collision as they both forage in the sweep zone however, as raptors are known to avoid turbines, it is likely that mortality rates would be minimal. The Project would not significantly impact on the Square-tailed Kite or Spotted Harrier. It is unlikely that the Project would significantly impact on the Little Eagle, however, this species is considered to be a key species and would be monitored as part of the bird and bat monitoring program.

Owls

The Project would not significantly impact on the Powerful Owl or the Barking Owl provided mitigation measures are implemented. Habitat loss for these species is largely through loss of hollow-bearing trees and stags as breeding resources. Hollow-bearing trees and stags would be retained where possible to mitigate impacts. The Project has been designed to avoid large tracts of remnant habitat. Furthermore, habitat loss would be offset by preserving and improving these large areas of woodland.

Bats

Whilst the proposal would reduce potential roosting habitat for the Yellow Bellied Sheathtail bat and foraging habitat for both of these bat species, the loss of habitat would be very small incomparison to the resources available in the greater Study Area. The Yellow-bellied Sheathtail Bat and Eastern Bentwing Bat could be impacted by turbine collision/barotrauma as they fly in the sweep zone. The Yellow-bellied Sheathtail Bat is likely to occur in low numbers and therefore unlikely to be impacted at a population level. Potential impacts to this species are not likely to be significant. Impacts to the Eastern Bentwing Bat would also be minor as this species was only recorded at two sites and not in great numbers. There is also no evidence to suggest this species utilises the site heavily for foraging from a known nearby maternity cave. It is therefore unlikely that the proposal would significantly impact on the Eastern Bentwing Bat, however, this species is considered to be a key species and would be monitored as part of the bird and bat monitoring program.

Koala

The Project would result in the removal of a small portion of sub optimal habitat for the Koala. A small portion of this sub optimal habitat would be fragmented to make way for infrastructure. The Koala is a very mobile species and readily takes to the ground to move through the landscape. The clearance of a small amount of sub optimal habitat is unlikely to fragment existing habitat or isolate an existing population of this species within the Study Area. Furthermore the adoption of mitigation measures to retain large tracts of woodland would further reduce any impacts to this species. The Project is unlikely to significantly impact on the Koala.

Squirrel Glider

The Squirrel Glider was recorded during the field surveys. The greatest impact to this species would be habitat fragmentation. The hollow bearing trees to be removed would not constitute optimal breeding habitat for this species thus would be unlikely to significantly impact on the lifecycle of this species. The removal of a portion of habitat within the road corridor may increase the level of habitat fragmentation on this species by impeding movement through the road corridor. If mitigation measures such as the retention of as many large trees as possible, and the replacement of hollows with artificial hollows within adjacent habitat in the area of impact are implemented, it is unlikely that the proposal would have a significant impact on the Squirrel Glider.

6.6.2 Key Threatening Processes

Key threatening processes (KTP) are processes that threaten, or could threaten, the survival or evolutionary development of species, populations or ecological communities. KTPs adversely affect two or more threatened species, populations or ecological communities, or cause species, populations or ecological communities that are not currently threatened to become threatened (OEH 2011). KTPs are listed under Schedule 3 of the TSC Act. The Project will result in the operation of the following KTPs:

- Clearing of native vegetation; and
- Removal of hollow bearing trees.

The impacts of this as they relate to threatened species and ecological communities in the Study Area are discussed in the Assessments of Significance provided in *Annex F.*

6.7 *CUMULATIVE IMPACTS*

Cumulative impacts refer to the impacts that accumulate over time as a result of successive projects in the same area. Consideration of cumulative impacts assesses the impacts of the Project in the context of all the existing and future projects in the area. There are no existing wind farms in the vicinity of the Study Area, however, one has been approved and three are proposed in the vicinity of the Bango Wind Farm including:

- Rugby Wind Farm (proposed, 52 WTGs, the nearest turbine will be approximately 10.6 km to the north east of the Project);
- Rye Park Wind Farm (proposed, >100 WTGs, the nearest turbine will be approximately 6.8 km to the east of the Project);
- Conroys Gap Wind Farm (approved, 15 WTGs, the nearest turbine will be approximately 22 km to the south of the Project); and
- Yass (proposed, up to 152 WTGs, the nearest turbine will be approximately 17.8 km to the south of the Project).

These Wind Farms and the Bango Wind Farm occur within a key breeding area for the Superb Parrot (Birdlife International 2013)

Cumulative impacts associated with multiple wind farms include on ground impacts, such as clearing of vegetation and habitat, and impacts to the airspace used by birds and bats.

Apple Box – Yellow Box Grassy Woodlands and other associated grassy woodlands that meet the description of the listed Box Gum Woodland and derived native grassland EEC and CEEC occur throughout the region. All these vegetation types are highly cleared vegetation types in the Lachlan CMA. The cumulative impact of clearing of these vegetation types would result in further reduction and possible fragmentation of the EEC and CEEC. However, the extensive clearing that has been undertaken in the area for agricultural purposes allows the majority of WTGs and other infrastructure to be sited in areas that do not comprise intact Box Gum Woodland or intact vegetation types. This principle of avoidance has been applied as much as possible to this Project. Furthermore, offsets will include Apple Box – Yellow Box Grassy Woodland, thus resulting in protecting areas of this vegetation type in perpetuity.

The Wedge-tailed Eagle is not listed under the TSC Act or the EPBC Act, but is considered to be a species that is particularly susceptible to the impacts of wind farms in NSW (Alison Treweek, OEH, pers. comm). Potential impacts to the Wedge-tailed Eagle include loss of breeding habitat in the form of large trees being removed, and death or injury from rotor collisions. The Wedge-tailed Eagle was recorded seven times at four locations during the BUS in the Study Area. Rotor collisions are a potential risk for this species, and evidence

certainly indicates that mortality occurs at operational wind farms in NSW. This species was the fourth most common species recorded flying at RSA height within the Study Area and is therefore susceptible to the impacts of rotor strike, which may cause mortalities and affect individuals within the Study Area.

A study completed on the Tasmanian Wedge-tailed Eagle (*Aquila audax fleayi*), modelled cumulative impacts of seven wind farms on the Tasmanian Wedge-tailed Eagle across the species' range (Smales et al 2005). The study concluded that the *cumulative impacts of collision with turbines on the overall population of Tasmanian Wedge-tailed Eagles…for current and presently proposed wind farms within the species' range, are very small and it is thus highly likely that their effects would be masked by normal fluctuations in the population due to natural environmental variables* (Smales et al 2005). It is therefore postulated that significant cumulative impacts on the common non-threatened mainland form of the Wedge-tailed Eagle could occur, but evidence indicates that it is unlikely, particularly given the species' abundance throughout NSW.

The operation of a number of wind farms in the area is likely to increase the chance of blade strike for birds and bats and has the potential to increase habitat alienation. The proposed layout has incorporated consideration of areas that are ecologically sensitive and avoid potential migration paths of native species. Turbine clusters have been sited to avoid occurring in or near areas of high habitat values.

6.8 OFFSET MEASURES

The residual impacts of the Project have been analysed using the BioBanking Credit Calculator, in order to determine the size and nature of an appropriate offset, in accordance with the BioBanking Regulation. The BioBanking Assessment is summarised below, with the full assessment including Credit Report provided in *Annex H*.

6.8.1 BioBanking Assessment Methodology

A BioBanking Assessment of the Project was undertaken by Accredited BioBanking Assessor Evelyn Craigie, following the BBAM, in accordance with the methods described in *Chapter 4.5*.

The relevant BioBanking Assessment details are provided in *Table 6.10*.

Table 6.12 BioBanking Assessment Details

Component	Data
Proposal ID	0089/2012/0333D
Assessor Name/Accreditation Number	Evelyn Craigie/0089
Assessment Type	Development
Catchment	Lachlan
Sub-catchment	Upper Slopes
Mitchell Landscape	Boorowa Volcanics

Assessment Circles

Initially eighteen x 1000 ha and 100 ha assessment circles were used to cover the entire Development Footprint. The percent native vegetation cover was estimated in each of the eighteen 1000 ha and 100 ha circles into one of three categories: <10%, 11-30% and 31-70% (none of the assessment circles had a percent native vegetation cover of > 70%). The circles and their vegetation zones (and associated Threatened Species Subzones) within the circles in each of the three categories were amalgamated.

Vegetation Zones

Vegetation zones are relatively homogenous areas of the same vegetation type and similar condition. Each vegetation zone should be a distinct vegetation type (according to the Vegetation Types Database) and similar broad condition state, i.e. moderate / good or low (DECC 2009). There are six vegetation zones across the site, as shown in *Table 6.11*.

Table 6.13 Vegetation Zones

BVT Code	Vegetation Zone	Equivalent Endangered Ecological Community (listed under the TSC Act)
LA103	Box Gum Woodland - Mod_Good-EPBC	White Box Yellow Box Blakely's Red Gum Woodland
LA103	Box Gum Woodland - Mod_Good-TSC	White Box Yellow Box Blakely's Red Gum Woodland
LA103	Box Gum Woodland - Mod_Good-TSC-DNG	White Box Yellow Box Blakely's Red Gum Woodland
LA103	Box Gum Woodland - Low	-
LA182	Red Stringybark Open Forest - Mod_Good	-
LA182	Red Stringybark Open Forest - Low	-

The Development Footprint area is based on the permanent Development Footprint and does not include areas of temporary disturbance.

6.8.2 *Biobanking Credit Requirements*

The BioBanking credit calculator provides a credit report showing the ecosystem and species credits required to offset the development. In summary, the proposal requires 1827 ecosystem credits and 2240 species credits. This output should be read in conjunction with the BioBanking assessment report included as *Annex* H.

The BioBanking Credit Converter was used to convert the Ecosystem Credit and Species Credit requirements into an equivalent amount of hectares required for the offset. The Ecosystem Credit and equivalent number of hectares required for the offset is shown in *Table 6.14*. The Species Credit and equivalent hectare requirements are shown in *Table 6.15*.

Table 6.14 Ecosystem Credit requirements and their equivalent in hectares

BVT Code	BVT name	Area in Study Area (ha)	Area in Development Footprint (ha)	Required Credits	Equivalent Hectares required
LA103	Apple Box - Yellow Box dry grassy woodland of the South Eastern Highlands	850.11	83.63	1428	153.5
LA182	Red Stringybark - Scribbly Gum - Red Box - Long-leaved Box shrub - tussock grass open forest the NSW South Western Slopes Bioregion	337.96	21.14	399	42.9

1. Data is based on the Credit Report provided in Annex H and the BioBanking Credit Converter

Table 6.15 Species Credit requirements and their equivalent in hectares

Species Name	Common Name	TSC Act Status	Extent of impact	Tg* value	Number of credits required	Equivalent hectares required
Hieraaetus morphnoides	Little Eagle	V	6.58	0.74	89	15
Circus assimilis	Spotted Harrier	V	6.58	0.74	89	15
Synemon plana	Golden Sun Moth	E	82.48	0.40	2062	344

*1. *Tg value relates to the species' response to environmental gain, as defined in the BioBanking Credit Calculator.*

6.8.3 *Offset Site Investigations*

The results of the BioBanking Assessment have informed preliminary offset site investigations. The credit requirement for each BVT was converted to hectares, using the credit to hectare converter developed by OEH, as shown in *Table 6.14*. The area generated for each BVT was then matched with equivalent vegetation types within the Locality, based on CMA scale vegetation mapping (DECC 2008) (see).

The species credit requirement was also converted to hectares, using the credit to hectare converter (see *Table 6.15*).

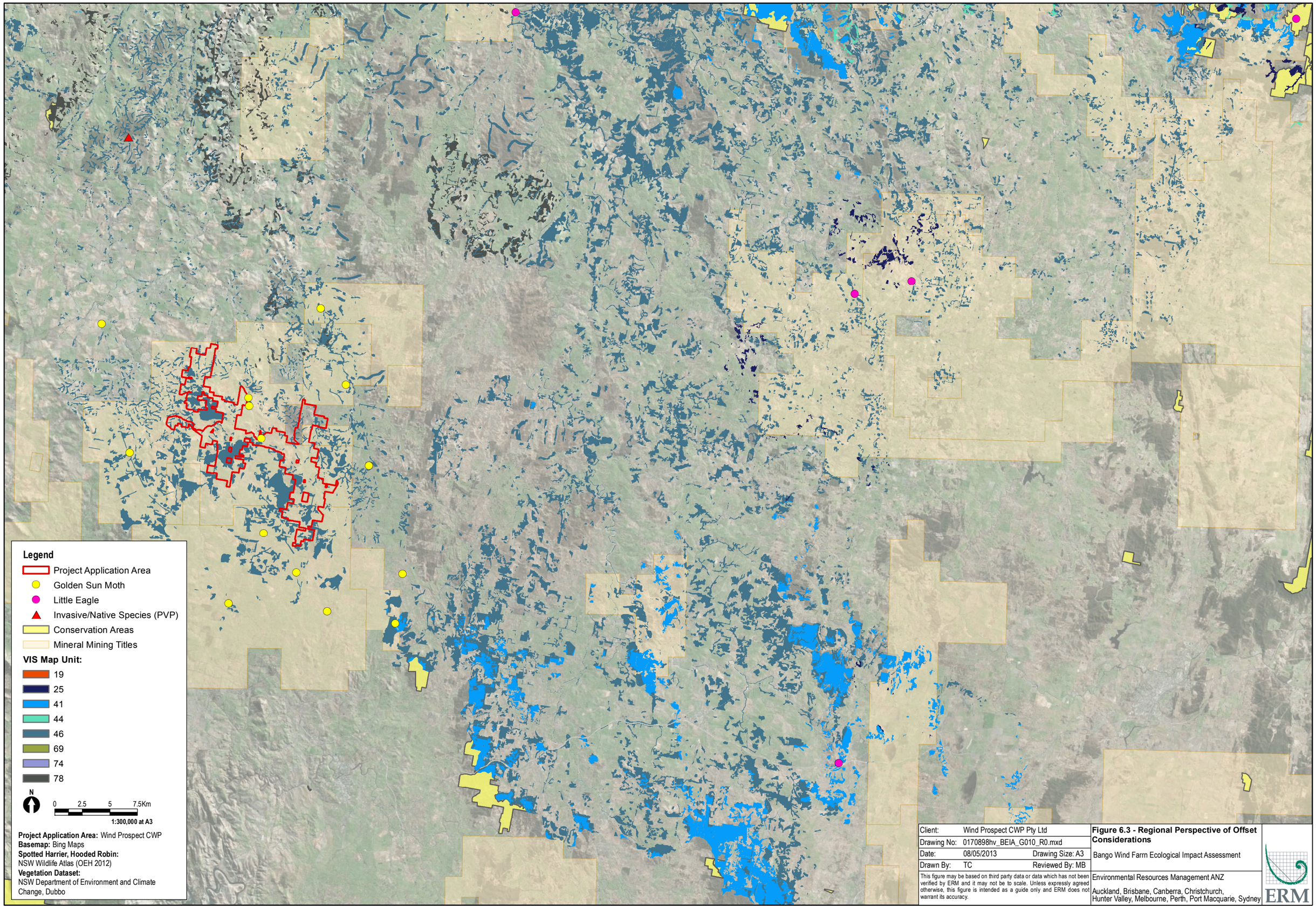
Identification of potential offset sites was further refined using the following spatial information: rivers and streams, mining leases, urban areas, National Parks and Reserves, State Forests, CMA Region and Subregion, vegetation mapping datasets, cadastre, existing offsets, conservation corridors and priority areas and Property Vegetation Plan (PVP) locations. A search was also undertaken to determine the potential presence of threatened species requiring species credits, using the Atlas of NSW Wildlife.

Several potential sites have been highlighted for further investigation as to their suitability in providing the required offsets (see *Figure 6.1* and *6.2*). Work is ongoing to identify further properties with suitable habitat to ensure the required offset is available prior to the start of construction. In determining priority sites for offsets, the following points will be considered:

- sites should contain the correct mix and area of the required vegetation types to limit multiple offset sites if possible;
- sites should have large lot sizes or multiple lots owned by the same owner to limit the number of potential landholders who may participate in offsets;
- sites should contain records of or habitat for species credits;
- sites close to National Parks or State Forests should be given priority as these areas provide connectivity within the landscape;
- sites with mining leases would require consent from the lessee when establishing a BioBank site on a property;
- sites likely subject to open cut mining should be avoided; and
- sites with Property Vegetation Plans may have significant discounts to credits generated under the BioBanking scheme.

Table 6.16 Impacted and Matched Vegetation Types for Offsetting Analysis

Impacted Vegetation Types			Matched Vegetation Types		
Veg Type ID	**Veg Type**	**Required Offset (ha)**	**Veg Type ID**	**Veg Type**	**ArcGIS (VIS Map Unit)**
LA103	Apple Box - Yellow Box dry grassy woodland of the South Eastern Highlands	153.5	LA103	Apple Box - Yellow Box dry grassy woodland of the South Eastern Highlands	44
			LA113	Black Sallee - Tussock Grass open woodland of the South Eastern Highlands	25
			LA120	Blakely's Red Gum - Yellow Box grassy woodland of the NSW South Western Slopes Bioregion (Benson 277)	46
			LA121	Blakely's Red Gum moist sedgey woodland on flats and drainage lines of the South Eastern Highlands and South Western Slopes	Unmapped
			LA145	Fuzzy Box - Inland Grey Box on alluvial brown loam soils of the NSW South Western Slopes Bioregion and southern BBS Bioregion (Benson 201)	69
			LA194	Riverine Inland Grey Box grassy woodland of the semi-arid (warm) climate zone (Benson 237)	74
			LA205	Snow Gum - Candle Bark grassland/woodland of the South Eastern Highlands	Unmapped
			LA219	White Box grassy woodland on well drained podsolic clay soils on hills in the NSW South Western Slopes Bioregion (Benson 266)	78
			CW102	*Apple Box - Yellow Box dry grassy woodland of the South Eastern Highlands*	44
			CW138	*Fuzzy Box - Inland Grey Box on alluvial brown loam soils of the NSW South Western Slopes Bioregion and southern BBS Bioregion (Benson 201)*	69
			CW215	*White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions*	Unmapped
LA182	Red Stringybark - Scribbly Gum - Red Box - Long-leaved Box shrub - tussock grass open forest the NSW South Western Slopes Bioregion	42.9	LA182	Red Stringybark - Scribbly Gum - Red Box - Long-leaved Box shrub - tussock grass open forest the NSW South Western Slopes Bioregion (Benson 290)	41
			LA183	Red Stringybark - White Box grassy open forest of the South Western Slopes	Unmapped
			LA223	White Cypress Pine woodland on sandy loam soils on the plains of central NSW (wheatbelt) (Benson 70)	19



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Drawing No:	0170898hv_BEIA_G010_R0.mxd	
Date:	08/05/2013	Drawing Size: A3
Drawn By:	TC	Reviewed By: MB

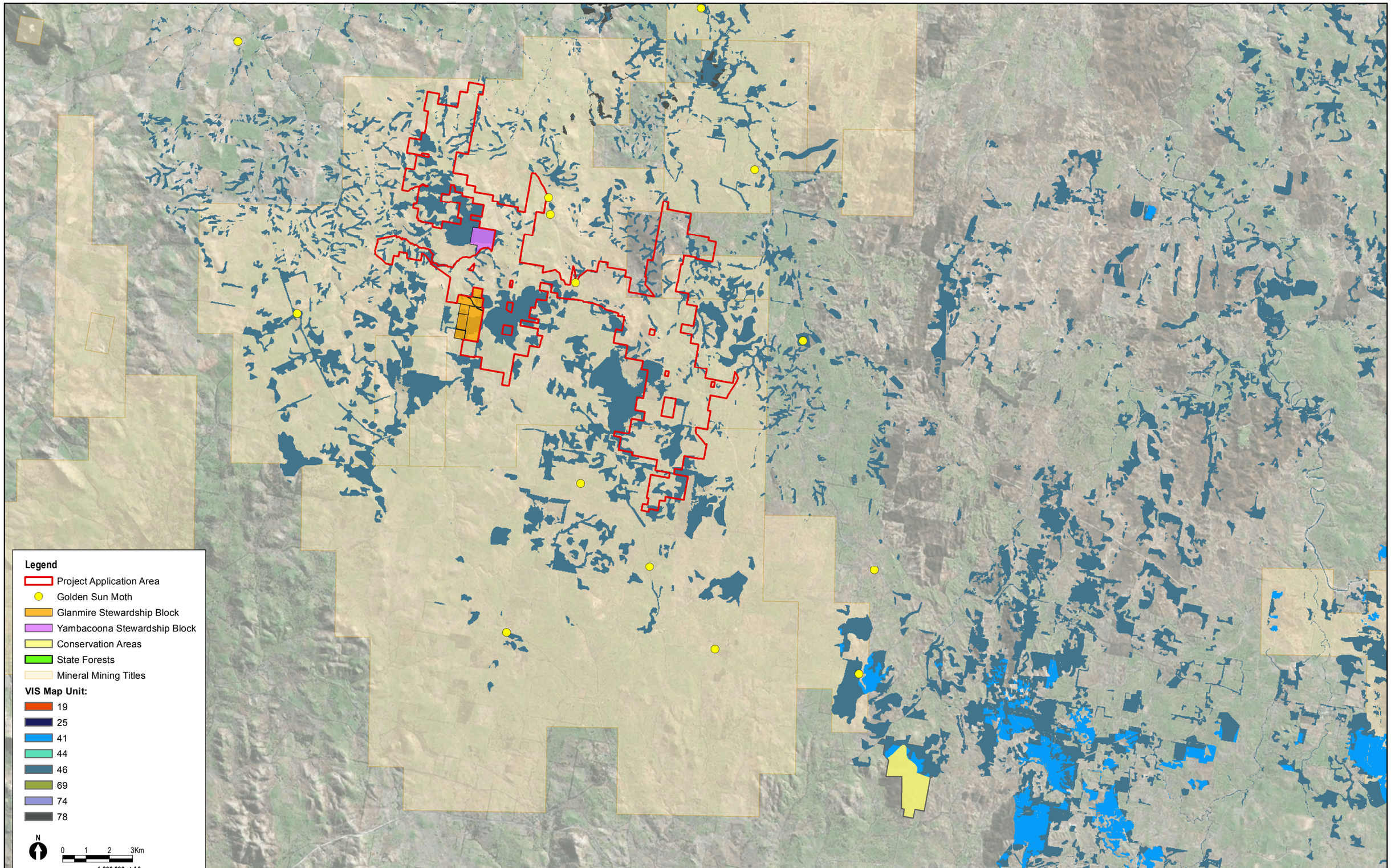
Figure 6.3 - Regional Perspective of Offset Considerations

Bango Wind Farm Ecological Impact Assessment

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch, Hunter Valley, Melbourne, Perth, Port Macquarie, Sydney

ERM



Client:	Wind Prospect CWP Pty Ltd		
Drawing No:	0170898hv_BEIA_G011_R0.mxd		
Date:	08/05/2013	Drawing Size: A3	
Drawn By:	TC	Reviewed By: MB	

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

Figure 6.4 - Local Perspective of Offset Considerations

Bango Wind Farm Ecological Impact Assessment

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch, Hunter Valley, Melbourne, Perth, Port Macquarie, Sydney

ERM

7 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

This chapter presents the methods, results and impact assessment for Matters of National Environmental Significance (NES) that have the potential to be impacted by the Project. There is some overlap and duplication with what has been presented in previous sections, however, it is appropriate to present this chapter as an independent section for assessment by DSEWPC.

This section forms the basis of the Significant Impact Assessment in accordance with the Commonwealth Significant Impact Guidelines for Matters of NES (DEWHA 2009a). The Significant Impact Assessment is provided in full in *Annex J.*

7.1 METHODS

This section describes the methods employed to assess the ecological values of the Study Area. At the commencement of the study, a desktop assessment was undertaken to identify the key ecological values which were likely to occur within the Study Area. The information gained during the desktop study was then reviewed and analysed to identify the key species and communities for field survey. The full methods employed during this ecological study are described in *Chapter 4* of this report. The following sections describe only those methods which were adopted to specifically address Matters of NES.

7.1.1 Desktop Assessment

A search of the Protected Matters Search Tool (PMST) was undertaken on 1 March 2013. The search covered the entire Locality within 10 km of the Study Area. The search did not identify any World Heritage Properties, National Heritage Places, the Great Barrier Reef Marine Park, or Commonwealth Marine Areas that relate to the search area.

In summary, the PMST identified that the search area:

- is upstream of three Wetlands of International importance;
- is likely to, or may contain three threatened ecological communities;
- is likely to, or may contain habitat for 19 threatened species; and
- is likely to, or may contain habitat for 9 migratory species.

The full PMST report is included in *Annex I.*

7.1.2 Field Survey

Vegetation

Existing vegetation mapping was ground truthed during field visits, allowing the stratification of vegetation types to be undertaken. Vegetation mapping was undertaken throughout spring and summer 2012 – 2013. The Study Area was traversed by vehicle and on foot, enabling all vegetation to be surveyed.

Fifteen 20 m x 20 m quadrats were sampled at selected sites that were representative of different vegetation types (refer *Figure 4.1*). Boundaries of vegetation communities in varying condition were recorded using a hand-held GPS and hand-drawings on aerial photographs and digitised in a geographic information system (GIS).

Flora

A floristic inventory was collected through the identification of all flora species encountered in plots/meanders or incidentally in the field, either in-situ or by collecting a sample for later identification. Where positive identification was not possible a sample was sent to the Royal Botanic Gardens in Sydney (RBGSyd) for identification using the Botanical Identification Service (BIS). All samples were identified to species level where sufficient material of the individual was available. In some cases identification to genus or family level was the best possible result.

Targeted flora surveys were undertaken for threatened species. Areas of suitable habitat were surveyed during the flowering season for the species, in accordance with the flowering season at reference sites (where applicable).

Fauna Habitats

Field assessment commenced in July 2012 and continued to February 2013. The Study Area was initially assessed through interpretation of satellite imagery. Areas supporting native vegetation and potential fauna habitat were located and then surveyed by vehicle and on foot. Fauna habitat types were characterised in the Study Area and the quality of the fauna habitat was assessed and categorised.

A hollow bearing tree survey was undertaken from Jan 2013 to February 2013 within an area bound by a 500m buffer around all proposed turbine locations. The survey was undertaken by two ecologists driving or walking where access was difficult. Hollow bearing trees were assessed visually, using binoculars where necessary. The total area surveyed for hollow bearing trees was approximately 4981 ha.

Invertebrates

Targeted surveys were undertaken for the Golden Sun Moth in accordance with the *Survey Guidelines for Detecting the Golden Sun Moth* (DEWHA 2009). Surveys were initially undertaken to assess areas of likely habitat. Surveys for moths were then undertaken during the flying season (November – January). Surveys were carried out over 12 suitable days between the hours 10:00 and 14:00 at temperatures above 20^0 C using the random meander method through areas of preferred habitat (refer *Figure 4.2*).

Frogs and Reptiles

Frog searches were undertaken in areas of observed habitat and microhabitats using nocturnal and diurnal visual encounter surveys (DEWHA 2010) either on foot or by vehicle. Target species for the surveys were the Booroolong Frog (*Litoria booroolongensis*) and the Growling Grass Frog (*Litoria raniformis*). Both of these species have been identified in the PMST as having habitat that may occur in the Locality.

Reptiles

Reptile surveys were combined with the diurnal and nocturnal surveys described for frogs. In addition, targeted survey and trapping was undertaken for the Pink-tailed Worm-lizard (*Aprasia parapulchella)* and the Striped Legless Lizard (*Delma impar),* although the survey methods also had the potential to capture other threatened species such as the Little Whip Snake (*Suta flagellum*) or Rosenberg's Goanna (*Varanus rosenbergi*). Grassland Earless Dragon (*Tympanocryptis pinguicolla*) was not surveyed using targeted surveys, after the species was removed from the subject species list for this Project, following an onsite meeting and formal advice from Matt Cameron of OEH.

Birds

A range of bird survey techniques were used in the ecological survey and all were undertaken in accordance with the AusWEA Interim Bird Risk Assessment Standards (AusWEA 2005). Bird surveys consisted of bird utilisation survey (BUS) and targeted surveys for woodland birds. All birds observed incidentally throughout the field surveys were identified and it was noted if they were flying within the Rotor Swept Area height range, which was identified as being between 25 and 200 meters. The following sections describe the methods of the bird surveys undertaken.

Bird utilisation survey

The Bird Utilisation Surveys (BUS) were undertaken from 14 November 2012 through to 23 February 2013 to capture data during the Superb Parrot breeding season. Surveys were undertaken at different times of the day regardless of weather conditions. The methodology involved 15 minute fixed

point, fixed radius counts at 20 survey sites spread across the Study Area (refer *Figure 4.4*). Sites were located at varying distances from habitat features such as hills/ridges, woodland and creeklines that are within areas of disturbance. Control/reference sites were also established in areas of representative habitat outside the areas of disturbance.

Superb Parrot

Point and transect surveys within areas of suitable habitat were undertaken throughout the survey period from 1 August 2012 through to 13 December 2012. A total of 17 surveys were conducted during this period in the early morning (sunrise to 10 am) and evening (4 pm to sunset) (refer *Figure 4.3*). Detection was made by sighting with binoculars or by call utilising a minimum of two ecologists as observers. Vehicle-based observations were also undertaken whilst commuting to, from and through the Study Area, recorded as incidental sightings often along roadside remnants. All sighting locations were recorded on a GPS.

Swift Parrot

Area searches and transects surveys were conducted through areas of suitable habitat within the Study Area, in the early morning and afternoon when birds are most active and vocal. Detection was by sighting using binoculars or call. Surveys were conducted in July in areas of potential foraging habitat where identified (refer *Figure 4.3*).

Woodland Birds

A total of 17 surveys were undertaken within or adjacent to areas of woodland habitat (refer *Figure 4.3*). Each survey was undertaken for a minimum of one hour. Bird surveys were completed by a two observers for one hour. Birds were identified using 10 × 42 mm binoculars and from characteristic calls. A minimum of two bird surveys were completed on two separate days across the woodland survey sites.

Bats

Anabat detectors and recorders were used to record the echolocation calls of micro-bats. Anabat detectors were set for a minimum of three nights per location. Mine entrances, woodland areas and open pasture were targeted during the surveys (refer *Figure 4.2*). Both Anabat units and stag watching was deployed to detect if the abandoned mines were being utilised by microbats. Harp traps were deployed in areas of woodland and in open areas adjacent to woodland in February 2013 (refer *Figure 4.2*). Harp trapping was undertaken over two sessions, each consisting of two Harp Traps being set for three nights, to make a 12 night Harp Trap total. For each harp trap survey one trap was placed in a potential flyway the other along the edge of woodland adjacent to an open area.

Mammals (Excluding Bats)

Mammal data was collected across the Study Area by incidental observation or by direct means utilising remote cameras, nocturnal spotlighting and mammal trapping. Mammal surveys were udnertaken from November 2012 to February 2013.

Incidental Records

Incidental fauna observations were recorded throughout all survey periods by turning over logs and other ground debris when habitat conditions appeared appropriate. Records of mammal scats, tree scars, tracks and other signs (e.g. diggings, shelter sites and burrows) were recorded incidentally as they were encountered throughout the Study Area.

Survey Limitations

As with all ecological assessments, a range of limitations are likely to have influenced the results of this study. The survey guidelines for all targeted species were adhered to in order to minimise the influence of survey limitations, although external factors such as weather conditions and land access contribute biases in survey results. These limitations are detailed in *Section 4.9.*

7.2 RESULTS

7.2.1 Desktop Assessment

Wetlands of International Importance

No declared Ramsar wetlands occur in the Study Area or the Locality. However, the following three declared Wetlands of International Significance have been identified downstream of the search area by the PMST:

- Banrock Station wetland complex - located approximately 770 km to the west of the Study Area. The site is a floodplain wetland complex comprising areas of freshwater and areas of secondary salinised floodplain with discrete wetland basins and channels. The site supports a high diversity of ecological communities (DSEWPC 2011a);

- Coorong and Lakes Alexandrina and Albert Wetland - located approximately 885 km to the south-west of the Study Area, in South Australia. The site is a long, shallow, brackish to hypersaline lagoon. It supports some threatened ecological communities and species, as well as extensive and diverse wetland assemblages (DSEWPC 2011b); and

- Riverland - located in South Australia, approximately 730 km to the west of the Study Area. The site incorporates a series of creeks, channels, lagoons, billabongs, swamps and lakes. The wetland is an important habitat for a large number of migratory and waterbirds (DSEWPC 2011c).

Threatened Ecological Communities

The PMST identified three ecological communities that are likely to, or may, occur within 10 km of the Study Area:

- Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South eastern Australia (Endangered);
- Natural Temperate Grassland of the Southern Tablelands of NSW and the Australian Capital Territory (Endangered); and
- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Critically Endangered).

Threatened Species

The PMST identified that the search area is likely to, or may contain the species listed in *Table 7.1.*

Table 7.1 Threatened Species with the Potential to Occur within search area (PMST)

Species Name	Common Name	EPBC Act Status*
Plants		
Ammobium craspedioides	Yass Daisy	V
Caladenia concolor	Crimson Spider Orchid	E
Diuris aequalis	Doubletail Buttercup	V
Eucalyptus robertsonii subsp. *hemisphaerica*	Robertson's Gum	V
Lepidium hyssopifolium	Aromatic Peppercress	E
Leucochrysum albicans var. *tricolor*	Hoary Sunray	E
Pelargonium sp. Striatellum (G.W. Carr 10345)	Omeo Stork's Bill	E
Prasophyllum petilum	Tarengo Leek Orchid	E
Rulingia prostata	Dwarf Kerrawang	E
Rutidosis leptorrhyncoides	Button Wrinklewort	E
Swainsona recta	Mountain Swainson Pea	E
Insects		
Synemon plana	Golden Sun Moth	CE
Amphibians		
Litoria booroolongensis	Booroolong Frog	E
Litoria raniformis	Growling Grass Frog	V
Reptiles		
Aprasia parapulchella	Pink-tailed Worm-lizard	V
Delma impar	Striped Legless Lizard	V
Birds		
Botaurus poiciloptilus	Australasian Bittern	E
Lathamus discolor	Swift Parrot	E
Leipoa ocellata	Malleefowl	V, Mi
Polytelis swainsonii	Superb Parrot	V

Rostratula australis	Australian Painted Snipe	V, Mi,
Fish		
Maccullochella peelii peelii	Murray Cod, Cod, Goodoo	V
Macquaria australasica	Macquarie Perch	E
Mammals		
Nyctophilus corbeni	Eastern Long-eared Bat	V
Petrogale penicillata	Brush-tailed Rock-wallaby	V
Phascolarctos cinereus	Koala	V
**CE=Critically Endangered; E = Endangered; V = Vulnerable; Mi=Migratory; Ma=Marine*		

7.2.2 *Field Survey*

BioMetric Vegetation Types

Two BioMetric Vegetation Types were identified in the Study Area, along with three other vegetation communities that do not meet the description of any BVTs:

- Apple Box - Yellow Box dry grassy woodland of the South Eastern Highlands (Apple Box – Yellow Box Grassy Woodland);
- Red Stringybark - Scribbly Gum - Red Box - Long-leaved Box shrub - tussock grass open forest the NSW South Western Slopes Bioregion (Red Stringybark Open Forest);
- Exotic Pasture;
- Cropping; and
- Planted Vegetation (native and exotic).

One TEC was identified in the Study Area: White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Box-Gum Grassy Woodland and Derived Grassland). This vegetation community occurs widely throughout the Study Area, but is patchy and in some areas it occurs as a derived native grassland. Patches of Yellow Box (*Eucalyptus melliodora*) with Blakelys Red Gum (*Eucalyptus blakelyi*) and other eucalypts occur across the Study Area. However, the understorey condition is generally poor and as such, the majority of these woodland patches do not meet the Commonwealth condition thresholds for this TEC. The current proposed layout avoids these woodland areas. Patches of grassland derived from Box Gum Woodland occur throughout the Study Area. The majority of these areas also do not meet the Commonwealth condition thresholds for Box-Gum Grassy Woodland and Derived Grassland.

A total of 2.27 ha of Critically Endangered White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland is considered to occur within the Study Area in one discrete patch along Tangmangaroo Road (see *Figure 5.2*). A total of 0.26 ha of this vegetation is expected to be impacted

by the proposed action for the construction of permanent Project infrastructure. The area of the CEEC within the Development Footprint was calculated based on the area of Layout Option 1 (ie the worst case scenario).

Natural Temperate Grassland has not been recorded in the Study Area. Areas of native grass within the Study Area are derived from Box-Gum Grassy Woodland and other Eucalypt Woodlands.

Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia have not been recorded in the Study Area.

Flora

One threatened flora species was recorded in the Locality during field surveys: Yass Daisy (*Ammobium craspedioides*) which is listed as Vulnerable under both the EPBC Act. A population comprising over 200 individuals was recorded approximately 750 m to the west of the Study Area in the Mt Buffalo Cluster (refer *Figure 5.3*).

Fauna

A range of fauna habitats were identified and surveyed during field investigations between July 2012 and February 2013. These habitats include Woodland, Native Grassland and Exotic Grassland. A range of habitat features occurred within these habitat types including Exposed Rock, Fallen Timber, Exotic Grassland and Roosting habitat for Bats. Detailed habitat descriptions can be found in *Section 5.5.*

Of the 153 fauna species recorded, a total two threatened species listed under the EPBC Act were confirmed within the Study Area, including one invertebrate (Golden Sun Moth) and one bird (Superb Parrot). One migratory species was recorded in the Study Area (Rainbow Bee-eater). The area of each habitat type within the Development Footprint was calculated based on the area of Layout Option 1.

7.2.3 Likelihood of Occurrence

Details the EPBC Act listed threatened species and communities that were identified by the PMST and their likelihood of occurrence within the Study area are provided in *Table 7.2*.

Table 7.2 Threatened species likelihood assessment

Species Name	Common Name	Likelihood of occurrence within Study Area	EPBC Act Status*
Ammobium craspedioides	Yass Daisy	Likely – recorded during recent field surveys in the Locality and optimal habitat occurs in the Study Area.	V

Caladenia concolor	Crimson Spider Orchid	Potential - Optimal habitat present in woodlands with an undisturbed understory.	E
Diuris aequalis	Doubletail Buttercup	Likely - Optimal habitat present in woodlands with an undisturbed understory and secondary grassland.	V
Eucalyptus robertsonii subsp. hemisphaerica	Robertson's Gum	Potential - Optimal habitat present in woodlands on the site.	V
Lepidium hyssopifolium	Aromatic Peppercress	Potential - Optimal habitat may be present in woodlands and secondary grassland.	E
Leucochrysum albicans var. tricolor	Hoary Sunray	Potential - Optimal habitat present in woodlands with an undisturbed understory and secondary grassland.	E
Pelargonium sp. Striatellum (G.W. Carr 10345)	Omeo Stork's Bill	Unlikely – Optimal or sub optimal habitat absent from the Study Area.	E
Prasophyllum petilum	Tarengo Leek Orchid	Potential – Optimal may be habitat present in woodlands with an undisturbed understory.	E
Rulingia prostata	Dwarf Kerrawang	Unlikely – Optimal and or sub optimal habitat absent from the Study Area.	E
Rutidosis leptorrhyncoides	Button Wrinklewort	Potential – Optimal or sub optimal habitat present in woodlands with an undisturbed understory and secondary grassland.	E
Swainsona recta	Mountain Swainson Pea	Potential - Optimal habitat may be present in woodlands with an undisturbed understory	E
Insects			
Synemon plana	Golden Sun Moth	Known – species has been recorded within the Study Area during recent surveys	CE
Amphibians			
Litoria booroolongensis	Booroolong Frog	Unlikely - Optimal or sub optimal habitat does not occur within the Study Area.	E
Litoria raniformis	Growling Grass Frog	Unlikely – Optimal or sub optimal habitat does not occur within the Study Area.	V
Reptiles			
Aprasia parapulchella	Pink-tailed Worm-lizard	Potential – Limited areas of sub optimal habitat occur.	V
Delma impar	Striped Legless Lizard	Potential – Limited areas of optimal habitat occur.	V
Birds			
Apus pacificus	Fork-tailed Swift	Unlikely – Sub optimal habitat	Mi, Mar
Ardea ibis	Cattle Egret	Potential - Cattle Egrets may utilise the pasture and croplands, during wetter periods.	Mi, Mar
Botaurus poiciloptilus	Australasian Bittern	Unlikely - due to absence of densely vegetated wetlands within the Study Area.	E

Gallinago hardwickii	Latham's Snipe	Potential - may fly over the Study Area. Dams within the Study Area are unlikely to provide suitable foraging habitat.	Mi, Mar
Haliaeetus leucogaster	White-bellied Sea-eagle	Potential - may fly over the Study Area, however, suitable habitat does not occur in the Study Area.	Mi, Mar
Hirundapus caudacutus	White-throated Needletail	Potential - may fly over the Study Area. Species has not been recorded in the Locality.	Mi, Mar
Lathamus discolor	Swift Parrot	Potential – Sub optimal habitat is restricted to some of the woodland areas.	E
Leipoa ocellata	Malleefowl	Unlikely – Optimal or sub optimal habitat does not occur within the Study Area.	V, Mi
Merops ornatus	Rainbow Bee-eater	Known -recorded within the Study Area.	Mi, Mar
Myiagra cyanoleuca	Satin Flycatcher	Unlikely - due to lack of optimal habitat.	Mi, Mar
Polytelis swainsonii	Superb Parrot	Known - Recorded throughout the Study Area and breeding is known to occur.	V
Rhipidura rufifons	Rufous Fantail	Unlikely - due to lack of optimal habitat.	Mi,
Rostratula australis	Australian Painted Snipe	Unlikely – Optimal habitat does not occur within the Study Area.	V, Mi,
Fish			
Maccullochella peelii peelii	Murray Cod, Cod, Goodoo	Unlikely – No optimal or sub optimal habitat present.	V
Macquaria australasica	Macquarie Perch	Unlikely - No optimal or sub optimal habitat present.	E
Mammals			
Nyctophilus corbeni	Eastern Long-eared Bat	Unlikely – No optimal habitat exists.	V
Petrogale penicillata	Brush-tailed Rock-wallaby	Unlikely – optimal habitat does not occur.	V
Phascolarctos cinereus	Koala	Potential – sub optimal habitat does occur	V
*CE=Critically Endangered; E = Endangered; V = Vulnerable; Mi=Migratory; Ma=Marine			

7.3 *SIGNIFICANT IMPACT ASSESSMENT*

Significant Impact Assessments was undertaken for all species and communities identified in *Table 7.2* that are known, likely or have the potential to occur in the Study Area. The assessments were undertaken in accordance with:

- *Significant Impact Guidelines 1.1: Matters of National Environmental Significance* (DEWHA 2009a); and
- *Significant Impact Guidelines for the critically endangered Golden Sun Moth (Synemon plana): EPBC Act Policy Statement 3.12* (DEWHA 2009b).

The Significant Impact Assessments are provided in full in *Annex J.* The following sub-sections provide a summary of the outcomes of the Significant Impact Assessments under the relevant headings.

7.3.1 Threatened Ecological Communities

Box-Gum Grassy Woodland and Derived Grassland occurs in the Study Area along Tangmangaroo Rd and extends along the road to the north and south of the Study Area. An overhead transmission line is proposed in this area. The area of Box-Gum Grassy Woodland within the Study Area comprises 2.27 ha and the area that is likely to be impacted is 0.26 ha.

An assessment against the significant impact criteria for critically endangered ecological communities (DEWHA 2009) was undertaken and is provided in *Annex J.* The proposed action is likely to have a significant impact on Box-Gum Grassy Woodland and Derived Native Grassland as it will reduce the extent of a critically endangered ecological community and increase fragmentation.

7.3.2 Threatened Flora

A Significant Impact Assessment was undertaken for five Endangered flora species and four Vulnerable flora species identified as Known, Likely or Potential to occur within the Study Area. Only one of these species, Yass Daisy (*Ammobium craspedioides*) has been recorded in the Study Area and is discussed further below.

A population of Yass Daisy comprising over 200 individuals was recorded approximately 750 m to the west of the Study Area in the Mt Buffalo Cluster (refer *Figure 5.3*). The population occurs outside the Study Area and will not be affected by the Project. An important population of Yass Daisy has not been recorded in the Study Area. Areas comprising the species' woodland habitat will be avoided and therefore, will not be impacted by the Project. The species also occurs in derived native grassland and it is possible that areas of potential grassland habitat will be affected by the Project. An assessment against the significant impact criteria for vulnerable flora species (DEWHA 2009a) was undertaken for the Yass Daisy and is provided in *Annex J.* The assessment against the significant impact criteria concluded that the Project would not result in a significant impact to an important population of the Yass Daisy.

The Project is not expected to result in significant impacts to any of the EBPC Act listed flora species assessed in *Annex J.*

7.3.3 Threatened Fauna

The Significant Impact Assessment considered the potential impacts of one Critically Endangered Species, one Endangered Species and four Vulnerable species listed under the EPBC Act, based on the Likelihood of Occurrence

Assessment in Section *7.2.3*. A summary of the assessment outcomes is provided below, with the full results presented in *Annex J.*

Golden Sun Moth

Infrastructure associated with the Project is proposed in areas where GSM were recorded and in areas of suitable habitat for the species. This includes WTGs, access tracks, overhead transmission lines and a substation. Through the iterative design process, areas of known and potential habitat have been avoided as much as possible. *Table 7.3* shows the area of habitat in the Study Area and Development Footprint.

Table 7.3 Areas of Golden Sun Moth Habitat

Area in Study Area (ha)	Total Area in Development Footprint (ha)	Permanent Impact Area (ha)	Temporary Impact Area (ha)
810.2	100.87	82.48	18.39

Areas are based on the areas of Apple Box – Yellow Box Grassy Woodland - Mod_Good-TSC-DNG, Apple Box – Yellow Box Grassy Woodland - Low and an outlier area of habitat comprising Red Stringybark Open Forest – Low

The Project does not involve clearing of habitat on a broad scale, rather, it comprises clearing of small areas and narrow linear areas. Many of the access roads are proposed along existing farm access tracks and there are areas comprising exotic pasture or weeds in which infrastructure can be placed.

Despite this, some areas of GSM habitat will be affected, given that the potential habitat for the GSM is widespread in the Study Area (100.88 ha) and access roads for the Project will be wider than existing farm tracks. However, as the development footprint is linear and narrow and the turbine and substation areas are small on a landscape scale, the overall development footprint both during construction and operation would only require clearing of a small area in comparison to the area of GSM habitat available in the Study Area (approximately 12%). The completed infrastructure would not be at a scale that would impose a barrier to GSM movements.

GSM occur in grasslands and therefore, in areas that experience little shade. As such, the potential impacts of increased shade in GSM habitat caused by turbine towers has been considered. The potential impacts of shading are based on observed habitat characteristics of the species and have not undergone scientific experimentation and therefore, they are unconfirmed. Potential impacts include:

- changes to male and female behaviour during the flying season;
- changes to soil moisture and temperature, resulting in a change in species at a site; and

- cooler and moister soil conditions impacting the survival and growth of larvae.

These potential impacts have been associated with developments such as multi-storey carparks, which would create shading over a large area on a permanent basis (pers. comm. A Rowell and T O'Sullivan 2013). The wind turbines would create discrete narrow areas of shading that are not large enough or of a permanent nature (taking into account the movement of the sun) to create changes to soil moisture and temperature. The greatest shading impact would be the area around the base of the turbines, which will experience the largest area of shading for the longest periods of time. This area would already be disturbed for the turbine base. In terms of behaviour during the flying season, the extent of habitat in the Study Area is large and therefore, adult GSM would be able to avoid shaded areas (pers. comm. A Rowell and T O'Sullivan 2013).

The proposed action would result in removal of 100.88 ha of GSM habitat (82.48 ha permanent loss and 18.4 ha disturbed and rehabilitated after construction), which comprises 12% of the total area of habitat available in the Study Area. An assessment against the significant impact thresholds for the GSM in the Significant Impact Guidelines for the critically endangered Golden Sun Moth (DEWHA 2009b) was undertaken and is provided in *Annex J*. As greater than 0.5 ha of GSM habitat will be cleared, the proposed action meets both of the impact thresholds for habitat loss (refer *Annex J*). As such, the proposed action will have a significant impact on the GSM.

Swift Parrot

The Swift Parrot is endemic to south-eastern Australia. It breeds only in Tasmania, and migrates to mainland Australia in autumn. This species prefers profuse flowering Box Ironbark Woodlands in NSW for foraging habitat. No preferred foraging habitat has been identified within the Study Area. This species was not recorded during field surveys. The Study Area does not form part of the annual migratory route for this species (OEH 2012 c).

The Project is not anticipated to reduce the area of occupancy of the Swift Parrot. The Project will not be fragmenting an existing important population as none has been identified within the Study Area. The Study Area would provide at best sub optimal foraging opportunities for the Swift Parrot. The proposed action will not result in the introduction of an invasive species to the habitat of the Swift Parrot. The Locality already comprises a highly fragmented landscape that is susceptible to the establishment of invasive species.

The risk of collision is listed as a potential impact for this species. However, modelling of the cumulative collision risk impact to Swift Parrots was carried out in 2005 (Smales 2005a). The results show that the cumulative impacts of collision with turbines on the overall population of Swift Parrots, for all

current and presently proposed wind farms (at 2005) within the species' range, are very small (approximately one parrot every 10 years).

It has been concluded from the Significant Impact Assessment (see *Annex J*) carried out for this species that the proposed action is unlikely to have a significant impact on the Swift Parrot.

Striped Legless Lizard

The Striped Legless Lizard is found mainly in Natural Temperate Grassland but has also been captured in grasslands that have a high exotic component. . It is also found in secondary grassland near Natural Temperate Grassland and occasionally in open Box-Gum Woodland. Approximately 380.53 ha of secondary or sub optimal habitat for this species have been identified within the Study Area. The project would result in the removal of approximately 52.5 ha or 13% of what would be considered secondary habitat for this species.

Surveys were undertaken in areas of the most suitable habitat and this species was not recorded during the field surveys. No important populations of this species have been identified within the Study Area. The Project would not reduce the area of occupancy of the Striped Legless Lizard in the Study Area. No habitat that is currently occupied by this species will be removed as part of the proposed action. The project would not be fragmenting an existing important population. The Study Area does not provide habitat that is critical to the survival of the Striped Legless Lizard. Some areas of habitat available to the Striped Legless lizard would be modified or destroyed. It has been concluded from the Significant Impact Assessment (see *Annex J*) carried out on this species that the proposed action is unlikely to have a significant impact on the Striped Legless Lizard.

Pink-Tailed Worm Lizard

The Pink-tailed Worm-lizard inhabits sloping, open woodland areas with predominantly native grassy groundlayers, particularly those dominated by Kangaroo Grass. Sites are typically well-drained, with rocky outcrops or scattered, partially-buried rocks. The closest record of this species is approximately 23 km north-west of the Study Area, and the Study Area is within the known distribution for this species. The species has not been recorded during targeted surveys, despite those being undertaken in accordance with the Survey Guidelines for Australia's Threatened Reptiles (DSEWPC 2011d) where optimal or sub optimal habitat was identified, during this study.

No important populations have been identified for this species within the Study Area. Approximately 380.53 ha of secondary grassland dominated by native grasses have been identified within the Study Area. A small portion of this (approximately 52.5 ha, or 13 %) contains potential habitat for the Pink-tailed Worm Lizard, however, this habitat is sub optimal due to the scattered nature of areas of small rocks and the intensive grazing that has occurred in

these areas. The construction of the wind farm would result in the loss or modification of a small portion of habitat suitable for this species.

The Project would not reduce the area of occupancy of the Pink-tailed Worm-lizard. The project would not be fragmenting an existing important population. The Study Area does not provide habitat that is critical to the survival of the Pink-tailed Worm-lizard. The Project involves the construction of access roads and the erection of wind turbine towers. The proposed action will not result in the introduction of an invasive species to the habitat of the Pink-tailed Worm-lizard. It has been concluded from the Significant Impact Assessment (see *Annex J*) carried out on this species that the proposed action is unlikely to have a significant impact on the Pink-tailed Worm-lizard.

Superb Parrot

The Superb Parrot mainly inhabits forest and woodlands dominated by eucalypts, especially River Red Gums and box eucalypts such as Yellow Box or Grey Box. The species also seasonally occurs in box-pine (*Callitris*) and Boree (*Acacia pendula*) woodlands (DSEWPC 2012). The Superb Parrot is dependent on aggregations of large hollow bearing trees and nests between September and December in hollow limbs or holes in the trunk of large eucalypts, mainly near water. In the inland slopes, most nests are in large Blakely's Red Gums, with many nest trees either dead or suffering from dieback. Much of the breeding habitat in the South-west Slopes is on private land. Superb Parrots are rarely observed on the inland slopes during winter, with the few birds seen usually being breeding pairs. The Study Locality is within known breeding area for this species (DSEWPC 2012).

The primary impact to Superb Parrots associated with the Project is that of injury or death of individual Superb Parrots due to collision with turbines and potential loss of breeding habitat through the removal of hollow bearing trees. The bird utilization surveys gathered data related to the flight activity of birds and this data has been used to assess the potential impacts to the species. The data obtained indicates that the species rarely flies within the height range of the proposed turbines (above 25 m).

The Project has been designed to avoid areas of woodland and paddock trees and therefore, is not likely to affect breeding habitat or cause fragmentation of habitat. Of the 449 mapped hollow bearing trees it is likely 15 will be removed as part of the proposed action. This constitutes approximately 3.4% of the total number of hollow bearing trees available to the Superb Parrot within 500 m of a proposed turbine location.

This species has been observed during the BUS flying at a height that is below rotor height; however one individual was recorded at RSA height. A collision risk model was run (*Section 6.3.3*) and it concluded that this species unlikely to collide with a turbine. Generally the observed flight patterns for this species were decisive and directional to foraging areas or to a paddock tree when startled.

This species appears to utilise the Study Area on a seasonal basis that coincides with cropping practices and the breeding season. Foraging areas are widespread across the Locality and it is anticipated only 3.4 % of potential breeding habitat within 500 m of a proposed turbine will be impacted. Thus it is unlikely the proposed action will impact on the species, affect foraging or breeding habitat to the extent that the species is likely to decline. The results of the Significant Impact Assessment (see *Annex J)* completed for this species found that the proposed action would not significantly impact on the Superb Parrot.

Koala

In NSW, the Koala inhabits a range of forest and woodland communities, including coastal forests, woodlands on the tablelands and western slopes, and woodland communities along watercourses. The primary feed trees in the Central and Southern Tablelands are the Ribbon Gum Eucalytus viminalis and the River Red Gum Eucalyptus camaldulensis with 18 secondary feed tree species including White Box, Yellow Box, Bundy (*Eucalyptus nortonii*) , Blakely's Red Gum, and Apple Box. There are two Stringybark supplementary species, including Red Stringybark and Yellow Stringybark (*Eucalyptus muelleriana*) (OEH 2008).

The Koala has not been recorded within the Study Area and the results of habitat assessments indicate that this species has the potential to utilise the Study Area. Under the Significant Impact Guidelines an important Koala population has not been identified within the Study Area. This species was not recorded during field surveys. Secondary and supplementary habitat for this species does exist within the Study Area. The Project would not reduce the area of occupancy of the Koala. This species has not been recorded within the Study Area.

No habitat that is currently occupied by this species will be removed as part of the proposed action; approximately 8.2% of secondary and supplementary habitat would be removed as part of the proposal. No areas of optimal habitat would be removed as part of the proposed action and there is unlikely to be a disruption to the breeding cycle of this species as a result of the proposed action. It has been concluded from the Significant Impact Assessment (see *Annex J*) carried out on this species that the proposed action is unlikely to have a significant impact on the Koala.

7.3.4 Migratory Species

Five Migratory species were identified as Known, Likely or Potential to occur within the Study Area based on the Likelihood of Occurrence Assessment in *Section 7.2.3*. A Significant Impact Assessment was undertaken for these species which is presented in *Annex J*.

Potential impacts to migratory species associated with the development of wind farms include:

- loss or degradation of flora and fauna habitat due to direct impacts such as clearing for turbine locations and access roads, and indirect impacts to bird species such as habitat avoidance; and
- injury or death of birds due to collision with turbines.

Extensive fauna surveys have been undertaken in the Study Area, as outlined within the earlier chapters of this report. It is unlikely that the Study Area provides an area of 'important habitat' for any migratory species, as described in the *Matters of National Environmental Significance Significant Impact Guidelines 1.1*. Therefore the Project is not expected to substantially modify, destroy or isolate an area of important habitat for a migratory species, or result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species.

It is also considered unlikely that the Project will seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species. Therefore the project is not anticipated to result in significant impact to migratory species as described under the *Matters of National Environmental Significance Significant Impact Guidelines 1.1.*

7.4 MEASURES TO AVOID OR REDUCE IMPACTS

The key approach to the management of impacts to Matters of NES for the proposed project relates to the layout design and the iterative process used to avoid impacts to ecological values where possible. The Project layout design has adopted avoidance and management measures in response to information gathered during the ecological field surveys, particularly in relation to threatened species and ecological communities listed under the EPBC Act. This approach has enabled WPCWP to avoid impacts wherever feasible, and to manage associated impacts such as habitat fragmentation and edge effects.

Management and mitigation measures will be implemented during both construction and operation of the proposed project to manage environmental impacts, which will incorporate specific measures for the GSM and Box-Gum Grassy Woodland and Derived Native Grassland CEEC. These measures will be supported by a number of management plans to be developed for the construction and operational phases of the Project. Details of avoidance, mitigation and offset measures are provided in *Chapter 6.*

7.5 MATTERS OF NES CONCLUSION

After detailed assessment of the significance of the proposed works, the assessments concluded that the proposed works will have a significant impact on the Golden Sun Moth and Box Gum Grassy Woodland and Derived Native

Grassland. A range of avoidance measures have been incorporated into the design of the Project and mitigation measures will be implemented to reduce the impacts to the threatened species and community.

The proponent proposes to develop an offset strategy to account for the residual impacts of the proposed action, which is being developed in consultation with OEH. The proponent intends to developed the offset package in accordance with the EPBC Act Environmental Offsets Policy, through a mechanism to be approved by DSEWPC during the EPBC Act assessment by preliminary documentation.

8 CONCLUSIONS

This ecological impact assessment has identified the ecological features of the Bango Wind Farm site and assessed the potential impacts to threatened species and ecological communities listed under the TSC Act, as well as Matters of NES listed under the EPBC Act.

Five vegetation communities were recorded in the Study Area, including two BVTs that occur in varying condition. The remaining vegetation communities largely comprise exotic species and do not meet the description of any BVTs. The majority of the Apple Box – Yellow Box Grassy Woodland meets the description for the Box-Gum Woodland EEC listing under the TSC Act and a small proportion also meets the description for the Box-Gum Grassy Woodlands and Derived Native Grasslands CEEC listing under the EPBC Act.

A total of 127 flora species were recorded in the Study Area. Nine threatened flora species listed under the EPBC Act and / or the TSC Act were considered likely to, or have the potential to, occur in the Study Area. Of these, none were recorded in the Study Area, however, one was recorded in the Locality.

A total of four fauna habitat types were recorded in the Study Area including native woodlands, native grasslands, exotic grasslands and aquatic habitats. Within these habitat types, a variety of fauna habitat resources were identified, including hollow bearing trees, paddock trees, tussock grasslands, disused mines, farms dams and creek lines.

A total of 152 fauna species were recorded in the Study Area. Thirty two threatened fauna species were considered likely to, or have the potential to, occur in the Study Area. This includes one invertebrate, one frog, three reptiles, 23 birds and four mammals. Of these, a total of 15 were recorded within the Study Area including one invertebrate, ten birds and three mammals. One migratory species listed under the EPBC Act was recorded in the Study Area.

The proposed wind farm has the potential to impact on a number of threatened species and ecological communities through direct and indirect impacts during the construction and operational phases. This includes Box-Gum Woodland, the Golden Sun Moth, Superb Parrot, Eastern Bent-wing Bat and Yellow-bellied Sheathtail Bat. Seven part tests were undertaken for these species and a number of other species that were considered likely or having the potential to occur in the Study Area. A total of 40 seven part tests were undertaken, including 39 for threatened species and one for an endangered ecological community. The seven part tests concluded that the Project is unlikely to have a significant impact on any of the threatened species.

Careful consideration has been given to minimisation of impacts, including avoidance, mitigation and offsetting measures. Avoidance of impacts has been applied through modifications to the wind farm layout. A range of general and species specific mitigation measures will be implemented to minimise impacts to native flora and fauna during both the construction and operation phases. An offset strategy will be developed to minimise residual impacts as much as possible and meet the 'improve or maintain' principle. This includes an offset strategy that was prepared using the BBAM.

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