

ATTACHMENT 6 BIODIVERSITY ASSESSMENT

Proposed development of a wind farm at Conroys Gap, New South Wales



Biodiversity Assessment

June 2006

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1 INTRODUCTION

This Biodiversity Assessment presents the findings of investigations into biodiversity values and likely impacts associated with a proposed wind farm at Conroys Gap, near Yass on the Southern Tablelands, New South Wales. The Assessment has been undertaken by **ngh**environmental to support the Environmental Assessment (EA) report prepared on behalf of the proponent Taurus Energy Pty Ltd.

The Biodiversity Assessment:

- provides a summary description of the proposed works;
- outlines the regional context of the study area in terms of biodiversity values;
- identifies and describes the biodiversity values of the subject site, including descriptions of methodologies and results of detailed flora and fauna surveys;
- identifies species and communities of conservation significance which are present or have potential to be present at the subject site, including potential threatened flora and fauna habitat and Endangered Ecological Communities;
- identifies and assesses the significance of the potential impacts and risks associated with the proposed works in relation to biodiversity values;
- assesses the significance of the potential impacts of the proposal on identified threatened species and communities listed in the *Threatened Species Conservation Act 1995* (Assessment of Significance, Appendix D);
- assesses the significance of the potential impacts of the proposal on Matters of National Environmental Significance listed in the *Environmental Protection Biodiversity Conservation Act 1999* (Assessment of Significance, Appendix E);
- specifically assesses the risks from bladestrike and habitat impacts to bird species at the site (Appendix F); and
- provides a series of recommended mitigation measures designed to reduce risks and minimise the impacts of the development on flora, fauna and ecological communities.

The Biodiversity Assessment is intended to meet the assessment requirements under Part 3A of the *Environmental Planning and Assessment Act 1979* and the *Threatened Species Conservation Act 1995*.

Further background information relating to the site and the proposal is contained in the accompanying Environmental Assessment.

2 THE PROPOSAL

2.1 Description of the site

The Conroys Gap proposal site is located on farmland north and south of Black Range Road, approximately 17 kilometres west of Yass, New South Wales (Figure 2.1). The site extends for around 7 kilometres, oriented in a north-south direction.

The study area is characterised by undulating to hilly terrain, with broken, generally north-south oriented ridgelines. The bulk of the site occurs on metasedimentary geology, with steeply dipping beds outcropping on ridgetops. The southern end of the site occurs over granitic geology, which is exposed on steep rock faces to the immediate west of the site.

There are no major watercourses present at the subject site and there is little remnant tree cover, particularly north of Black Range Road. Several small or intermittent watercourses drain the site northwards to the Jugiong Creek system and south to Lake Burrinjuck.

The tenure of land at the subject site land is private freehold. The land is currently used for commercial agriculture (sheep and cattle grazing) and farm residences. The proposal would directly involve four properties.

2.2 Proposed works

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

- up to 15 wind turbines, each approximately 5 metres in diameter at the base, with three blades up to 46 metres long mounted on a tubular steel tower up to 80 metres high;
- electrical connections between wind turbines using underground cable, and an aerial powerline up to 4 kilometres long connecting the turbines to the substation;
- a substation and transmission connection linking the wind turbines to the existing Transgrid 132kV transmission system located adjacent to the site;
- access tracks to turbines and other facilities, and upgrades to access via Paynes Road and the Hume Highway (subject to consultations and engineering assessments), for the installation and maintenance of the wind turbines;
- an onsite control room and equipment storage facilities.

The wind farm would have a maximum capacity of up to 30 megawatts, and an operational life of up to 30 years. The area of the development footprint would be approximately 7 hectares.

The wind farm proposal encompasses a number of possible turbine layouts. The Biodiversity Assessment has been conducted on the basis of a broad development envelope which takes in all of the possible turbine sites and associated access tracks and cabling routes. Figure 2.2 illustrates the proposed wind farm potential development envelope.

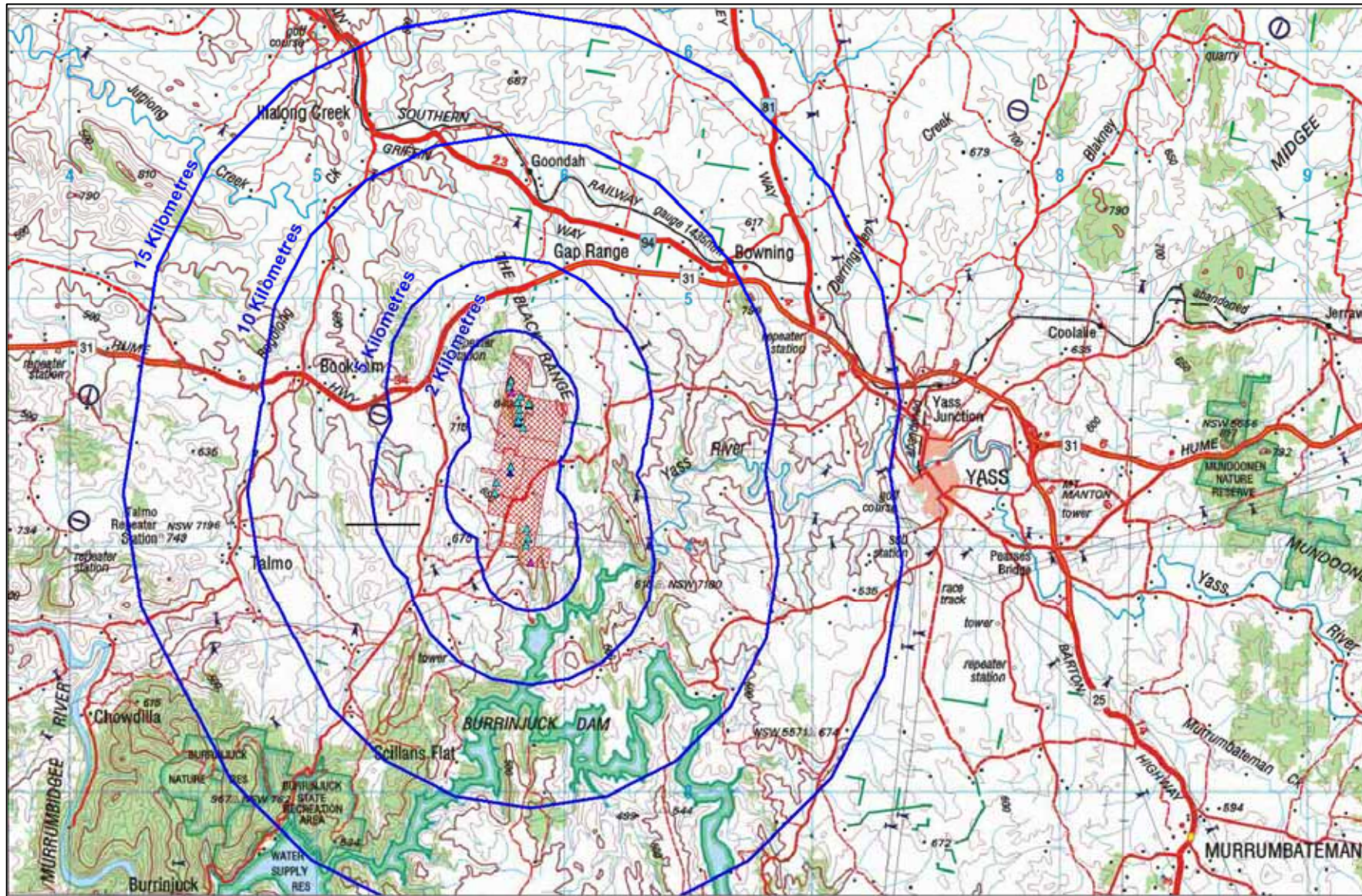


Figure 2.1 Location of the proposed wind farm

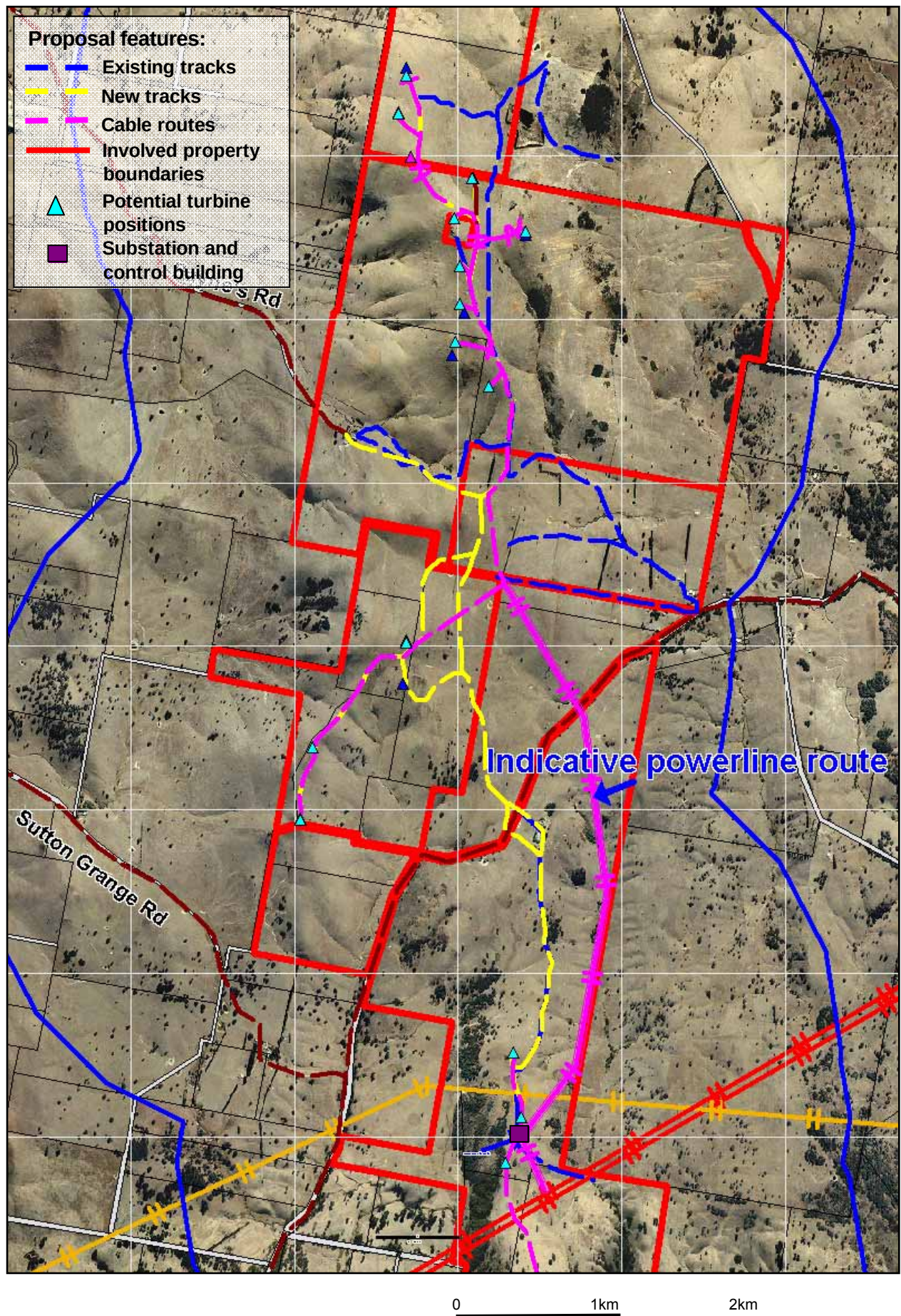


Figure 2.2 Distribution of proposed works at the site

2.3 Approach of this assessment

The preparation of the Biodiversity Assessment involved desktop research, consultations with people with local and specialist knowledge, fieldwork, data analysis, significance assessment and report compilation. The Biodiversity Assessment covers all of the potential areas of impact relating to the three turbine layout options in the proposal.

2.3.1 Desktop research and consultations

Information was sourced on threatened species, populations, and communities having potential to be present at the subject site and in the wider study area. A range of reference books, research papers, conference papers, wind farm assessments and web tools and publications were sourced, focusing on relevant species and the study area. Several experts were contacted, and are cited in relevant sections and the Acknowledgements. In addition, government representatives and landholders provided relevant local information.

2.3.2 Fieldwork

Site fieldwork was carried out on 8-11 November 2005 and 5 March 2006. Fieldwork sought to describe and measure key biodiversity attributes, assess the presence and condition of significant values and determine the nature and extent of impacts likely to result from the proposal. Field activities included general broadscale surveys and targeted surveys for threatened species and Endangered Ecological Communities known to be present, or with potential to be present at the site.

2.3.3 Analysis, assessment and report compilation

Data collected during fieldwork was analysed to determine threatened species habitat suitability, representation of vegetation types and the significance of biodiversity values present at the proposal site. The Biodiversity Assessment report was structured using the conventional values-impacts-significance assessment format, for flora, ecological communities and fauna. Dedicated assessments of impact significance are presented for threatened species and communities, consistent with State and Commonwealth legislative requirements. In view of the potential for wind farms to impact on bird populations, a specific risk assessment for birds has also been undertaken, focusing on significant and vulnerable species. A series of recommended mitigation measures to avoid and reduce impacts on flora and fauna at the site has been developed, based on identified values and potential impacts.

3 REGIONAL CONTEXT

Regional context is important in the consideration of rarity and conservation significance, interactions between the subject site and surrounding habitats, and potential wind farm impacts which may have repercussions beyond the immediate subject area.

A review of biodiversity features has been undertaken at two scales:

- region scale
 - using data compiled for established regionalisations (South-Eastern Highlands Bioregion, Southern Tablelands). Key regional attributes include the abundance, distribution and conservation status of communities and species and the prevalence of threats and disturbance regimes.
- district scale
 - examining an area around the proposal site over a radius of up to 30 kilometres. Species and habitat interactions within this area include foraging and breeding ranges, dispersal patterns and migration routes for fauna, and dispersal and genetic exchange opportunities for flora species.

3.1 Region scale

3.1.1 Regionalisations

INTERIM BIOREGIONALISATION OF AUSTRALIA (IBRA 5.1)

The study area is located in the South Eastern Highlands Bioregion of the Interim Bioregionalisation of Australia (IBRA 5.1) (Thackway and Cresswell, Environment Australia 2000), within the Murrumbateman sub-region (Morgan 2000). The Bioregion extends from Orange in the north, south into Victoria and includes most of the ACT. It has a total area of about 8.7 million hectares, or approximately 6.11 per cent of the state (NPWS 2005).

The Bioregion covers the dissected ranges and plateaux of the Great Dividing Range. The Murrumbateman sub-region is an undulating plateau with rounded hills and peaks, entrenched meandering streams with chain of ponds tributaries. Soils are derived from fine-grained sediments and metasediments, with minor areas of coarse acid volcanics (DEC 2005). The Bioregion and sub-region typically support grassy woodland habitats on flats and low hills and dry shrubby forests on higher hills and ranges (NPWS 2005)

PLANNING FRAMEWORK FOR NATURAL ECOSYSTEMS OF THE ACT AND NSW SOUTHERN TABLELANDS

The proposal site also occurs within the Southern Tablelands region, which has been defined by the NSW and ACT Governments for the purposes of biodiversity protection and conservation planning (Fallding 2002). Within this region, the proposal site lies in the Yass and Wee Jasper Landscape Units. The Yass Landscape Unit is characterised by undulating country largely carrying Box-Gum Woodland, with the major land uses being cropping, grazing, rural subdivisions and urban uses, with two major transport links and lake-based recreation on Lake Burrinjuck (Fallding 2002). Lying south of Black Range Road, the Wee Jasper Landscape Unit is characterised by karst areas, rugged terrain and the Murrumbidgee River corridor below Burrinjuck Dam. Native vegetation in the unit is largely dry forest (Fallding 2002). Land uses include grazing, recreation, conservation and two small villages.

3.1.2 Vegetation

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

Of the remnant vegetation that remains in the Southern Tablelands region, 1% is grassland, 3% is grassland-woodland mosaic, 9% is Box-Gum Woodland, 21% is dry forest, 12 % is wet forest and 0.5% is riparian forest. Box-Gum Woodlands occupied around 23% of the region prior to European settlement. 9% of the region currently carries this community, in varying condition (Fallding 2002). Over 1200 flora species occur in the region. There are 88 threatened plant species in the South Eastern Highlands Bioregion; 36 are listed as endangered, 50 are listed as vulnerable, and 1 species is considered extinct (DEC 2005a).

3.1.3 Fauna

A range of riparian and wetland habitats occur in the IBRA South Eastern Highlands Bioregion, including river oak forest, heathy swamps, sedgeland and sphagnum bogs. Lower elevation wetlands are extensively depleted and degraded by draining, landfilling, salinity, nutrient pollution, flow regime disruption, grazing, sedimentation and weeds. Eighty-eight fauna species from the bioregion are listed in the schedules of the TSC Act (Wildlife Atlas, DEC 2005a); 25 are listed as endangered and 63 as vulnerable.

The threatened status of some species is linked to the general depletion, fragmentation and degradation of lowland grassland and grassy woodland habitats. These include woodland bird species and several reptile species.

54 mammal, 279 bird, 25 frog and 58 reptile species have been recorded in the Southern Tablelands region (Fallding 2002). The vegetation and fauna habitats over much of the region are heavily fragmented and dysfunctional. Also in this region, there are 54 fauna species listed as threatened, including 17 mammals, 24 birds, 6 frogs and 5 reptiles. 13 fauna species have become extinct due to land use or habitat changes. There are 98 fauna species of regional conservation importance (Fallding 2002).

Waterbirds are likely to move between large waterbodies and wetland habitats at the region scale. Lake George (c. 65 kilometres south-east of the subject site), Lake Burley Griffin and associated wetlands (60 kilometres to the south), Lake Burrinjuck (3 kilometres to the south) and major rivers in the region are likely to form part of the foraging range for several mobile waterbird species.

Seasonal wetland and swamp habitats have declined throughout the region due to increasing irrigation and water extraction from rivers, increased small dams and increased use of deep-rooted perennial pastures resulting in reduced runoff. Most wetland bird species in the region show signs of long-term decline (Reid *et al.* 2004).

3.1.4 Conservation and environmental management

The Bioregion has about 726,530 hectares or 14.86 per cent of the South Eastern Highlands Bioregion managed in conservation tenures. A large proportion of grassland and woodland remnants are on private lands (DEC 2005).

The Box-Gum Woodlands and natural temperate grasslands in the Bioregion have been heavily cleared and fragmented by agricultural activities, are poorly represented in reserves and are listed as Endangered Ecological Communities. Lower elevation wetlands and riparian forests are also extensively depleted. Sites with high biodiversity value are rare, isolated and fragmented.

Key environmental management issues in the Yass Landscape Unit include dryland salinity, rural subdivision pressures around Yass and major areas showing signs of former severe clearing (Fallding 2002). The Unit consists primarily of areas likely to have limited conservation values. Roadside remnants are an important conservation resource (Fallding 2002).

The Conroys Gap study area is located in the upper catchment of the Murrumbidgee River. It is estimated that over half of the catchment has been completely cleared of native vegetation. Some of the areas where native vegetation remains are in severely degraded condition (MCMA 2005).

3.2 District scale

A district-scale review of habitats in the area was conducted with reference to aerial photography and topographic maps, vehicle-based survey results and contacts with local landholders and authorities. In particular, the locations of important wetland, woodland and forest habitat areas, and potential connectivity with the subject site was examined. The assessment was limited by air photograph quality, road access and the inability to ground-truth, but does give a broad indication of district-level habitat quality and the relative significance of habitat at the subject site.

For the purposes of this report, the district occupies an area surrounding the proposal site over a radius of 30 kilometres. Key conservation values include:

- the district forms part of the core breeding area for the Superb Parrot;
- the district is the centre of distribution for the threatened Yass Daisy;
- the district contains remnant Box-Gum Woodland (EEC).

3.2.1 District habitat features

WATERCOURSES AND WETLANDS

The subject site contains no major watercourses, and relatively few are present in the district. The Yass River is the principal watercourse south and east of the site. The main tributaries near the subject site are Washpen Creek, Bowning Creek and Deeringullen Creek, which provide connectivity with lowland woodlands and lower order creeks to the north. The Yass River flows into Lake Burrinjuck downstream of the proposal site. Upstream of the lake, steeper banks carry small linear degraded forest and woodland remnants. The river corridor and lake are likely to provide locally important habitat for waterbirds, with connectivity to the Murrumbidgee system and more significant wetlands below the Burrinjuck Dam. Farmland surrounding the subject site is dotted with small farm dams, which provides habitat for mobile waterbirds, but possibly at the expense of river flows and river-dependant species (Reid *et al.* 2005).

GRASSLAND, WOODLAND AND FOREST REMNANTS

Some lowland areas may carry remnant natural grassland, potentially supporting threatened grassland flora and fauna. This community is likely to have occurred in a matrix with woodland communities. No natural grassland areas were recorded at the subject site, or observed in surrounding areas during the survey. Natural grassland has been recorded at Hattons Corner Nature Reserve, near Yass.

The subject site is one of the most heavily cleared areas in the district, with the general loss of all indigenous eucalypts over large parts of the 'Linbrook' and 'Springvale' properties. The high levels of historical clearing are attributed to government requirements for property development (J. Payne, landholder pers. comm.) Woodland is reduced to understorey in varying condition on the involved properties, a discontinuous and narrow linear woodland remnant occurs beside Black Range Road and scattered woodland trees occur on neighbouring properties. Woodland remnants in the district, particularly those with tree cover, are used by a range of woodland bird species, including the threatened Superb Parrot and potentially several other threatened woodland bird species. A significant woodland remnant occurs beside Black Range Road, along Washpen Creek, around 3.5

kilometres east of the subject site. This remnant supports a population of the threatened Yass Daisy and a range of plant species of regional conservation significance.

A few small patches of disturbed dry sclerophyll forest are present on ridge sideslopes (Photographs 6, 19-24). A larger patch of remnant forest occurs north-west of the site (Photograph 2). Remnant forest in the district is commonly associated with steep slopes and rock outcrops. The 'Ferndale' property south of Black Range Road has small remnant forest patches in varying condition. The closest large area of intact forest is Burrinjuck Nature Reserve, Burrinjuck Waters State Park and adjoining private land, which carry tableland dry sclerophyll and montane wet sclerophyll forest types.

3.2.2 Conservation reserves in the district

The Yass Landscape Unit (Fallding 2002) contains one medium sized nature reserve (Mundoonen NR) and one very small nature reserve (Hattons Corner NR). The medium-sized Burrinjuck NR lies southwest of the unit. There are few large areas of remnant woodland or forest within 50 kilometres of the study area. Areas of montane and tableland forest are located to the south west, the closest being Burrinjuck Nature Reserve.

BURRINJUCK NATURE RESERVE AND BURRINJUCK WATERS STATE PARK

Burrinjuck Nature Reserve occupies 3,240 hectares and is located 12 kilometres south-west of the study area. The reserve is contiguous with Burrinjuck Waters State Park, on the shores on Lake Burrinjuck, which has a strong recreational management focus. The dam was constructed in 1927, and raised in 1957, to supply water to the Murrumbidgee Irrigation Area. It impounds the Murrumbidgee River and the lower sections of the Yass and Goodradigbee Rivers. The area of stored water is 5,600 hectares and the shoreline is 645 kilometres in length (Yass Valley Council 2005).

HATTONS CORNER NATURE RESERVE

This small (4 hectare) karst reserve is located beside the Yass River, around three kilometres west of Yass, and fourteen kilometres east of the subject site. It is reserved principally for its geological values, but does contain an area of remnant grassland, and several ROTAP and regionally uncommon plant species (DEC 2005b).

MUNDOONEN NATURE RESERVE

Mundoonen Nature Reserve is located midway between Yass and Gunning, approximately 30 kilometres east of the study area. The reserve occupies 1,485 hectares, and together with adjoining private land forms part of a 3,000 hectare area of forests and woodland. Vegetation in the reserve is largely dry sclerophyll forest, with a small pocket of Box-Gum Woodland. Fauna of conservation significance recorded in the reserve include the Koala and Powerful Owl.

WEE JASPER NATURE RESERVE

Wee Jasper Nature Reserve is a 700 hectare reserve located around 30 kilometres south of the study area. Significant fauna recorded in the reserve includes the Regent Honeyeater, Gang-gang Cockatoo, White-throated Needle-tail and Eastern Bent-wing Bat.

BLACK ANDREW NATURE RESERVE

This is a 1,559 hectare reserve located south of Burrinjuck, around 25 kilometres south-west of the study area. The reserve, with the Brindabella National Park and State Conservation Area, and reserves to the south, forms an almost continuous belt of forest extending to the Australian Alps. The reserve supports several dry and wet sclerophyll forest types. Disused mine shafts are used for roosting by dispersing juvenile bats, including the Eastern Bent-wing Bat. Other threatened fauna recorded in the reserve include the Yellow-bellied Glider, Powerful Owl, Barking Owl, Brown Treecreeper and the Booroolong Frog.

BRINDABELLA NATIONAL PARK AND STATE CONSERVATION AREA

The 18,472 ha National Park and recently declared 2,880 ha State Conservation Area adjoin the ACT boundary, around 40 kilometres south of the study area. The reserves carry tableland and montane forest and subalpine woodland communities. Threatened species recorded in the park include the Powerful Owl, Pink Robin, Brown Treecreeper, Gang-gang Cockatoo, Olive Whistler, Northern Corroboree Frog, Eastern Bent-wing Bat, Yellow-bellied Glider and Tiger Quoll.

SMALL RESERVES AND WOODLAND REMNANTS

Small Box-Gum woodland remnants are scattered throughout the Yass district, particularly along roadsides (including Black Range Road), cemeteries (Bookham and Bowning Cemeteries) and Travelling Stock Reserves (Nanima, Bedulluck, Merryville, Coolalie, Eedy's, New and Wargeila TSRs) and a small reserve at Yass Gorge (Fallding 2002, Rainer Rehwinkel pers. comm.). Lowland paddocks are also likely to carry remnant woodland; paddock tree density varies throughout the district and is generally low in the vicinity of the study area.

4 FLORA AND ECOLOGICAL COMMUNITIES

4.1 Approach and methodology

4.1.1 Preliminary assessments

The survey fieldwork was preceded by a desktop assessment to identify species and communities of conservation significance which may be present in the study area. Topographic maps, air photographs, previous research and assessments and records contained in national and state databases were consulted to identify known and potential values. Key web-based databases included the Commonwealth Protected Matters search tool using a 30 kilometre buffer, Bionet and the DEC Wildlife Atlas (based on the Yass 1:100,000 map sheet area).

The Planning Framework for Natural Ecosystems of the ACT and NSW Southern Tablelands (Fallding 2002) was also consulted for threatened species and community records in the study area and analogous habitats within the region. Habitat potential for threatened species which have been recorded in the wider Southern Tablelands region was assessed using past records and known ecological relationships.

4.1.2 Field survey and mapping

The proposed turbine development zone, inter-turbine cable routes, new track routes and grid connection powerline route were surveyed for flora values on 8-10 November 2005 (northern and central turbine sites and powerline route) and 5 March 2006 (southern turbine sites). The methods and outputs of the assessment are intended to meet the requirements contained in the Draft Guidelines for Threatened Species Assessment (DEC, DPI 2005).

The flora survey area included all areas that would potentially be directly or indirectly affected by the proposal, with an appropriate buffer.

The survey area is indicated on Figure 4.1, and comprises:

- the ridge crests and upper slopes where turbines are proposed for construction (c. 350 hectares);
- 20 metre wide corridors centred on the proposed new tracks and cable routes (c. 13 hectares);
- a 100 metre wide corridor centred on the proposed overhead powerline connecting the turbine sites to the substation and Transgrid system (c. 28 hectares).

The subject site was stratified into 7 broadly homogeneous survey zones based on habitat type, the extent of existing disturbance and the nature of proposed development impacts.

In addition, the periphery of existing tracks at the site which may be used during the construction phase of the proposal was examined for significant or sensitive vegetation features which may be impacted by increased traffic load or road improvement works.

Species lists were compiled for disturbed/exotic areas and for predominantly natural vegetation communities. Areas carrying native vegetation were surveyed using the 'random meander' method (Cropper 1993), rather than quadrats, to maximise opportunities for detecting significant or sparsely distributed plant species. The relative cover/abundance of all vascular plant species was recorded in each survey zone using a six level Braun-Blanquet scale. Species occurrences were recorded progressively and cover/abundances were then generalised over the extent of the survey zone. Species recorded and their cover/abundance scores are listed in Appendix A.

Candidate areas of heavily disturbed habitats or areas carrying mainly exotic species were surveyed to record species composition. Because of their low likely conservation significance, not all of these highly modified areas were inspected in detail.

In addition, dedicated searches in specific habitat areas were undertaken for threatened species which were assessed as having at least a moderate potential to be present at the site (refer Appendix C). The identification of vegetation types is based on the classification developed for the Southern Region Comprehensive Regional Assessment (CRA) (Thomas *et al.* 2000). These types, or 'Forest Ecosystems', are classified primarily on the basis of vascular plant structure and composition.

Botanical nomenclature follows Harden (1990-2001), except where recent taxonomic changes have occurred. Noxious weeds identified are those declared for the Southern Slopes County Council control area under the *Noxious Weeds Act 1993*.

Map references locating significant vegetation features, vegetation type boundaries and noxious weeds were obtained using a hand-held 12 channel GPS unit, and are based on the AGD (old) datum to ensure compatibility with currently available topographic map sheets. AGD references can be converted to GDA (new datum) by adding 184 metres to the northings and 113 metres to the eastings. The study area is covered by the Yass (8628-S) 1:50,000 topographic map sheet.

4.1.3 Threatened species and communities

Threatened species and communities declared under the *Threatened Species Conservation Act 1995* or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* were specifically targeted in the assessment. Threatened species or communities recorded in the study area, or with potential to occur there, were identified using predictive vegetation mapping (Fallding 2002, Thomas *et al.* 2000), previous survey records and a DEC Wildlife Atlas search based on the Yass 1:100,000 map sheet. The Commonwealth online Protected Matters search tool was used to identify flora and other values in the study area listed under the EPBC Act.

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

A precautionary approach has been adopted where distribution and habitat information is incomplete or uncertain.

4.1.4 Survey limitations

The survey area covers almost 370 hectares, which includes substantial buffer areas to allow for the finescale planning and siting of elements of the proposed development. Given the large area, and uncertainty regarding precise areas of impact, a random meander method was used to survey each zone within the survey area (refer section 4.1.2). Survey intensity was increased toward the centre of the survey areas, where impacts are more likely.

While the range of environmental variation was covered within each zone, not every part of the zones was inspected in fine detail. Exceptions were made in cases where potential habitat for significant species was present, such as sites supporting intact Box-Gum Woodland understorey and remnant forest. These areas were subjected to targeted searches for threatened species. Not all of the pasture areas dominated by exotics were inspected in detail because of their low likely conservation significance. Candidate areas of these habitats were surveyed to record general species composition.

Specific areas that would be impacted by access road construction, realignment, widening or other improvement works were not well defined at the time of survey and were not surveyed in detail. Access track road verges were surveyed from a slow-moving vehicle for threatened species such as the Yass Daisy and to assess likely habitat potential.

The survey was undertaken in late spring, during a wet growing season which followed an extended drought period. This is likely to have introduced a strong bias toward fast-growing annual and perennial species, particularly exotic weed and pasture species regenerating vegetatively or from soil or wind-borne seed. This may have masked the 'normal' representation of native perennial grasses and forbs at the site. The drought may have reduced the visibility or abundance of some drought sensitive species to the extent that they were not recorded during the survey.

The spring timing of the main flora survey will mean that some annual or geophytic species (such as terrestrial orchids) which flower outside the survey period will not have been recorded. Ephemeral species which flower in response to irregular disturbance events such as fire will also have gone unrecorded. The follow-up survey examining the proposed southern turbine sites was undertaken in early autumn, during very dry conditions when groundlayer vegetation was desiccated. Many herbaceous and annual species would not have been recorded during this survey. In view of the known habitat requirements of threatened species which have been recorded in the region, it is considered unlikely that any threatened species will have been overlooked. The probability of species of conservation significance having been omitted due to seasonal factors is further discussed in Appendix C and section 4.2.5.

The subject site was currently or had recently been grazed by sheep at the time of survey, which may have affected the recording of some taller or grazing-sensitive species. However, given the apparently low stock numbers and the abundant availability of pasture, the impact of current grazing on the survey results is probably low.

4.2 Assessment and survey results

4.2.1 Survey zones

The subject site was stratified into 7 survey zones, which are relatively homogeneous in terms of flora, habitat, existing disturbance and proposed development impacts. The survey zones are illustrated on Figure 4.1 and are described below:

NT Northern turbine site ridges (c. 170ha) and new track to Linbrook (c. 2.5ha) (total c.172.5 ha)

- generally treeless ridgetops, upper slopes and saddles with largely native grass cover with exotic pasture and weed species
- gradients range from flat to undulating on broad ridgelines to steep sideslopes exceeding 30° in places. Most ridge crests have outcropping metasedimentary rock.
- refer Photographs 1-3, 5-6.

NV Northern valley cable route (c. 2 ha)

- mid-lower slopes and floor of the valley between the central and eastern ridges of the northern turbine sites. The valley is sited high in the McCullums Creek catchment. Largely native low grass cover with soil exposure, sheet erosion on sideslopes and incised creeklines.
- gradients range from <5° to around 20°. Soils are stony on sideslopes, with saturated seepage areas at the time of survey.
- refer Photographs 4, 7, 9-10.
- Note that this area, and ridge to the east, have been excluded from the development envelope in the wind farm proposal.

- CT Central turbine site ridges, northern substation site and cable routes (c. 135 ha)**
- treeless ridgetops, upper slopes and saddles with mixed exotic-native grass cover, considerably lower diversity and abundance of native species than the northern ridge sites. Less exposed than northern sites and with little outcropping rock.
 - the zone includes the proposed northern substation site, in a low-lying, poorly drained paddock dominated by exotic pasture species.
 - gradients in the zone range from flat to undulating on ridgelines and valleys to steep sideslopes exceeding 30°.
 - refer Photograph 8.
- BR Black Range Road crossings: powerline and new tracks (c. 0.1 ha)**
- three short sections of the Black Range Road roadside reserve, where the proposed powerline and two new access tracks cross the road.
 - the crossing points centres on gaps in the roadside tree cover (refer section 4.3.4), and groundcover is dominated by exotic weed and pasture species, with isolated occurrences of hardy native species.
 - gradient in the zone is 0°-5°.
 - refer Photographs 11-14.
- PV Powerline corridor: cleared valley floor (c. 18 ha)**
- the disturbance corridor of the proposed powerline south from Black Range Road passing through the heavily disturbed valley floor and lower slopes on the 'Ferndale' property.
 - groundcover is dominated by exotic weed and pasture species. Small pools are present in the watercourse and tributaries, with native and exotic wetland species.
 - gradients range from 0° to over 30° on some steep sideslopes.
 - refer Photograph 15, 18.
- ST Southern turbine sites, powerline corridor (mid-upper slopes), southern substation site and access tracks: (c. 27 ha)**
- southern turbine ridgetops and the drier mid-upper slopes on the 'Ferndale' property.
 - groundcover is mostly mixed native-exotic pasture, in varying proportions, with isolated individual trees and small tree patches, and some areas of *Acacia paradoxa* thicket and an extensive Tree-of-Heaven infestation.
 - gradients range from 5° to around 25° on some slopes.
 - refer Photographs 16, 17, 20, 25, 26.
- SR Southern turbine sites and powerline corridor: forest remnants (c.18 ha)**
- several small dry shrub forest remnants, typically comprising scattered older trees surrounded by mature regrowth.
 - dominant tree species vary; Red Spotted Gum (*Eucalyptus mannifera*) beside the access track to the turbine sites, Long-leaved Box (*E. gonicalyx*) in the south of the powerline corridor, and Red Box (*E. polyanthemus*), Red Stringybark (*E. macrorhyncha*) and White Gum (*E. rossii*) near the southern turbine sites.
 - granite outcrops west of the southern turbine sites carry a rock scrub assemblage including the shrubs *Leionema lamprophyllum*, *Prostanthera decussata* and *Cryptandra amara*.
 - the forest remnants generally occur on 0-15° slopes and have an open grassy understorey which is subjected to grazing.
 - refer Photographs 19, 21-24, 27.

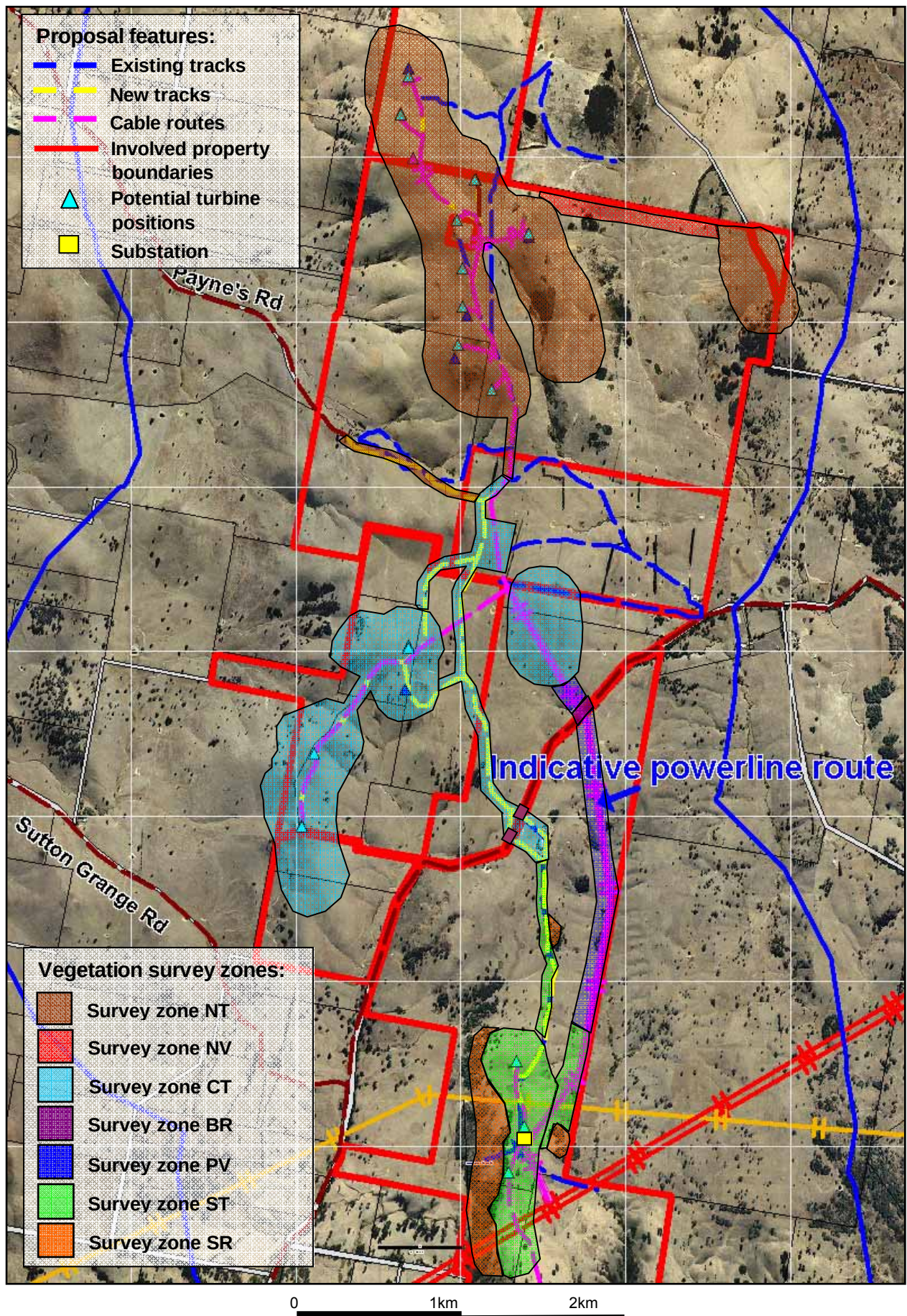


Figure 4.1 Vegetation survey zones

4.2.2 Vegetation communities

The majority of the study area is farmland that has been cleared and grazed for many decades. These areas generally lack sufficient integrity to enable confident attribution to the Southern Region vegetation types defined by Thomas *et al.* (2000). The location of the site in the transition zone between the tablelands and the western slopes also has implications for the composition and distribution of vegetation in the study area.

Nonetheless, there appears to be remnant native vegetation derived from at least three Southern Region vegetation types present in the study area. The types which most closely correspond to remnants in the study area and their approximate distribution at the site are described below. In addition, small areas of permanent or intermittent water carry a suite of native and introduced aquatic species.

The types and their distribution at the site are described below, based on the three broad groupings of Red Stringybark–Broad-leaved Peppermint–Red Spotted Gum forest, ‘Ferndale’ dry shrub forest and Box-Gum Woodland. Full diagnostic species lists and habitat information for the Southern Region CRA vegetation types mentioned are contained in Thomas *et al.* (2000).

RED STRINGYBARK – BROAD-LEAVED PEPPERMINT – RED SPOTTED GUM FOREST

Red Stringybark (*Eucalyptus macrorhyncha*) is present on ridges and slopes as secondary grassland and scattered trees in the northern turbine, southern turbine and powerline valley zones. Broad-leaved Peppermint (*E. dives*) is present as a small remnant patch comprising around 14 mature trees with a few Hickory Wattle trees (*Acacia implexa*) over a dense bracken fern groundcover, on a ridge slope in the northern turbine zone (refer Photograph 6). A small stand dominated by Red Spotted Gum (*E. mannifera*) with Broad-leaved Peppermint and Red Stringybark as sub-dominants, occurs beside the existing access track midway between Black Range Road and the southern turbine sites (Photograph 27). In all stands, understorey vegetation has been greatly modified by agriculture, with the general elimination of the medium-tall shrub stratum. This forest community is likely to have originally covered the ridgelines and sideslopes of the northern majority of the proposal area occurring on metasediments.

This community corresponds to Forest Ecosystem 109: Widespread Tablelands Dry Shrub/Tussock Grass Forest in the Southern Region CRA classification. A few small areas of remnant groundcover, shrubs and eucalypts derived from this community occur on the ridge crests and upper slopes of the proposed turbine sites. Key positive indicator and diagnostic species present at the site include the trees *Eucalyptus mannifera*, *E. dives* and *E. macrorhyncha*, the shrubs *Hibbertia obtusifolia* and *Brachyloma daphnoides*, the forbs *Gonocarpus tetragynus* and *Hydrocotyle laxiflora* and the grasses *Chionochloa pallida*, *Poa sieberiana* and *Poa meionectes*. Some pea shrub and *Acacia* species are likely to have been eliminated by past clearing and grazing pressure.

In some areas this community also carries species characteristic of Forest Ecosystem 120: Western Slopes Shrub/Herb/Grass Dry Forest – notably *Acacia implexa*, *Hypericum gramineum*, *Desmodium varians*, *Bulbine bulbosa*, *Stypandra glauca* and *Luzula densiflora* – and the two types may have occupied the slopes and ridgelines as an intergrading complex.

‘FERNDALE’ DRY SHRUB FOREST REMNANTS

Dry forest remnants variously dominated by Long-leaved Box (*Eucalyptus goniocalyx*), Red Box (*E. polyanthemos*), Red Stringybark (*E. macrorhyncha*) and White Gum (*E. rossii*) occur on the ‘Ferndale’ property, on granitic geology west of the southern turbine sites and in the southern part of the powerline corridor (Photographs 19-24). These remnants occur on ridgetops and upper slopes. The understorey is generally herbaceous and affected by grazing. This forest is likely to have originally occupied the ridges and slopes in the granitic southern part of the proposal area.

The remnant forest community can be assigned to Forest Ecosystem 114: Tablelands Dry Shrub/Tussock Grass Forest. Indicator species present at the site include *E. goniocalyx*, *Hibbertia obtusifolia*, *Gonocarpus tetragynus*, *Wahlenbergia stricta* and *Poranthera microphylla*. Like the previous community, the vegetation here also has some elements of a western slopes type, Forest Ecosystem 121, such as *Daucus glochidiatus*, *Hypericum gramineum*, *Senecio tenuiflorus* and *Microtis unifolia*. However, type 114 remains the best fit for the vegetation at the site.

A steep granite escarpment west of the southern turbine sites carries a rock scrub assemblage including the shrubs *Leionema lamprophyllum*, *Prostanthera decussata* and *Cryptandra amara* (Photograph 23).

VALLEY WOODLAND

A woodland assemblage dominated by Blakely's Red Gum (*E. blakelyi*) and Yellow Box (*E. melliodora*) is present in a discontinuous linear remnant beside Black Range Road in the vicinity of the proposed powerline and track crossing points (survey zone BR, Photographs 11-14). The understorey at the actual crossing points is largely dominated by introduced grass species, with some patchy representation of native groundcover species such as *Microlaena stipoides*, *Themeda triandra*, *Poa sieberiana*, *Austrodanthonia* spp. and *Lomandra filiformis* ssp. *coriacea*. The woodland community is also present as secondary grassland in the Northern Valley survey zone.

These woodland communities are likely to have occupied the valley floor, low hills and lower slopes throughout the Yass district, including the valleys in the study area north of Black Range Road and much of the valley section of the powerline route through the 'Ferndale' property (zones NV, BR, PV).

Since their habitat coincides with prime farmland, these woodland communities have been heavily impacted by clearing, grazing, cultivation and the introduction of weed and pasture species. Some parts of the subject site have lost nearly all evidence of the natural woodland, including the proposed northern substation site (included in CT) and much of the 'Ferndale' valley floor (PV). Areas in valleys in the north of the study area and the creek valley through the Ferndale property have lost tree cover and much of the groundcover. Relatively intact woodland remnants are present on roadsides to the east of the study area.

Some riparian areas are likely to have carried Forest Ecosystem 92: Tablelands Acacia/Grass/Herb Dry Forest, dominated in the overstorey by *E. bridgesiana* and *E. melliodora*. Indicators of this type are present in the northern valley survey zone (NV), and include *Leptospermum myrtifolium*, *Gonocarpus tetragynus*, *Acaena novae-zelandiae*, *Schoenus apogon*, *Microlaena stipoides*, *Poa sieberiana* and *Cheilanthes austrotenuifolia*. Woodland remnants in the study area also carry indicators of Forest Ecosystem 160: Northern Slopes Dry Grass Woodland (*E. blakelyi*, *Aristida ramosa*, *Austrostipa scabra* ssp. *falcata*, *Lomandra filiformis* ssp. *coriacea*, *Chrysocephalum apiculatum*, *Solenogyne dominii*) and Forest Ecosystem 161: Tablelands and Slopes Dry Herb/Grass Woodland (*Austrostipa scabra* ssp. *falcata*, *Acaena echinata*, *Epilobium billardierianum*, *Asperula conferta*, *Schoenus apogon*, *Solenogyne dominii*). It is possible that either or both of these types would also have been present in valleys in the study area.

MODIFIED AQUATIC HABITATS

Wetland communities are present in streams and dams in the study area, particularly associated with instream pools in the 'Ferndale' section of the proposed powerline route (zone PV, refer Photograph 18). Because of their inherent fertility, and impacts arising from erosion, sedimentation, grazing, clearing and disruption to flow regimes, these habitats have been extensively colonised by weeds.

Wetland and riparian assemblages in the study area are heterogeneous, and may be locally dominated by willows (**Salix* spp.), blackberry (**Rubus ulmifolius*), the native spike rush (*Eleocharis acuta*), native rushes (*Juncus* spp.), bullrush (*Typha* sp.), or an array of introduced grasses (**Polypogon monspeliensis*, **Hordeum* spp., **Bromus* spp., **Holcus lanatus*), rushes (**Juncus articulatus*) and forbs (**Rorippa* spp., **Callitriche stagnalis*, **Ranunculus muricatus*, **Medicago*

arabica). In some areas, other native forbs (such as *Persicaria hydropiper*), grasses (such as *Amphibromus nervosus*) and sedges (*Carex incomitata*, *Cyperus sphaeroideus*, *Schoenus apogon*, *Isolepis* sp.) persist but are generally in the minority.

EXOTIC PASTURE

The moister, more fertile valley floors in the study area generally carry pasture dominated by exotic grasses and legumes, with some representation of native species. Exotic pasture and other heavily modified areas occupy around 40% of the Southern Tablelands region (Fallding 2002). There are very few natural paddock trees on the 'Linbrook' and 'Springvale' properties.

Species recorded in the vegetation types in the survey zones, with their cover/abundance scores, are listed in Appendix A.

4.2.3 Communities of conservation significance

The conservation status of each of the natural vegetation types present as remnants in the study area is summarised in Table 4.1, based on data presented in Thomas *et al.* (2000)

Table 4.1 Conservation status of natural vegetation types in the study area

Vegetation type	Pre-1750 extent (ha)	Extant (ha)	Reserved in CRA Southern Region (ha)
Forest Ecosystem 109: Widespread Tablelands Dry Shrub/Tussock Grass Forest	154,451	69,789 (45.2% of 1750 extent)	8,576 (5.5% of 1750 extent)
Forest Ecosystem 114: Tablelands Dry Shrub/Tussock Grass Forest	202,415	95,557 (47.2% of 1750 extent)	11,681 (5.8% of 1750 extent)
Forest Ecosystem 92: Tablelands Acacia/Grass/Herb Dry Forest	42,726	7,417 (17.3% of 1750 extent)	111 (0.3% of 1750 extent)
Forest Ecosystem 160: Northern Slopes Dry Grass Woodland	335,030	12,902 (3.8% of 1750 extent)	102 (0.03% of 1750 extent)
Forest Ecosystem 161: Tablelands and Slopes Dry Herb/Grass Woodland	88,499	1,918 (2.2% of 1750 extent)	nil

Table 4.1 shows the high level of depletion of the Box-Gum Woodland vegetation types which would have originally occupied the valleys and lower slopes of the study area. The impact of this depletion is compounded by the severe fragmentation and continuing degradation of remaining stands. Applying the general JANIS reservation target of 15% for each forest type (JANIS 1997), each of the natural vegetation types which would originally have occupied the study area are under-represented in the conservation reserve system. Under these criteria, 60% of the remaining stands of vulnerable types and 100% of endangered types should be reserved or otherwise protected.

BOX-GUM WOODLAND ENDANGERED ECOLOGICAL COMMUNITY

Forest Ecosystems 160 and 161 fall within the White Box Yellow Box Blakely's Red Gum Woodland Endangered Ecological Community ('Box-Gum Woodland' EEC). Type 92 overlaps the EEC, with grassy examples featuring Yellow Box covered by the EEC Determination. Yellow Box is likely to have been a significant component of the type 92 community in the study area.

These vegetation types are also included within the Grassy White Box Woodlands community listed as endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

Box-Gum Woodland EEC remnants are threatened by a range of processes, including further clearing, firewood cutting, livestock grazing, weed invasion, inappropriate fire regimes, soil

disturbance, increased nutrient loads, soil acidification and salinisation and loss of connectivity (NSW SC 2002).

In relation to disturbed and degraded remnants, vegetation in the South Eastern Highlands is considered to form part of the EEC if:

- the site supports or is likely to have supported White Box, Yellow Box or Blakely's Red Gum;
- the site is predominantly grassy; and
- the site has few if any native species but would, under appropriate management, respond to assisted regeneration, such as where natural soils and the soil seed bank are at least partially intact (after NPWS EEC Identification Guidelines).

Sites are excluded from the EEC if no native species are present in the understorey and the site is unlikely to respond to assisted regeneration.

The Box-Gum Woodland EEC Determination notes that some remnants survive partly or wholly cleared of trees, and conversely, remnants may also survive with the tree layer intact but with the understorey degraded or lost through grazing or pasture modification. Both of these states are represented in remnants at the subject site.

The EEC is present at one location, in the Northern Valley survey zone, on the McCullums Creek valley floor and lower slopes where tree cover has been lost but a number of key grassy woodland indicators persist in the native pasture groundlayer (including *Hibbertia obtusifolia*, *Brachyloma daphnoides*, *Chrysocephalum apiculatum*, *Bulbine bulbosa*, *Glycine clandestina*, *Desmodium varians*, *Hypericum gramineum*, *Oxalis perennans*, *Wahlenbergia communis*, *Isotoma fluviatilis*, *Ammobium craspedioides*, *Solenogyne dominii*, *Craspedia variabilis*, *Brachyscome* spp., *Thysanotus tuberosus*, *Hypoxis hygometrica*, *Drosera peltata*, *Bothriochloa macra*, *Themeda triandra*, *Austrodanthonia* spp.).

The potential current distribution of the EEC in the Northern Valley survey zone is indicated on Figure 4.2. The community is shown in Photographs 4, 9-10.

Conservation significance

Box-Gum Woodland vegetation in the Northern Valley (McCullums Creek) survey zone at the subject site has moderate-high conservation significance, in view of the general depletion of grassy woodland vegetation in the region. Conservation value is restricted by the loss of floristic and structural integrity and disturbance to soils from sheet and gully erosion, and possibly a rising saline watertable.

The site has some recovery potential with the reinstatement of the tree stratum, stabilisation of soils and appropriate grazing management. Site recovery may extend the habitat available to the adjacent population of the threatened Yass Daisy, located on the neighbouring property immediately north of the site.

The EEC Determination notes that native species within the EEC which do not appear to tolerate grazing by domestic stock include *Dianella revoluta*, *Diuris dendrobioides*, *Microseris lanceolata*, *Pimelea curviflora* and *Templetonia stenophylla* (Prober & Thiele 1995 in NSW SC 2002). None of these species were recorded at the subject site.

The dominant pasture species typically change from *Themeda australis*, *Austrostipa aristiglumis* and *Poa* spp. to *Austrostipa falcata*, *Austrodanthonia* spp. and *Bothriochloa macra* as grazing intensity increases (Moore 1953a in NSW SC 2002). The vegetation in the Northern Valley survey zone is dominated by *Microlaena stipoides*, *Austrodanthonia* spp, with occasional *Austrostipa scabra* ssp *falcata* (syn. *A. falcata*), *Bothriochloa macra* and *Themeda triandra* (syn. *T. australis*), reflecting the long history of grazing at the site.

However, the ACT Lowland Woodland Conservation Strategy (ACT Government 2004) notes that *Diuris* and *Thelymitra* orchid species are highly sensitive to disturbance, and *Bulbine bulbosa* and

Craspedia variabilis are moderately sensitive to disturbance. The presence of these species in reasonable abundance in the northern valley survey zone suggests that the soil seed bank may be intact and the site may have good understorey recovery potential.

The significance of the impact of the proposal on the EEC at this site is assessed in the Assessment of Significance included in Appendix D.

Non-EEC Box-Gum Woodland remnants

Mature Yellow Box and Blakely's Red Gum trees are present beside Black Range Road in the vicinity of the proposed powerline and new track crossings (survey zone BR, Photographs 11-14). While natural understorey appears to be present beside Black Range Road to the east of the study area, the actual crossing points have lost most tree cover and carry largely exotic grass and legume groundcover, with isolated individuals of disturbance-tolerant native plant species. Recommendations on the finescale siting of the crossings are given in section 4.3.4.

Given the extent of local disturbances from clearing and road works, the longstanding dominance by exotic understorey species, the highly modified nature of neighbouring paddocks and the limited width of the remnant (around 4-5 metres either side of the road), it is considered unlikely that a native soil seed bank with any substantial degree of diversity or integrity would persist at the sites. This area is therefore not considered to belong to the Box-Gum Woodland EEC.

Former EEC habitat along the powerline route through the 'Ferndale' property now supports a largely exotic herbaceous groundlayer cleared of native tree cover.

The EEC Determination notes that some remnants consisting of only an intact overstorey or an intact understorey, may still have high conservation value due to the flora and fauna they support. Local examples are the treeless habitat of the threatened Yass Daisy (*Ammobium craspedioides*) in the northern valley zone (mostly outside the area of impact), and remnant trees in local roadsides and paddocks which provide habitat for the threatened Superb Parrot.

WETLAND COMMUNITIES

The small wetland areas dominated by native species at the site have local conservation significance because of the general degradation of these communities throughout the region. The conservation value of these areas primarily relates to their role in maintaining water quality and flow conditions, stabilising soils and providing fauna habitat, rather than inherent botanical values.

4.2.4 Species recorded at the subject site

A total of 188 vascular plant species were recorded during the flora survey, including 80 exotic species. A full list of species recorded in the seven survey zones, and their cover/abundance, is provided in Appendix A. As noted above, this list is not exhaustive due to the extensive nature of the survey area, and the omission of some species which flower outside the survey period.

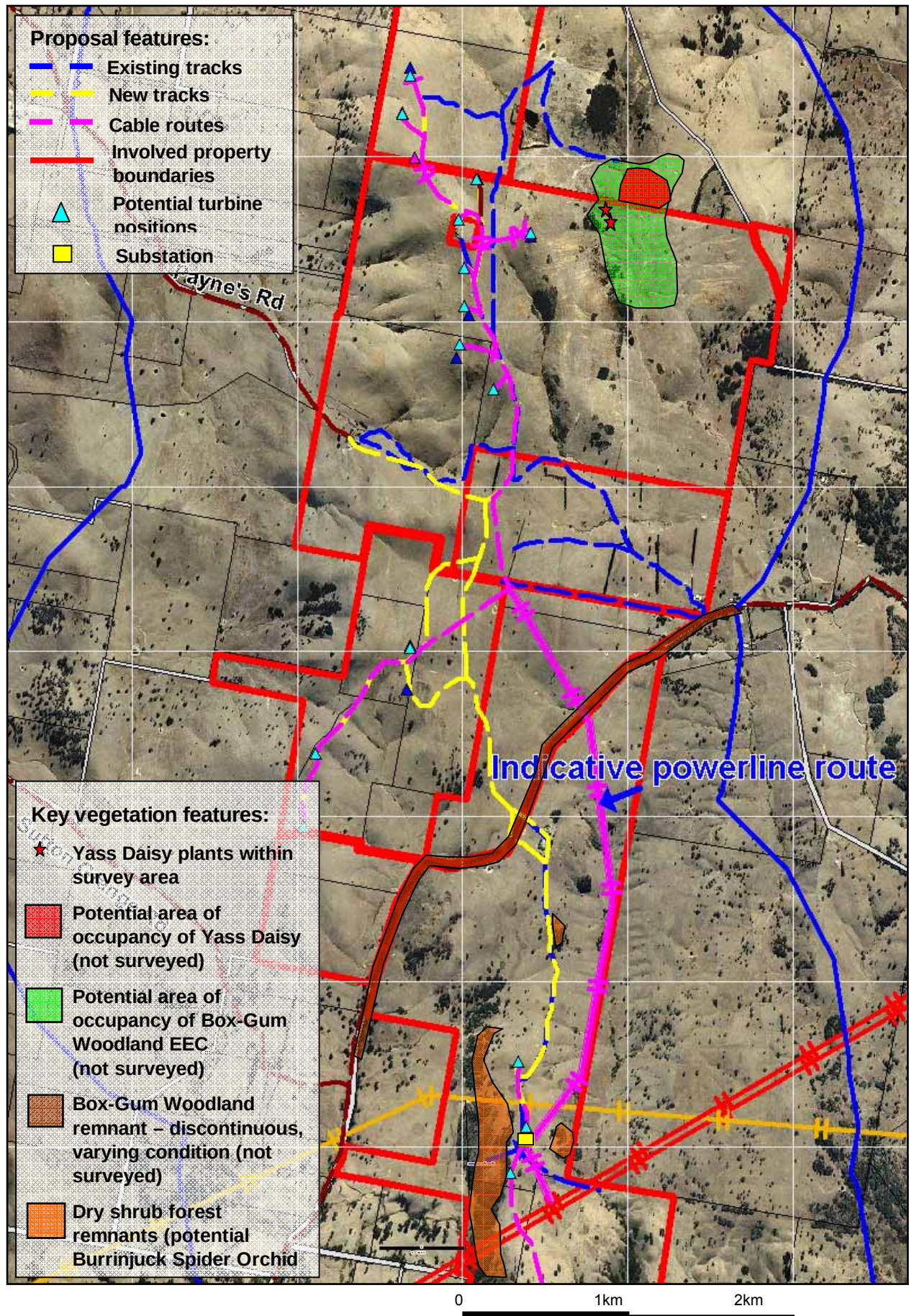


Figure 4.2 Key vegetation features of the subject area

4.2.5 Species of conservation significance

THREATENED AND NATIONALLY SIGNIFICANT SPECIES

A number of threatened flora species have potential distribution ranges covering the study area. These species, their known distribution and habitat requirements and their likelihood of being present at the subject site are identified in the Threatened Species Evaluation in Appendix C. Based on this analysis, four threatened species have a moderate or high potential of being present in the study area:

Yass Daisy (*Ammobium craspedioides*)

A sizeable population (hundreds) was observed on the Waldren property, over the fence immediately north of the northern valley survey zone, near McCullums Creek, north of a line between AGD 659024 6145691 and AGD 659335 6145635.

Two plants were recorded within the survey zone, at AGD 658901 6145625 and AGD 658889 6145630. The survey zone had lower and sparser groundcover than the Waldren property presumably due to greater grazing pressure. In surveys conducted in the Booroowa Shire to the north, all of the occurrences of this species were on land characterised by a light grazing regime (NPWS 2002).

The species is also scattered in roadside remnants beside Black Range Road, east from AGD 660976 6143223. Some of these occurrences are recorded in the Wildlife Atlas and Bionet databases. This species and its habitat at the site are shown on Photographs 9 and 10 and mapped on Figure 4.2.

Burrinjuck Spider Orchid (*Caladenia* sp Burrinjuck)

This species has potential habitat in small remnant stands of dry shrub forest within the southern remnant survey zone (refer Photographs 19-24 and Figure 4.2). This community is broadly analogous to known habitats in Burrinjuck Nature Reserve to the south (NPWS 2003). The species flowers from late August to October and would not have been recordable at the time of the survey. The disturbance history and highly restricted distribution of the species reduces the likelihood of its presence at the site.

Hoary Sunray (*Leucochrysum albicans* ssp *albicans* var *tricolor*)

Hoary Sunray is widespread, though uncommon in the Southern Tablelands region and is not listed as threatened in NSW. The species is sensitive to grazing but persists on road verges in some areas. It is a large conspicuous daisy and the survey coincided with the flowering period for this species. It was not recorded during the survey, and is likely to have been detected if present at the subject site. The long grazing history of farmland in the study area further reduces the likelihood of its presence at the site.

Silky Purple Pea (*Swainsona sericea*)

Potential habitat for this species exists in remnant grassy woodland understorey in the northern valley survey zone (NV). However, given the high level of disturbance at the site, and the failure to record the species during the survey, the chances of the species being present at the site are greatly reduced. This species would have been flowering at the time of survey, and should have been visible in the low sward in the survey area, had it been present.

In addition, two species have low-moderate potential to occur at the site:

- Tarengo Leek Orchid (*Prasophyllum petilum*)
- Small Purple Pea (*Swainsona recta*)

The Tarengo Leek Orchid and Small Purple Pea may not have been flowering or obvious at the time of survey. Given the grazing history of the site, and the highly restricted known distribution of both *Prasophyllum petilum* and *Swainsona recta* it is considered unlikely that either of these species would occur at the site. Nonetheless, safeguards have been identified in section 4.3 to account for their possible occurrence. Photographs and descriptions of the Tarengo Leek Orchid and Small Purple Pea are included in Appendix H.

The Yass Daisy and Burrinjuck Spider Orchid have been included in the Assessment of Significance presented in Appendix D. The Hoary Sunray and Silky Purple Pea have not been included because they were not detected at the subject site during the survey, despite their being perennial, reasonably conspicuous and with a flowering period coincident with the timing of the survey. The Tarengo Leek Orchid and Small Purple Pea are not included in the Assessment of Significance because of their low likelihood of being present at the site.

REGIONALLY SIGNIFICANT SPECIES

There are a range of grassland and grassy woodland species which are of regional conservation significance due to the general depletion of these communities. These species include Zornia (*Zornia dyctiocarpa*), Australian Anchor Plant (*Discaria pubescens*), Emu-foot (*Cullen tenax*), Mountain Swainson-pea (*Swainsona monticola*), Wedge Diuris (*Diuris dendrobioides*), Purple Diuris (*D. punctata* var. *punctata*), Hairy Buttons (*Leptorhynchus elongatus*), Austral Trefoil (*Lotus australis*), Yam Daisy (*Microseris lanceolata*), *Picris* species, a milkwort (*Polygala japonica*) and Wild Sorghum (*Sorghum leiocladum*) (ACT Government 2004). These species are very likely to occur on less disturbed roadsides between the subject site and Yass, but none were recorded within the subject site.

4.2.6 Matters of National Environmental Significance

Matters of national environmental significance listed under the *Environment Protection and Biodiversity Conservation Act 1999* within a 30 kilometre buffer of the study site were identified using the EPBC Act search tool (<http://www.deh.gov.au/erin/ert/epbc/index.html>) in November 2005. The biodiversity component of the report is included in Appendix E, with an Assessment of Significance of the impacts of the proposed development on these matters.

The search tool report indicates the following threatened flora or ecological communities listed under the EPBC Act are or may be located within the search area:

- two Threatened Ecological Communities (Grassy White Box Woodlands, Natural Temperate Grassland);
- six threatened plant species (Yass Daisy, Crimson Spider-orchid, Tricolour Diuris, Narrow Goodenia, Wee Jasper Grevillea, Austral Toadflax).

In addition, five natural heritage areas listed on the Register of the National Estate occur within the search area; Derringullen Creek Area, Hattons Corner Area, Lake Burrinjuck *Grevillea iaspicula* Sites 1 and 2, and the Upper Lake Burrinjuck Area.

The Threatened Species Evaluation in Appendix C assesses the potential for threatened species to be present at the proposal site, based on available habitat, known ecological requirements and local distribution records. Habitat suitability for migratory bird species is further assessed in Appendix F. Species which have at least a moderate potential to occur at the proposal site are included in the Assessment of Significance for species listed under the EPBC Act (Appendix E).

The flora survey recorded remnant vegetation attributable to the Endangered Ecological Community Grassy White Box Woodland (referred to in the Biodiversity Assessment as 'Box-Gum Woodland') in

the McCullums Creek valley to the east of the subject site. Areas under the proposed powerline and Black Range Road crossings would have originally carried Box-Gum Woodland, but have lost tree cover and are now dominated by exotic species.

One nationally threatened species was recorded in the study area during the flora survey; the Yass Daisy (*Ammobium craspedioides*), listed as vulnerable under the EPBC Act. Two listed flora species were not recorded but were assessed as having moderate or high potential to be present in the study area (refer Appendix C); the Burrinjuck Spider Orchid (*Caladenia* sp Burrinjuck), and the Hoary Sunray (*Leucochrysum albicans* ssp *albicans* var *tricolor*). Potential habitat is present for two further listed species - the Small Purple Pea (*Swainsona recta*) and Tarengo Leek Orchid (*Prasophyllum petilum*) – but are considered unlikely to be present due to habitat degradation.

4.2.7 Disturbance and weeds

Forests and woodlands in the study area have been progressively ring-barked and felled over the past century to provide pasture. Clearing and agriculture has produced a range of direct and indirect impacts to flora habitats, including altered microclimate, loss of pollinator and dispersal fauna, sheet erosion of soils, watercourse bed incision and damming, localised sedimentation, elevated soil nutrients and rising saline groundwater.

Agricultural activities have also resulted in the colonisation of a range of introduced plant species, with greatest displacement of natives occurring in moister, more fertile valley floor areas and areas subjected to pasture improvement and cultivation. In many areas, grazing is likely to have reduced or eliminated selectively grazed or grazing sensitive species, such as Kangaroo Grass (*Themeda triandra*), terrestrial orchids, wattles and sub-shrubs.

The subject site carries a high proportion of exotic weed and pasture species, ranging from less than one quarter of total herbaceous cover (in the northern valley survey zone) to almost total displacement of native species (throughout much of the powerline valley floor zone). The major exotic species are grasses, clovers, Sheep Sorrel, asteraceous weeds (Capeweed, thistles), and localised riparian/wet area occurrences of Yorkshire Fog, Blackberry, Willow, Jointed Rush and Watercress.

A large and spreading thicket of suckering Tree-of-Heaven (*Ailanthus altissima*) occurs on a midslope in the southern turbine survey zone, at AGD 658488 6140496 (Photograph 17).

Cover values for exotic species in the turbine ridge, powerline sideslope and Black Range Road zones are greatly inflated by seasonal factors. In particular, the long dry period which preceded the spring will have degraded the native perennial grass sward. This, with the good rains that have accompanied the current spring, has provided opportunities for fast growing annuals such as Silvery Hairgrass (*Aira cupaniana*), Wintergrass (*Poa annua*), Shivery Grass (*Briza minor*) and Soft Brome (*Bromus molliformis*); the latter has achieved more than 50% cover in some areas. Some native annuals, such as Austral Sunray (*Triptilodiscus pygmaeus*), have also benefited from the wet spring.

Six weeds declared under the *Noxious Weeds Act 1993* were recorded at the subject site. Locations of these weeds at the subject site are provided in Table 4.2 below. These locations are the main occurrences observed during the survey and are not exhaustive.

The noxious weed species are listed as Class 4 weeds for the Southern Slopes County Council control area. The control objective for Class 4 weeds is to minimise the negative impact of those plants on the economy, community or environment of New South Wales.

Table 4.2 Locations of main occurrences of declared noxious weeds

Noxious weed species	Class	Location
*Nodding Thistle <i>Carduus nutans</i>	4	Few plants in powerline valley zone (near AGD 658652 6140658)
Blackberry <i>Rubus fruticosus</i> agg.	4	Small occurrences widespread, major occurrences localised in creekline north of Black Range Road in powerline road crossing zone, and in powerline valley zone (AGD 658847 6141793).
Sweet Briar <i>Rosa rubiginosa</i>	4	Few isolated plants in northern turbine zone (middle ridge).
Serrated Tussock <i>Nassella trichotoma</i>	4	Scattered throughout the northern ridgetop turbine survey zones, and less commonly in the southern turbine powerline sideslope zone.
Paterson's Curse <i>Echium plantagineum</i>	4	Few plants in powerline road crossing zone (near AGD 658720 6142594) and on ridge near Springvale in southern turbine zone.
*Scotch Thistle <i>Onopordum acanthium</i>	4	Few plants in southern turbine/powerline sideslope zone (near AGD 658355 6139810)

* tentative identification based on non-flowering specimens

4.3 Impact assessment

4.3.1 Construction impacts

Direct impacts

The proposal would result in the removal of vegetation under the development footprint, including the turbine towers and surrounding hardstand areas, control building, substation, new and widened access tracks and powerline poles. This vegetation would be removed for the life of the wind farm (up to 30 years).

Underground cable corridors would generally follow access tracks constructed to and between the wind turbines and other facilities. Existing tracks run from the Springvale property onto the trig ridge and from Black Range Road south to the southern turbine cluster site.

Permanent (30 years) vegetation loss

Native secondary grassland derived from dry shrub forest types:

Forest Ecosystem 109: Widespread Tablelands Dry Shrub/Tussock Grass Forest

Forest Ecosystem 114: Tablelands Dry Shrub/Tussock Grass Forest

Forest Ecosystem 92: Tablelands Acacia/Grass/Herb Dry Forest

Turbine towers and footings (28m ² x 15 turbines)	0.04 ha
Access tracks to and between turbines (7,500m x 5m)	3.75 ha
Control building (5m x 10m)	0.005 ha
Substation (70m x 70m)	0.490 ha
Total	4.285 ha

Exotic grassland

Access tracks to and between turbines (1,500m x 5m)	0.75
Aerial cable poles (powerline - up to c.70 poles x 2 m ²)	0.01 ha
Total	4.93 ha

Temporary vegetation loss and rehabilitation

Native secondary grassland derived from dry shrub forest types (as above)

Turbine tower temporary hardstand and laydown	1.35 ha
- (30m x 30m) 900m ² x 15 turbines	

Native secondary grassland (dry shrub forest) and exotic grassland

Construction facilities (100m x 75m)	0.75 ha
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Total	2.1 ha
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Based on these estimates, the works would permanently displace approximately 4.3 hectares of secondary grassland derived from dry shrub forest types on the ridgetop turbine and substation sites, and a smaller area of exotic pasture under the powerline and the new access tracks connecting the northern, central and southern turbine clusters.

2.1 hectares of native secondary grassland vegetation would be disturbed and reinstated following the construction of the turbines and rehabilitation of areas used for construction facilities. The routing of the powerline through cleared parts of the 'Ferndale' property and the siting of the southern turbines to the east of the remnant forest patches would avoid the need to clear native forest. Similarly, the selection of Paynes Road to access the site would avoid the need to trim branches from trees beside Black Range Road.

The proposal would not directly affect the northern valley (McCullums Creek) or the ridge to the east of the valley. This area was removed from the proposal in light of the results of biodiversity, visual and noise assessments. Measures would be adopted to protect this area from the peripheral and indirect impacts of the development.

Indirect and peripheral impacts

Vegetation surrounding the development footprint would be affected by vehicle access and parking, materials laydown and spoil deposition and retrieval. Peripheral impacts may include soil compaction, soil erosion and sedimentation. The works have the potential to introduce and spread weed species. The concrete batch plant and associated flush pit, if used, would alter local subsoil conditions over the medium term.

Pollution risks are associated with the concrete batch plant, fuels and lubricants and construction chemicals used at the site. With appropriate safeguards and practices (refer EAR), these risks to native vegetation are expected to be low. Similarly, the increased bushfire risks to vegetation caused by construction activities are expected to be manageable and acceptable. Dust would be generated from the excavation and building activities at the construction sites, and by traffic using unsealed access routes, over the 6-9 month construction period. The limited duration of dust deposition is not expected to significantly affect soils and vegetation at the site.

Impacts on threatened species and communities

The impacts of the proposal on the threatened Yass Daisy (*Ammobium craspedioides*) and the Box-Gum Woodland Endangered Ecological Community located in the Northern Valley survey zone are identified and assessed in the Assessment of Significance presented in Appendix D.

The proposal would not directly affect the northern valley (McCullums Creek) EEC area or the associated Yass Daisy habitat. This area was removed from the proposal in light of the results of biodiversity, visual and noise assessments. Measures would be adopted to protect this area from the peripheral and indirect impacts of the development.

CONCLUSION

In view of the local abundance of secondary grassland derived from dry sclerophyll forest, the low conservation value of exotic pastures, the low impacts on local trees and threatened species and communities, the proposal is not expected to significantly affect flora values at the site.

4.3.2 Operational impacts

The operational impacts of the proposal may include alteration to the prevailing grazing regime at the turbine sites, and some alteration to native fauna use of the sites. Inspection, maintenance and monitoring visits would be required, although existing tracks would be used and impact on vegetation is expected to be minimal. Access tracks would be maintained to minimise ongoing erosion and sedimentation impacts. The maintenance program would also include regular inspections for weed and rabbits, and control as required. Maintenance access would be confined to existing tracks, hardstand or heavily disturbed areas.

The impacts of major repairs would be similar in nature to construction impacts, but more limited in extent. The proposal would produce an ongoing pollution risk from the oil-cooled substation; design measures have been incorporated to ensure that any spill would be contained by bunding and treated expeditiously.

The operational impacts of the proposal on vegetation are not expected to significantly affect flora values at the site.

4.3.3 Decommissioning impacts

Decommissioning impacts would be similar to, but less extensive than, construction impacts. The area of impact would be reduced because underground footings and cabling would not be removed from the site. The control building may also be retained on the site. Access tracks would be upgraded as required, and appropriate weed hygiene and rehabilitation measures would be implemented. The decommissioning phase of the proposal is not expected to significantly affect local flora values. Relevant mitigation measures implemented during the construction phase would also apply to decommissioning works.

4.3.4 Impact avoidance and mitigation

FURTHER SURVEY WORK

- If areas of dry shrub remnant forest on the 'Ferndale' property require clearing, the areas should first be surveyed for the Burrinjuck Spider Orchid (*Caladenia* sp Burrinjuck) during the late August-October flowering period.

MICROSCALE SITE SELECTION

- The southern turbines and access track should be sited to avoid the need to clear or trim remnant eucalypts to the west of the southern turbine sites.
- The powerline should be routed to avoid the need for clearing or trimming of the Long-leaved Box (*Eucalyptus goniocalyx*) forest remnant on the 'Ferndale' property.
- The Black Range Road crossing points for the proposed new tracks near the Ferndale residence should be sited in available gaps between mature Yellow Box and Blakely's Red Gum trees in the road reserve. The northern track crossing appears to be sited in such a gap; the southern crossing may need to be shifted slightly to the north (to AGD 658311 6141864) to avoid mature trees.

DESIGN AND CONSTRUCTION MEASURES

General measures

- Site stabilisation, rehabilitation and revegetation would be undertaken without delay, following the rehabilitation guidelines in the EA.
- Works would avoid impacts to mature eucalypts wherever possible. Wherever practicable, excavations and vehicle/machinery movements should occur outside the canopy dripline of large eucalypts.
- As a general rule, disturbed areas would be used for vehicle and machinery access, materials laydown, stockpiling of cleared vegetation and the deposition and retrieval of spoil whenever practicable.
- Works would be avoided during, and immediately following heavy rainfall events to protect soils and vegetation at the site.
- Any compaction of soil resulting from vehicle access and laying of materials, particularly during saturated soil conditions, would be avoided and remediated as necessary.
- Excavated topsoil, subsoil and weathered rock would be stored separately and replaced in a manner that approximates the original profile as closely as possible.
- Where practicable, whole sods would be removed with an excavator where these areas are well-vegetated with dense root systems. Sods would be stored in moist, shaded conditions and replaced following the works. Sod storage time would be minimised and sods would be replaced in a manner that maximises the chances of re-establishment.
- Appropriate fire fighting equipment would be held on site when the fire danger is very high to extreme, and a minimum of one person on site would be trained in its use.
- Machinery and vehicles used in construction works would be washed before and after site access to reduce the introduction and spread of weeds and pathogens.
- Laydown sites for excavated spoil, equipment and construction materials would be weed-free or treated for weeds wherever practicable.
- Weed monitoring would be carried out at all sites after the completion of construction works and ongoing weed control would occur where noxious or invasive species are recorded. In particular, monitoring would be undertaken during the following late spring/early summer, and remedial action taken as required.
- Only certified weed free hay bales would be used for sediment control, if available.
- Wherever practicable, the overstorey canopy in forest communities would not be disturbed to assist weed suppression.
- Imported materials such as sand and gravel would be sourced from sites which do not show evidence of noxious weeds or *Phytophthora* infection.

Project-specific measures

- Contractors and staff would be made aware of the significance and sensitivity of the Northern Valley/upper McCullums Creek valley area (Box-Gum Woodland EEC and threatened Yass Daisy habitat). The area would be protected from peripheral and indirect impacts and would not be used for site access or materials/equipment laydown.
- In areas dominated by exotic groundcover species, exposed soils in the excavation corridor would be lightly mulched with chipped vegetation or sterile hay, and sown with a cover crop such as oats or millet, depending on season and seed availability, or an appropriate pasture seed mix (in consultation with landowners).
- In areas dominated by native grasses, exposed soils would be lightly mulched with chipped native vegetation or sterile hay, and sown with Weeping Grass (*Microlaena stipoides*) and/or Wallaby Grass (*Austrodanthonia* spp), or a cover crop such as oats or millet, depending on season and seed availability. In such areas, seed-bearing native pasture hay could be used for mulching, depending on availability.

- Fertiliser would not be used to promote revegetation in native grass-dominated areas of the site to reduce weed pressures.
- The development sites would be inspected for weeds prior to the commencement of works, in consultation with the Southern Slopes County Council. Noxious weeds in the vicinity of the works site (refer Table 4.2) would be treated prior to the commencement of works, subject to seasonal factors.
- Where cement is included in cable trench backfill, at least 20 centimetres of cement-free topsoil would be replaced as the top layer in the backfill.

5 FAUNA

5.1 Approach and methodology

5.1.1 Preliminary assessments

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

5.1.2 Field surveys and mapping

The fauna survey was carried out for nocturnal and diurnal species over the period 8-11 November 2005. Additional raptor nest searches and habitat assessment for the southern turbine sites was undertaken on 5 March 2006. The survey is intended to provide preliminary qualitative data to determine whether higher level investigation is warranted. In particular, the survey focused on rare and threatened species, species protected under international conventions, species which may be dependent on habitat in the study area, large or unusual concentrations of a species and species which may be especially sensitive to wind farm developments.

The survey provides data for use in assessments of impact significance and risk, for the monitoring of impacts during the operational phase and for the development of mitigation strategies.

The survey involved:

- habitat assessment, including searches for species sign (scats, runways, feeding signs etc), and the recording of food and shelter resources, limiting or specialised habitat features such as hollows and the structure and composition of vegetation;
- four trapping transects of Elliot small mammal traps and cage traps (baited with rolled oats, peanut butter and pistachio essence);
- frog call identification and recording at potential habitat sites;
- reptile searches involving rock-turning and observation in rocky habitats;
- five bird census transects, noting presence, abundance and behaviour;
- Anabat microbat call detection and analysis;
- vehicle-based spotlighting for nocturnal birds and mammals;
- large forest owl and Barking Owl call playback.

The locations of the survey sites are indicated on Figure 5.1. The survey sites, effort and results are included in Appendix B and summarised in Table 5.1. The survey sampled the range of habitats in areas that would be directly impacted by the proposal, particularly the turbine ridges. The survey also covered areas in and adjacent to the subject site which have greatest likelihood of providing habitat for threatened fauna, including threatened reptiles, woodland birds and microbats (refer section 3.2.5).

Map references locating surveys sites and transects were obtained using a hand-held 12 channel GPS unit, and are based on the AGD (old) datum to ensure compatibility with currently available topographic map sheets. AGD references can be converted to GDA (new datum) by adding 184 metres to the northings and 113 metres to the eastings. The study area is covered by the Yass (8628-S) 1:50,000 topographic map sheet.

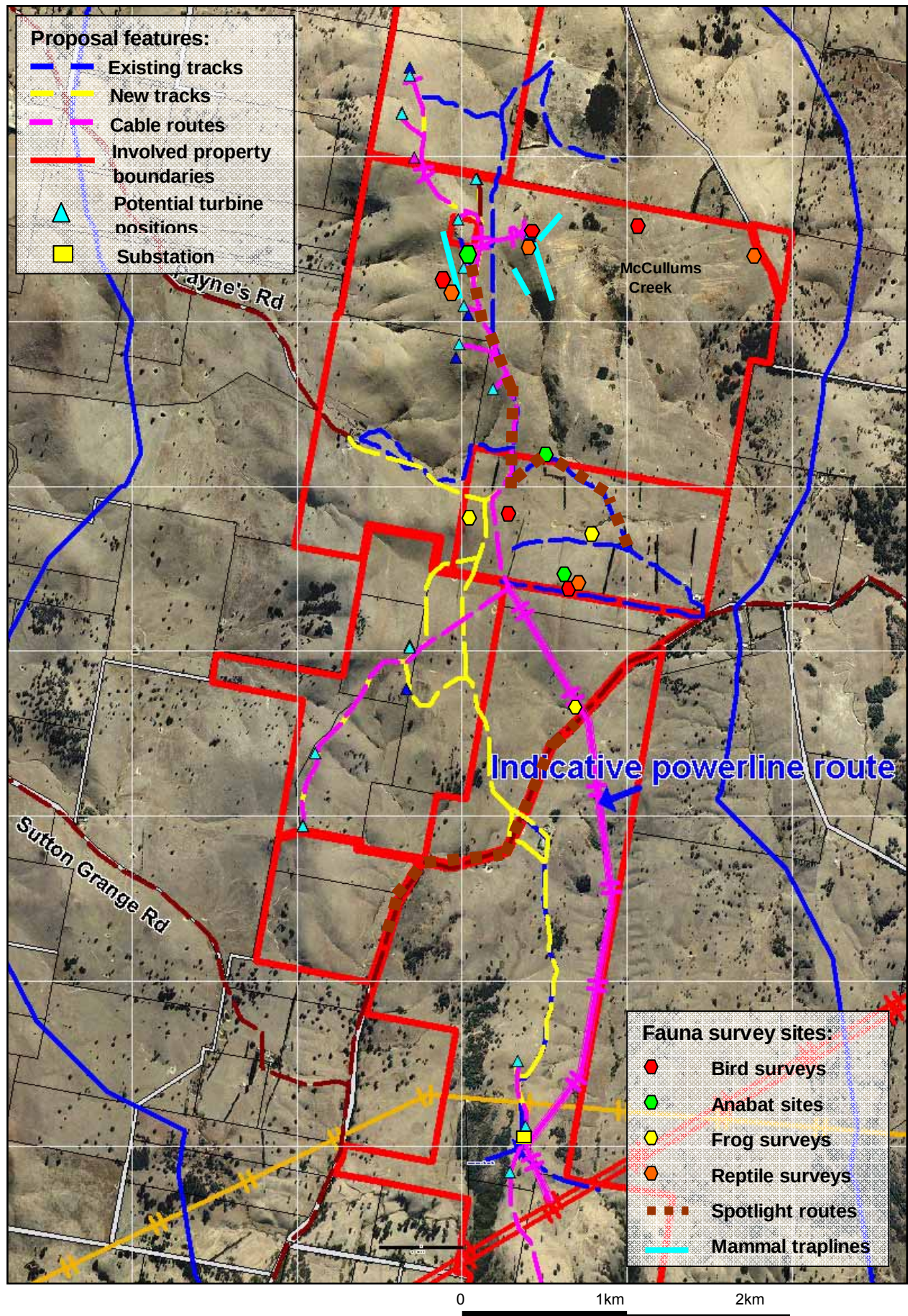


Figure 5.1 Fauna survey sites

5.1.3 Threatened and other significant species

The NPWS Wildlife Atlas was consulted for records of threatened species and other species of conservation significance in the study area, based on the Yass 1:100,000 map sheet. Other state and national databases were used to identify known and modelled significant fauna species distributions, including Bionet, Commonwealth Protected Matters search tool using a 30 kilometre buffer around the subject site. A list of threatened fauna with potential to occur at the site was compiled to assist with field survey design and targeting (Appendix C). A precautionary approach has been adopted where distribution and habitat information is incomplete or uncertain.

5.1.4 Survey limitations

The late spring timing of the fauna survey, and warm weather during the early part of the fieldwork, was favourable for recording the majority of species. The limited duration and intensity of the survey may have resulted in the omission of some sparsely distributed, ephemeral or seasonal species. For example, some occasional wetland bird species which visit small dams and watercourses at the site are likely to have been omitted. However, considering the quality and diversity of habitats at the subject site, the selected survey methods and intensity are considered appropriate to the preliminary assessment of the wind farm proposal.

The method used to detect bat species was the Anabat ultrasonic call analysis and recording system. This equipment has a limited range (around 20 metres), and would not have covered the potential turbine bladeswept area (34-126 metres above the ground). High-flying bat species in particular, which may forage thousands of metres above the ground (ABS 2000), are likely to have been unrecorded. The Anabat system is intended for species identification and does not indicate abundance or habitat utilisation rates.

5.2 Assessment and survey results

5.2.1 Fauna habitats in the study area

Six broad habitat types were identified in the study area, related to topography and vegetation:

- **modified wetland areas and watercourses**
 - small dams and watercourses, generally cleared of tree cover and heavily degraded by weeds, streambed erosion and sedimentation.
 - dams levels were high, and small watercourses were running on the 'Springvale' and 'Linbrook' properties during survey following recent rains. Dams were fringed with long grass and sedges, offering refuge for a range of species including frogs, snakes and skinks.
 - dam edges and instream pools are occasionally dominated by native sedges, with exotic pasture grasses and clovers dominant in surrounding areas. Willows and a range of other introduced plant species dominate the creek channel through the 'Ferndale' property.
- **exotic pasture on valley flats and lower slopes**
 - occupying the more fertile, moister areas on flats generally between the northern and central turbine clusters, dominated by exotic pasture grasses and legumes.
 - planted shelterbelts (non-local native and introduced species) are present along some fencelines.

- **cleared ridgetops and side slopes**
 - undulating ridgetops with steep to very steep sideslopes, outcropping fine-grained and steeply dipping metasediments in the north, and granitic boulders in the south.
 - large rock crevices, boulder piles, smaller rocks and scattered fallen logs and stags provide shelter and basking habitat to reptiles.
 - vegetation cover is mixed native-exotic grasses and forbs, with a higher proportion of exotics and less outcropping rock on the southern turbine ridges. Some parts of the northern ridges carry dense bracken fern cover.
 - isolated mature eucalypts (mostly Red Stringybark, *E. macrorhyncha*) are present but infrequent.
- **dry shrub forest remnants**
 - small areas of remnant dry forest are present on ridges and sideslopes on the central east ridge (*Eucalyptus dives*, in poor condition) and the southern turbine/powerline corridor zone on the 'Ferndale' property (*Eucalyptus goniacalyx*, *E. rossii*, *E. polyanthemos*, *E. mannifera*, *E. macrorhyncha*).
- **grassy woodland remnants (cleared)**
 - the Northern Valley (McCullums Creek) survey area carries degraded grassy woodland understorey, dominated by native grasses.
- **grassy woodland remnants (with tree cover)**
 - the section of Black Range Road crossed by the proposed powerline carries degraded grassy woodland remnant with some tree loss and general replacement of native understorey with a tall cover of exotic pasture and weed species.
 - this habitat is distributed along Black Range Road, and provides tree hollows for bats, birds and arboreal mammals. No hollows were observed in trees in the vicinity of the powerline route or proposed track crossing points.

5.2.2 Field survey results

WEATHER CONDITIONS

Two nights were spent spotlighting for nocturnal fauna. The first night (8 November 2005) was warm (20°C) and fine, wind was moderate from the north-west and cloud cover was around 10%. The second night (10 November 2005) was fine but markedly cooler (10°C), also with moderate winds from the north-west and around 10% cloud cover. Daytime conditions also varied from fine, warm and sunny (25°C), with moderate north-westerly winds on 8-9 November to fine, cool and sunny (15°C) and strong north-westerly winds on 10-11 November 2005.

Recent rains had provided good local conditions for wetland birds and frogs. The warm, sunny weather which prevailed over the early part of the survey was favourable for reptile observation. The warm weather early in the survey also provided good conditions for microchiropteran bats on the trig ridge. Bat records on the southern ridge site may have been depressed by the cooler weather which prevailed when the Anabat record was undertaken at that site.

SPECIES RECORDED DURING THE SURVEY

46 fauna species were recorded during the field survey of the subject site; including 7 terrestrial mammal species, 3 microbat species, 25 bird species, 8 reptile species and 6 frog species. Species recorded in each habitat are summarised in Table 5.1. Complete survey data is provided in Appendix B.

Only two small mammal species were captured in Elliot traps, three records over 177 trap nights (one native, one introduced). This suggests a very low small mammal abundance and diversity at the site.

Similarly, the medium-sized mammal cage traps yielded no captures over 27 trap nights. The low trap rate can be attributed to poor available habitat resources (shelter, food sources) and the recent history of drought which would have removed much of the vegetation cover. 46 microbat calls were recorded and sent to Doug Mills (DEC) for analysis, resulting in the identification of 3 species.

Specialist analyses of scats collected on the trig ridge identified dog scats containing rabbit fur and a possible fox scat containing insect and plant material. Local fox numbers are kept low by biannual cooperative baiting programs undertaken by farmers in the district using baits supplied by the Rural Lands Protection Board (James Payne, landholder pers. comm.).

The most abundant mammal at the site is the introduced European Rabbit, which is likely to be a principal food source for local Wedge-tailed Eagles. Bird fauna recorded in the cleared paddock and ridge areas of the subject site was restricted to a few species (refer 5.2.3 below).

Table 5.1 Fauna survey effort and results summary

Habitat	Method and effort	Sites	Results
Cleared ridgetops	Trapping (transects A, B-C, D): A. 20 Elliot traps and 2 cage traps over 3 nights B. 20 Elliot traps and 4 cage traps over 3 nights D. 9 Elliot traps and 1 cage traps over 3 nights	A. Trig ridge B. Central east ridge (west upper slope) D. Central east ridge (east upper and midslope)	Nil
	Bird census transects 3 transects x 0.5 hours	B1. cleared ridges and valley between the trig ridge and easternmost turbines B2. central east ridge B3. trig ridge	Refer Appendix B Includes Wedge-tailed Eagle, Nankeen Kestrel, Brown Falcon, Little Eagle, Tree Martin, Galah, Magpie, Richard's Pipit
	Reptile search - rock-turning and observation in rocky habitats - 5 sites x 0-.5-1.5 hours	R1. Eastern turbine ridge R2. Central east ridge R3. Central east ridge R4. Trig ridge R5. Southern turbine ridge	R1. Bearded Dragon, Shingleback R2. Cunningham's Skink, Common Blue Tongue Lizard R4. Cunningham's Skink, Blotched Blue Tongue Lizard R5. Cunningham's Skink, Shingleback, Red-bellied Black Snake
	Owl call playback 0.25 hrs x 1 night	crest of trig ridge	Nil
	Vehicle-based spotlighting (S1 part) - 1 night x 0.25 hours	along the trig access track	microbat species, Rabbit
	Anabat bat call analysis three nights x 12 hours	1. trig ridge 2. near southern ridge sites 3. paddock near fenceline trees	White-striped Mastiff Bat, Gould's Wattled-bat, a Forest Bat
	Opportunistic records	a. turbine ridges, b. powerline ridge on 'Ferndale'	a. Wombat, Swamp Wallaby, Rabbit, Bearded Dragon, Superb Fairy Wren, b. Australian Hobby, Spotted Harrier,

Habitat	Method and effort	Sites	Results
Remnant dry shrub forest	Elliott and cage trapping (incorporated in cleared ridge habitat transect)	central east ridge	Nil
	Bird census transects 1 transect x 0.5 hours (incorporated in ridge transect)	remnant woodland on the west face of the central east ridge	(incorporated in ridge transect B2)
Modified wetland and gully habitat	Trapping (transect C): - 10 Elliot small mammal traps and 2 cage traps x 3 nights	Gully east of trig ridge	Southern Bush Rat *Black Rat
	Bird census 0.5 hrs at 1 transect	B4. valley wet pasture, dams and drainage lines	Refer Appendix B Includes Starling, Blackbird, Brown Falcon, Magpie, Welcome Swallow
	Frog search and call identification 0.5 hrs at 3 sites	F1. small dam beside trig access track F2. small dam near southern turbine sites F3. watercourse near Black Range Road at powerline crossing point	F1. <i>Lymnodynastes peronii</i> , <i>Crinia signifiera</i> , <i>Crinia parinsignifiera</i> F2. <i>Crinia parinsignifiera</i> , <i>Lymnodynastes tasmaniensis</i> F3. <i>Crinia parinsignifiera</i> , <i>Lymnodynastes tasmaniensis</i>
	Opportunistic records	1. Eastern ridge and gully east of trig ridge 2. dam near proposed northern substation site 3. transect C gully B4. wet paddock near dam at proposed northern substation site	1. Swamp Wallaby 2. Australian White Ibis, Australian Wood Duck 3. Delicate Skink, Garden Skink Bird transect B4. <i>Litoria peronii</i>
Remnant grassy woodland (cleared)	Bird census – transect B1 (part)	northern valley	incorporated in B1
	Opportunistic records	northern valley	Wedge-tailed Eagle
Remnant grassy woodland (with tree stratum)	Vehicle-based spotlighting (S2) - 1 night x 0.5 hour	Along Black Range Road from the proposed powerline crossing east for approximately 1 kilometre	Common Brushtail Possum, Tawny Frogmouth, <i>Lymnodynastes dumerelii</i>
	Opportunistic records	a. Black Range Road at powerline crossing b. 3 km east of the site on Black Range Road	a. Shingleback Skink b. Superb Parrot
Exotic pasture	Bird census (B5) 1 transect x 0.5 hours	B5. along the trig access track through cleared paddocks with planted windrows (non-local native species)	Refer Appendix B Includes Starling, Blackbird, Eastern Rosella, Wedge-tailed Eagle, Tree Martin, Magpie, Wood Duck
	Vehicle-based spotlighting (S1 part) - 1 night x 0.25 hours	B5. along the trig access track between Springvale house and the trig ridge	Common Brushtail Possum, microbat species, Rabbit, <i>Crinia signifiera</i> , <i>Litoria peronii</i> , <i>Crinia parinsignifiera</i>
	Opportunistic records	B5. along the trig access track between Springvale house and the trig ridge	Red-bellied Black Snake

5.2.3 Profile of potential bird usage

GENERAL DESCRIPTION OF AVIFAUNA

The recorded abundance and diversity of birds in the cleared paddock and ridge areas of the subject site was generally low. The most commonly recorded species were Magpies, Richards Pipits and Wedge-tailed Eagles. One or two Wedge-tailed Eagles were observed at the site on each day of the survey, usually soaring around 20 metres above the ground. On one occasion, five eagles were observed at the site. Remnant forest patches provide likely habitat for disturbance and fragmentation tolerant forest birds. Waterbodies and watercourses at the subject site are small and mostly ephemeral, and are not likely to provide a sustained habitat for large numbers of waterbirds.

Survey data on species recorded, numbers of individuals and relevant behaviours are provided in Appendix B, and the findings are used in the risk and impact assessments.

RAMSAR WETLANDS AND MIGRATORY WETLAND SPECIES

There are no Ramsar wetlands close to the subject site, and no large concentrations of migratory wetland species are expected to occur in the local area. Local waterbodies are small and largely ephemeral, and degraded by clearing, siltation and weeds.

THREATENED BIRD SPECIES HABITAT

The threatened fauna evaluation presented in Appendix C indicates that the subject site provides potential habitat for four threatened bird species; Superb Parrot, Gang-gang Cockatoo, Diamond Firetail and Regent Honeyeater. The significance of potential impacts of the proposal on these species is assessed in an Assessment of Significance presented in Appendix D.

RARE OR LIMITING HABITAT FEATURES

Rare and limiting habitat features in the locality include Box-Gum Woodland and eucalypt tree hollows. No intact Box-Gum Woodland is located within the subject site, although woodland understorey is located in the McCullums Creek valley to the east of the northern ridges.

There are very few hollows in paddock trees at the subject site and most trees in forest remnants are mature regrowth yet to reach hollow-forming age. A mature Red Spotted Gum in the north of the southern turbine envelope (658295 6140489) has a medium-sized trunk hollow which could provide bird and arboreal mammal nesting habitat (Photograph 20).

No rare or limiting food sources for threatened bird species is expected to be located at the subject site. The rabbit population on the turbine ridges, coupled with the ridge slope updraft, may provide an important, and limiting, hunting resource for the Wedge-tailed Eagle. This issue is further discussed in section 5.3 (Box 5.2).

PROTECTED AREAS

The nearest large protected area is Burrinjuck Nature Reserve, which is contiguous with Burrinjuck Waters State Park, located 12 kilometres south-west of the study area (refer section 3.2.2).

GEOGRAPHICAL FEATURES THAT CONCENTRATE BIRD MOVEMENTS

The proposal is located on a series of broken ridges oriented roughly north-south. The ridges may concentrate hunting and foraging behaviour for some species (particularly raptors) and dispersal movements for waterbirds.

MIGRATION CORRIDORS

Waterbirds

Daily and seasonal migration corridors for waterbirds in the study area are not known. The subject site is not located between significant habitat areas and bird movements across the site may be diffuse and irregular, rather than concentrated and seasonal. No congregations of waterbirds were recorded at the subject site during the survey, and, given the habitat scale and quality, none would be expected to occur there. A single Ibis was recorded from a wet drainage line at the subject site during the survey; when disturbed it flew low along the drainage line.

Some waterbird species, including White Ibis, White-faced Heron and ducks, would be expected to disperse to forage in farmland north of Lake Burrinjuck, including the study area.

However, rather than crossing the turbine ridges, waterbirds are likely to more frequently move through valley areas between dams and pools. Small ephemeral wetland habitats are present in watercourses, paddock dams and wet pastures in the study area and surrounding farmland. Possible flight paths for waterbird species in the wider study area, based on topography, connectivity and habitat, are indicated on Figure 5.2.

White Ibises used Lake Burrinjuck, south of the subject site, for breeding until the recent drought (pers. comm. C. Davey). With the breaking of the drought, breeding would be expected to resume and Ibis numbers in the study area may increase. Ibis and other waterbirds may travel between Lake Burrinjuck and the large waterbodies in Canberra, to the south.

Waterbirds travelling long distances from and to Lake Burrinjuck, located three kilometres to the south of the southernmost turbine site, are likely to have attained a travelling altitude greater than the turbine height. No waterbirds or migratory wetland species were assessed as being at moderate or high risk of blade-strike or habitat impacts at the Conroys Gap site (refer Appendix D).

Woodland birds

Daily and seasonal migration corridors for woodland birds and other species in the study area are not known. Most woodland passerines in the study area are likely to use habitat with at least some tree cover. Many threatened woodland species are poor dispersers and are unlikely to venture far from remnant woodland patches. Ground foraging woodland birds like the Diamond Firetail are highly selective with respect to microhabitat and preferred foraging sites (Antos 2001). The subject site is one of the most extensively cleared areas in the district. Woodland remnants are present in surrounding valleys in the form of scattered trees in paddocks and linear tree cover along roads.

The principal flight paths for woodland species are likely to follow valleys and lowland areas carrying remnant woodland and water sources. Black Range Road, running roughly east-west across the subject site, carries intermittent woodland tree cover which could provide a dispersal path for woodland species. Birds moving at tree canopy height through this corridor are unlikely to be affected by the wind turbines located on adjacent ridges.

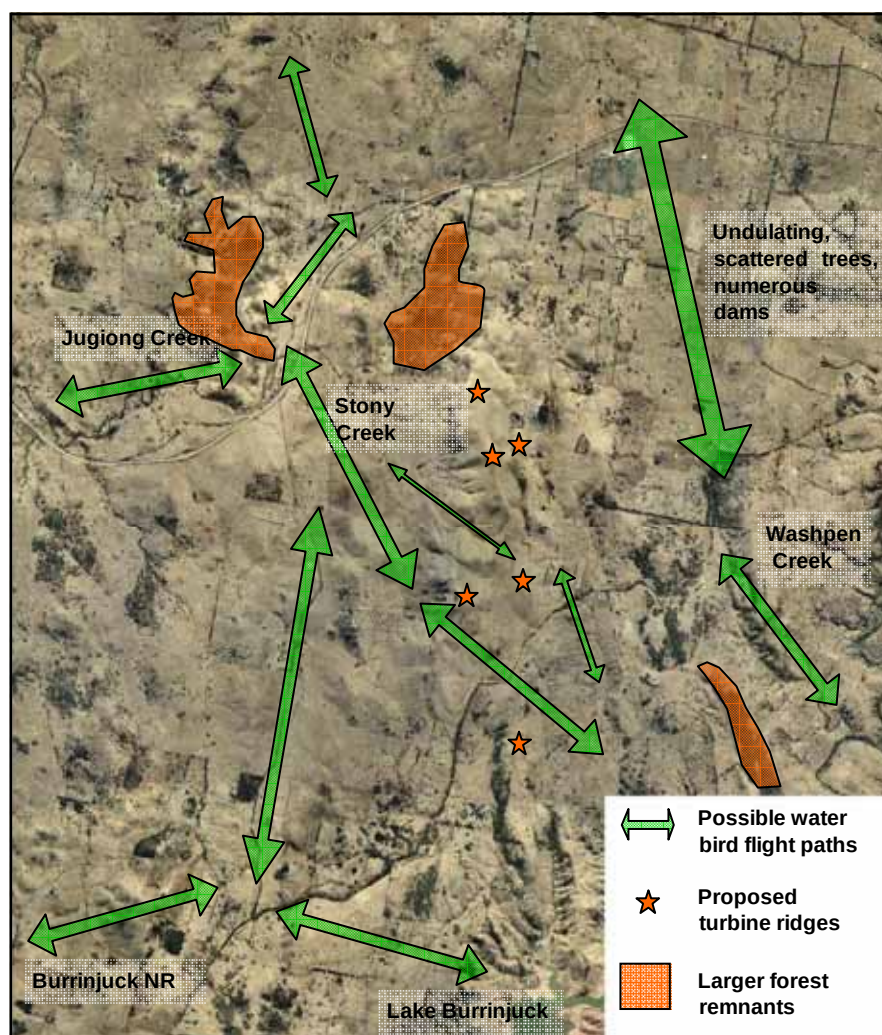


Figure 5.2 Possible waterbird flight paths and large remnant forest patches

5.2.4 Sensitive habitat features

HOLLOW-BEARING AND MATURE TREES

No obvious hollows were observed in mature trees in most parts of the subject site. A number of live and dead paddock trees have cracks and holes which may provide shelter for microchiropteran bats. Large hollow-bearing trees have been locally depleted by clearing for agriculture and are likely to be a limiting habitat resource for dependent species.

Most trees in remnant forest patches are mature regrowth yet to reach hollow-forming age. A mature Red Spotted Gum in the north of the southern turbine envelope (658295 6140489) has a medium-sized trunk hollow which could provide bird and arboreal mammal nesting habitat (Photograph 20). This tree, and a moribund Long-leaved Box beside it, are dieback affected. The site is grazed and there is no regeneration. Trees at this site are unlikely to persist in the medium-long term.

Remnant forest areas and planted shelterbelts provide marginal habitat for adaptable species such as the Brushtail Possum. Possums, gliders, microbats and hollow-nesting birds are likely to utilise habitat in adjacent woodland areas, including remnant grassy woodland beside Black Range Road between the study area and Yass.

Rare and limiting habitat features in the locality include Box-Gum Woodland and eucalypt tree hollows. No intact Box-Gum Woodland is located within the subject site, although woodland understorey is located in the McCullums Creek valley to the east of the northern ridges.

WATERCOURSES AND WETLANDS

While there are no examples of undisturbed or high quality wetland habitats in the study area, the local dams and watercourses may provide essential habitat for resident frog and skink populations and resting and foraging habitat for waterbirds moving between more significant habitat areas. Aquatic and wetland habitats in the study area are generally heavily degraded by clearing, erosion and weed invasion. Seasonal wetland habitats have declined throughout the region due to increased dams, irrigation and water extraction from rivers (Reid *et al.* 2004).

SURFACE ROCK

Surface rock providing reptile habitat, including marginal potential habitat for the threatened species, is present on the ridges and sideslopes at the subject site. Surface rock is used by lizards and snakes for shelter, thermoregulation and prey species habitat. Rock composed of fine-grained metasediments is locally abundant on the ridges and upper slopes of the northern turbine site, and granite platforms and outcrops are present on slopes west of the southern turbine sites. Given the general habitat loss in the local district and the disturbance history of the subject site, threatened species are assessed as having a low-moderate potential to be present in these habitats at the subject site.

FOOD SOURCES

No limiting food sources for threatened fauna species is expected to be located at the subject site. The rabbit population on the turbine ridges, coupled with the ridge slope updraft, may provide an important hunting resource for the Wedge-tailed Eagle and Little Eagle. This issue is further discussed in section 5.3 (Box 5.2).

5.2.5 Threatened species

No fauna species that are listed as endangered or vulnerable on Schedule 1 or 2 of the *Threatened Species Conservation Act 1995* were recorded at the subject site during the survey. The threatened Superb Parrot was recorded beside Black Range Road 3 kilometres to the east of the study area (AGD 662800 6145705), in remnant Box-Gum Woodland beside the road.

The threatened species known to occur in the region, their habitat requirements and the likelihood of their utilising habitat available at the subject site route are identified in the threatened species habitat evaluation in Appendix C. Habitat, ecology and distribution information is drawn from DEC (2005) except where otherwise cited. Local distribution records are sourced from the Wildlife Atlas, Bionet and survey fieldwork. The evaluation identified that parts of the survey area have at least moderate potential to provide habitat for nine threatened fauna species:

Mammals

Little Pied Bat
Eastern Bent-wing Bat

Invertebrates

Golden Sun Moth

Birds

Barking Owl
Superb Parrot
Swift Parrot
Gang-gang Cockatoo
Diamond Firetail
Regent Honeyeater.

The significance of potential impacts of the proposal on these species is assessed in an Assessment of Significance presented in Appendix D.

5.2.6 Matters of National Environmental Significance

Matters of national environmental significance listed under the *Environment Protection and Biodiversity Conservation Act 1999* within a 30 kilometre buffer of the study site were identified using the EPBC Act search tool (<http://www.deh.gov.au/erin/ert/epbc/index.html>) in November 2005. The biodiversity component of the report is included in Appendix E, with an Assessment of Significance of the impacts of the proposed development on these matters.

The search tool report indicates the following threatened or migratory fauna species or habitats listed under the EPBC Act are or may be present within the search area:

- the catchments of two Ramsar wetland sites (Fivebough and Tuckerbil Swamps);
- four threatened bird species (Swift Parrot, Superb Parrot, Australian Painted, Snipe Regent Honeyeater);
- two threatened fish species (Murray Cod, Macquarie Perch);
- one threatened insect (Golden Sun Moth);
- three threatened mammals (Tiger Quoll, Eastern Long-eared Bat, Smoky Mouse);
- two reptile species (Striped Legless Lizard, Pink-tailed Worm-lizard);
- four terrestrial migratory species (White-bellied Sea-Eagle, White-throated Needletail, Satin Flycatcher, Regent Honeyeater);
- two migratory wetland species (Latham's Snipe, Painted Snipe);
- ten listed marine species.

In addition, the search identified five natural areas on the Register of the National Estate; Derringullen Creek Area, Hattons Corner Area, Lake Burrinjuck *Grevillea iaspicula* Sites 1 and 2, and the Upper Lake Burrinjuck Area.

The Threatened Species Evaluation in Appendix C assesses the potential for threatened species to be present at the proposal site, based on available habitat, known ecological requirements and local distribution records. Habitat suitability for migratory bird species is assessed in Appendix F. Species which have at least a moderate potential to occur at the proposal site are included in the Assessment of Significance for species listed under the EPBC Act (Appendix E).

Four listed threatened fauna species are assessed as having at least a moderate potential of being present in habitat in the survey area; the Golden Sun Moth, Superb Parrot, Swift Parrot and Regent Honeyeater. Two terrestrial migratory species also have at least a moderate potential to use habitat in the proposal area; the Regent Honeyeater and the White-throated Needletail.

5.3 Impact assessment

5.3.1 Construction impacts

HABITAT LOSS AND MODIFICATION

Approximately 4.3 hectares of secondary grassland habitat derived from dry shrub forest would be removed in the construction of the wind turbines, substation and new access tracks. The ridgetop habitat is used by reptiles, birds, macropods and rabbits. The habitat is not high quality and is abundant throughout the district. The minor areal losses are not expected to significantly affect any local fauna population. Around 2 hectares of secondary grassland would be disturbed and reinstated following construction. These impacts are expected to be temporary and should not significantly affect local fauna.

The routing of the powerline through cleared parts of the 'Ferndale' property and the siting of the southern turbines to the east of the remnant forest patches would avoid the need to clear or trim native trees. Similarly, the powerline and new track crossing points on Black Range Road would be

located in cleared gaps, avoiding the need to clear or trim woodland trees. The selection of Paynes Road to access the site would also avoid the need to trim branches from trees beside Black Range Road.

The proposal would not directly affect the northern valley (McCullums Creek) or the ridge to the east of the valley. This area was removed from the proposal in light of the results of biodiversity, visual and noise assessments. Measures would be adopted to protect this area from the peripheral and indirect impacts of the development.

DUST, NOISE, VIBRATION AND VISUAL DISTURBANCES

The dust, noise, vibration and activity associated with the 6-9 month construction phase at the construction sites and along the access routes may affect the foraging behaviour of local fauna species, particularly birds and macropods. Given the local abundance of similar habitat, this temporary effect on habitat utilisation is not likely to significantly affect local populations of these generally highly mobile species.

POLLUTION RISKS

The concrete batch plant, construction activities using concrete and the storage and use of fuels, lubricants and construction chemicals carries a pollution risk for aquatic habitats. These risks are considered acceptable and manageable using appropriate safeguards and practices (refer EA).

5.3.2 Operational impacts

GENERAL

The key operational impacts of the proposal relate to the operation of the wind turbines. The potential bladeswept area of the turbines would range from 34 to 126 metres above the ground. The impacts of the wind farm would be most acutely felt by those species utilising aerial habitat within the bladeswept zone. At the Conroys Gap site, this fauna belongs to two groups; birds and microchiropteran bats.

Terrestrial fauna may be affected by turbine noise and blade flicker, although, given the low fauna diversity and abundance at the site, these impacts are not likely to be significant.

BIRD IMPACT RISK ASSESSMENT

Impact risk assessments for raptor, waterbird, migratory and threatened species recorded at the Conroys Gap site, or with potential to use habitat at the site, are identified in Table 5.2 below. The assessments are drawn from the bird impact risk assessment provided in Appendix F.

The risk assessment identifies and evaluates risks posed by the proposed wind farm development at Conroys Gap in terms of:

- collision with wind turbines, or 'bladestrike'. For these purposes, 'bladestrike' refers to mortality caused by direct collision with turbine blades and by birds being swept down by the wake behind a turbine blade; and
- habitat loss or avoidance caused by the presence of the turbines and associated infrastructure.

The risk assessment is qualitative, combining assessments of likelihood and consequence to produce a final risk assessment of low, moderate or high risk for selected species. Likelihood incorporates biological, behavioural and environmental risk factors. Consequence includes the significance of habitat loss and bladestrike in terms of habitat rarity and importance, population impacts, recovery potential and species conservation status. A distinction is drawn between the significance of impacts to individual birds at the site and impacts to the wider population.

The risk rating assumes the implementation of relevant mitigation measures described in section 5.3.

The assessment draws on the Interim Standards for Risk Assessment relating to birds and wind farms (Brett Lane and Associates 2005) and the Australian Standards for Risk Assessment (AS/NZS 4360) and Environmental Risk Management (HB203:2000).

Table 5.2 Overall impact risk for vulnerable bird groups (bladestrike and habitat impacts)

Species	Risk to individuals at site	Risk to population
RAPTORS		
Wedge-tailed Eagle (<i>Aquila audax</i>)	Moderate	Moderate-high
Little Eagle (<i>Hieraaetus morphnoides</i>)	Moderate	Moderate
White-bellied Sea-eagle (<i>Haliaeetus leucogaster</i>)	Low	Low
Australian Kestrel (<i>Falco cenchroides</i>)	Low-moderate	Low
Brown Falcon (<i>Falco berigora</i>)	Moderate	Low
Peregrine Falcon (<i>Falco peregrinus</i>)	Low-moderate	Low
Australian Hobby, Little Falcon (<i>Falco longipennis</i>)	Moderate	Low
Spotted Harrier (<i>Circus assimilis</i>)	Moderate	Low
Barking Owl (<i>Ninox connivens</i>), Barn Owl (<i>Tyto alba</i>) and other owl species	Low-moderate	Low-moderate
Tawny Frogmouth (<i>Podargus strigoides</i>)	Low	Low
THREATENED SPECIES (PASSERINES AND PARROTS)		
Diamond Firetail (<i>Emblema guttata</i>)	Low	Low
Regent Honeyeater (<i>Xanthomyza phrygia</i>)	Low-moderate	Low-moderate
Superb Parrot (<i>Polytelis swainsonii</i>)	Low-moderate	Low-moderate
Swift Parrot (<i>Lathamus discolor</i>)	Low-moderate	Low-moderate
Gang-gang Cockatoo (<i>Callocephalon fimbriatum</i>)	Low-moderate	Low-moderate
WATERBIRDS AND MIGRATORY SPECIES		
Painted Snipe (<i>Rostratula benghalensis</i>)	Low	Low
Latham's Snipe, Japanese Snipe (<i>Gallinago hardwickii</i>)	Low	Low
White Ibis (<i>Threskiornis molucca</i>)	Low-moderate	Low
Australian Wood Duck (<i>Checonetta jubata</i>)	Low-moderate	Low
White-faced Heron (<i>Ardea novaehollandiae</i>)	Low-moderate	Low
White-throated Needle-tail, Spine-tailed Swift (<i>Hirundapus caudacutus</i>)	Low-moderate	Low
Satin Flycatcher (<i>Myiagra cyanoleuca</i>)	Low	Low

BLADESTRIKE IMPACTS

The proposed wind turbines have the potential to cause mortalities in local bird populations due to collision with turbine blades or being swept down by the wake behind a turbine blade.

Biological, environmental and design factors which may affect risk by contributing to either the likelihood of bladestrike, or the significance of the consequence of bladestrike are discussed in Box 5.1, below.

Cumulative bladestrike risk modelling

Biosis Research Pty Ltd, on behalf of the Commonwealth Department of Environment and Heritage, has recently completed an assessment of the cumulative wind farm collision risk for threatened and migratory birds (Biosis Research 2006). The study involved cumulative risk modelling for four threatened species (the Orange-bellied Parrot, Tasmanian Wedge-tailed Eagle, Swift Parrot and White-bellied Sea-eagle) and a preliminary risk assessment for 34 bird species with potential to occur at wind farm sites in Gippsland, Victoria. 39 operating and planned wind farms in south-east Australia were used in the assessment, including Crookwell, Gunning and Taralga on the Southern Tablelands.

The modelling took into account turbine number and size, local population size and density, duration of residency and the ability of birds to actively avoid collision with turbines. Avoidance rates are expressed as a percentage of flights made by a bird in which the bird takes no evasive action to

avoid collision. Directly observed avoidance rates have been documented as 100% for a range of species at Codrington, Victoria, including the Wedge-tailed Eagle, Brown Goshawk, Nankeen Kestrel, Swamp Harrier, Brown Falcon, Richards Pipit, Magpie-lark, Magpie, Raven, Straw-necked Ibis, White Ibis, Egret spp. and White-faced Heron (Meredith *et al.* 2002). Calculated avoidance rates at Codrington – taking recorded mortalities into account – showed a reduced rate for the Magpie (99%) and Brown Falcon (>95%) (Meredith *et al.* 2002). The cumulative risk modelling applies three collision avoidance rates; 95%, 98% and 99%.

Swift Parrot

Wind farms are generally sited in cleared areas which would not provide quality habitat for the Swift Parrot. This highly mobile species may however traverse wind farm sites moving between habitat areas. It is considered that a bird species with the flight characteristics of the Swift Parrot would be likely to have an actual avoidance rate of around 99% (Biosis Research 2006). While collision risks would increase during very windy or foggy weather, this species is unlikely to be active during these conditions.

The model assumed 10 annual movements of birds per annum through the Crookwell, Gunning and Taralga wind farms, and assumed a population size of 10 birds for Gunning and Taralga, and 2 for Crookwell. 25% of flights were conservatively assumed to be within the bladeswept zone. The modelled average annual number of deaths due to turbine collision at these wind farms is less than 0.01452 all cases. The cumulative total of deaths for all of the 39 wind farms modelled is small; between 0.08 and 0.13 birds per annum. This equates to slightly more or less than a single parrot being killed every ten years.

Tasmanian Wedge-tailed Eagle

The cumulative bladestrike collision risk of eight wind farms on the Tasmanian Wedge-tailed Eagle were modelled by Biosis Research (2006) for each of the three given avoidance rates. For the 95% avoidance rate, the predicted annual cumulative mortality rate is 0.1898. This would increase the mortalities of the entire Tasmanian population by 2.5 birds per annum. For 98% avoidance rate, mortalities would increase by 1.4 birds per annum. At 99% avoidance rate, mortalities would increase by approximately 1 bird per annum. The actual avoidance rate is considered to be 99% or higher, and hence the cumulative effects of the wind farms is likely to be one bird per annum (Biosis Research 2006).

The assessment concluded that while the cumulative impacts of collision would be negative, the impacts would be very small and it is highly likely that these effects would be masked by normal fluctuations in the population due to natural variables. A population viability analysis also found that a significant increase in extinction risk would only occur if impacts were five times the predicted level.

Gippsland species preliminary risk assessment

A preliminary assessment of risk to 34 EPBC Act listed species with potential to occur in the vicinity of five operating or planned Gippsland wind farms was recently undertaken by Biosis Research (2006). Species assessed included migratory wetland species, including Latham's Snipe, and the White-throated Needletail. The assessment concludes that collision impacts are likely to be low or negligible for all of these species. It is considered that a very small proportion of the Australian population of these species would ever move through a wind farm site and that, if they do enter a wind farm, they would be likely to actively avoid collisions or fly outside the bladeswept zone (Biosis Research 2006).

BOX 5.1 BLADESTRIKE RISK FACTORS FOR BIRDS

A number of factors may operate which affect risk by contributing to either the likelihood of collision with blades, or the significance of the consequence of bladestrike. These factors may be related to particular species, sites or development designs.

Behavioural traits and biology/physiology

Aspects of bird biology and behaviour which may add to bladestrike risk include:

- foraging, courting or migration behaviour over open farm country at potential bladeswept area height;
- flying during periods of reduced visibility, such as during fog or low cloud or dusk/night travel;
- flocking behaviour, particularly large and/or tight flocking patterns;
- period of residency;
- an inability to see moving blades ('motion smear').

The capacity of birds to 'habituate' to turbines may vary between species. Some species groups appear disproportionately vulnerable to bladestrike. Northern hemisphere studies point to three groups which are most vulnerable to bladestrike; gulls, raptors and migrant songbirds (Airiola 1987 in Canada Bird Studies 2001).

Population factors and conservation status

Species which are rare or declining, or which are naturally distributed at low density (such as top order raptors) may be at greater risk because, while collision rates may be low, each mortality has high significance. Similarly, species with low reproductive rates, or poor capacity to disperse and recolonise habitats may be at greater risk of significant impacts from blade collisions at the population scale. Species which are very abundant may have a higher frequency of bladestrike, but this impact as a proportion of the total population may not be significant and risk therefore would be considered low.

Local weather patterns

Many studies have shown that poor weather conditions increase the occurrence of turbine collisions (Canada Bird Studies 2001). Weather conditions which reduce the ability of birds to perceive the turbine blades or avoid collisions (such as fog and strong gusty winds) add to risks for susceptible species. Hence, sites which experience these conditions at higher frequency may be correspondingly riskier for these species.

Relative location of habitat and prey sources

The relative location of key habitat areas (such as updraft zones, prey populations, wetlands and nesting sites) and natural diurnal and seasonal migration routes also affects risks to birds.

Development structural factors

Structural characteristics of the development, such as the presence of guy lines (Erickson *et al.* 2001), aerial cabling and perching opportunities (especially lattice structures) may also be critical factors affecting the frequency of bird collision. Warning lights on towers may attract night migrating birds (Cochran and Graber 1958 in Canada Bird Studies 2001) and insect prey. US studies suggest that red flashing lights on wind turbines do not attract night migrants (Kerlinger and Kerns 2003), and would not attract insects, which are generally not sensitive to the red end of the spectrum.

Experiences at existing wind farms

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

A recent review of overseas wind farms showed low mortality rates for most wind farms (Langston and Pullen 2002). On average for all birds, new generation projects in the US (outside California) have recorded three fatalities per megawatt per year (Erikson *et al.* 2001). A review of European and North American wind farms indicates that most wind farms in agricultural settings affect between 2

and 4 birds per turbine per year (Lane and Associates 2004). However, the most commonly recorded bird group to collide with European and North American turbines were night-migrating songbirds, of which there are comparatively few in Australia.

Looking at wind farms in Europe, Winkelman (1994) produced an estimated average of 0.04 to 0.09 mortalities per turbine per day. 43% of these were killed by being swept down by the wake behind a blade, 36% flew directly into a blade, and for 21% the cause of death was unknown. At Altamont Pass in the United States, 55% of raptors were killed by striking a blade, 8% from electrocution, 11% from wire collision and 26% from unknown causes (Orloff and Flannery 1992 in Canada Bird Studies 2001). Winkelman concluded that the number of birds killed per unit of energy produced is low compared to other human-related causes of bird death.

There are relatively few published bird mortality studies at Australian wind farms, and most are of short duration. The studies do however suggest a generally low rate of blade collision, and that species at most risk are locally common birds which are active at the bladeswept height, including some raptors, skylarks, magpies and some seabirds (Meredith 2003, Hydro Tasmania 2004).

Monitoring research at the three operational wind farms in Victoria has recorded no rare, threatened or endangered birds killed by wind turbines to date. Searches conducted by Biosis Research for dead birds around seven turbines at the Codrington Wind farm (Victoria) showed three bird deaths attributable to impact with wind generators. The species concerned were the introduced skylark (1), Richard's pipit (1) and Australian magpie (1). Incidental carcass finds showed a further adult brown falcon death. The estimated total number of deaths likely from Codrington's 14 turbines over one year is 18 to 38 birds, or 1.2 to 2.7 birds per turbine per year (Brett Lane and Associates 2005).

At the Toora Wind Farm in Victoria, no bird carcasses were found during a year of monitoring or during informal inspections. Wedge-tailed eagles were regularly observed before and after operations began at this site. Eagles were observed to avoid the turbines by flying around or between them, not into them (Brett Lane and Associates 2005). A study at Codrington also found that all birds approaching the turbines were observed to take avoidance action, by flying over, around or under the rotating turbine blades (Biosis Research Pty Ltd 2002).

The rate of bird collisions at Woolnorth Wind Farm stage 1 in north-west Tasmania is estimated at 14 native birds per year or 2.3 birds/turbine/year (Hydro Tasmania 2004). Monitoring at Woolnorth recorded 18 bird collisions in 2003, 7 of which were the introduced Skylark. One of these collisions was a Wedge-tailed Eagle, which is threatened in Tasmania. Eagles have been observed living near the turbines for more than 12 months and the collision occurred during a period of limited visibility (Hydro Tasmania 2003).

BIRD HABITAT AND HABITAT UTILISATION IMPACTS

The operational phase of wind farm developments has the potential to affect bird habitats and habitat utilisation patterns by:

- degrading off-site habitats (for example, from polluted runoff or weed introductions);
- alienating and fragmenting breeding or foraging habitat;
- altering migration behaviour.

Off-site degradation resulting from the construction and operational phases of the project are readily avoided and controlled using standard best-practice mitigation methods. Risks to local bird populations from off-site habitat degradation are assessed as low.

In Europe, the effects of wind farms on habitat utilisation are considered to have a greater impact on birds than collision mortality (Strickland 2004). European studies suggest that most habitat displacement involves migrating, resting and foraging birds. Studies have reported displacement effects ranging from 75 metres to as far as 800 metres away from turbines (Strickland 2004). Winkelman (1994) found that resident birds avoided turbines at distances of 250-500 metres. This is likely to reduce the risk of bird mortality, but may affect populations where the alienated habitat is particularly important or limiting.

RISK ASSESSMENT RESULTS

The Conroys Gap subject site is located in a heavily cleared agricultural setting and has low diversity and low abundance of bird fauna. The most common species present during the survey period were the Australian Magpie, Richard's Pipit and Wedge-tailed Eagle. Other raptors recorded were the Little Eagle, Australian Hobby and Spotted Harrier. No raptor nests were observed in the study area, although adjacent timbered areas were not searched. Waterbirds included the Australian White Ibis, White-faced Heron and Australian Wood Duck. No threatened species or protected migratory species were recorded at the subject site. The threatened Superb Parrot was recorded 3 kilometres to the east of the study area (AGD 662800 6145705), in remnant woodland beside Black Range Road.

All species recorded at the site and most likely to be affected by the proposal are widespread and not considered threatened. At the time of survey, there were no unusual or significant congregations of birds at the site.

The risk assessment (Appendix F) focuses particularly on bird groups which have been shown to be at greater risk in studies at other wind farms (raptors, waterbirds, migratory species), and rare, threatened or protected species which have potential to be present in the study area (Superb Parrot, Swift Parrot, Diamond Firetail, Regent Honeyeater and the Gang-gang Cockatoo). 21 species were assessed from these principal risk groups.

There are several blade-strike risk factors operating at the Conroys Gap site:

- local populations of threatened and vulnerable bird species are present, including declining species and species which are sparsely distributed in the landscape;
- the turbines would be located in high topographic positions and will therefore be more affected by low cloud cover, reducing visibility. The subject site may experience winter fog cover, but such occurrences are not common, and are considerably more frequent in lower country east of the site toward Yass (James Payne, landholder, pers. comm., Cathy Kaveney, landholder, pers. comm.). In the case of very strong winds, turbines would be shut down, reducing collision risk.
- while the proposed turbine towers would not have guy wires and would not provide perching opportunities, wind monitoring towers located near the turbines would be supported by guy wires and have a 300mm face width lattice construction that may provide limited perching opportunities for birds.

Some structural and design characteristics of the proposal serve to reduce collision risks, including widely spaced, high turbines, tubular towers without perch opportunities and the underground installation of reticulation cabling.

Raptors

Six raptor species were considered to be at moderate or moderate-high risk at the individual level; Wedge-tailed eagle, Little Eagle, Australian Kestrel, Brown Falcon, Australian Hobby and the Spotted Harrier. Two species were assessed to be at moderate or moderate-high risk at the population impact level; Wedge-tailed Eagle and the Little Eagle. These raptor species typically construct stick nests in eucalypts, and soar over open country at turbine blade height. Both are likely to be dependent on rabbits as a local food source. These species are frequently recorded close to human development, and are likely to be able to habituate to the proposed wind farm over time. A Californian study shows a similar number of raptor nests before and after wind plant construction (Howell and Noone 1992 in Strickland 2004). Raptor populations have also been found to co-exist with turbines at Australian wind farms, including at Codrington (Biosis Research Pty Ltd 2002, Wonthaggi EES Panel 2003), Toora (Brett Lane and Associates 2005), Crookwell (URS 2004) and Woolnorth (Hydro Tasmania 2003).

Compared to larger raptors with extensive breeding territories, such as the Wedge-tailed Eagle, the Brown Falcon, Australian Hobby and Spotted Harrier have higher reproductive rates and are more

abundantly distributed. Risks to the Wedge-tailed Eagle at the site are discussed in the case study in Box 5.2. Given the low frequency of recorded collision at existing Australian wind farms, it is unlikely that the blade-strike impacts of the proposed Conroys Gap wind farm would create a continuing population sink for the regional Wedge-tailed Eagle population. However, the alienation of ridgetop hunting resources may have more pervasive consequences for this species.

For most species, the proposal area is unlikely to provide limiting, uncommon or significant habitat. In view of the substantial buffer distances involved, the wind turbines are not expected to alter habitat utilisation rates on neighbouring farmland, remnant woodland and wetlands.

In the case of the Wedge-tailed Eagle (refer Box 5.2) and possibly the Little Eagle, the high ridge habitat may provide an important updraft hunting resource and food supply (rabbits). The loss of this habitat may not affect existing birds but, if the area forms part of a breeding territory, it may affect breeding success over the longer term. The precise impact of habitat alienation on the local eagle population is difficult to predict. Further pre-works investigations are required to determine if nests are located near the subject site, and operation-phase monitoring will be required to record blade-strike mortality, habitat avoidance and impact on breeding success.

Waterbirds

No waterbirds or migratory wetland species were assessed as being at moderate or high risk at either the individual or population level (refer Appendix F). Of the waterbirds, species which fly at night, fly at blade height or which form large circling flocks are likely to be at greatest risk of blade-strike.

Overseas studies have shown that some waterbird species are able to perceive and avoid turbines, both during the day and at night (Erickson *et al.* 2001). At Crookwell, property owners noted that waterbirds have habituated to large man-made structures such as powerlines and demonstrate collision avoidance tactics in their flight patterns (URS 2004). Because of this capacity to avoid turbines, the US National Wind Coordinating Committee (2000) considers waterbirds to be at lower risk from blade-strike than some other groups.

In studies of bird mortalities from colliding with powerlines in the Hunter Valley, the species most at risk were found to be those with large bodies and awkward flight characteristics, species which fly in tight and/or fast-moving flocks and night-flying species (Hunter Wetlands Research 1996 in URS 2004). In this case, powerlines were located close to a major roosting/nesting site, and 12-42 metres above the ground. Pelicans, White Ibis and Swans were most affected.

The subject site is not located between significant habitat areas and bird movements across the site may be diffuse and irregular, rather than concentrated and seasonal. Ibis and other waterbirds may travel between Lake Burrinjuck and the large waterbodies in Canberra. Some species, including White Ibis, White-faced Heron and ducks, would also be expected to disperse to forage in farmland north of Lake Burrinjuck, including the study area.

Small numbers of waterbirds were recorded at the site, in dams and wet drainage lines. Short-range foraging journeys by these species may follow chains of small seasonally available wetland habitats scattered over the lowland areas of the district. Major migration routes for these species are not known. Longer range migrations may involve crossing high ridges at blade height or higher, but the frequency of this occurring at the Conroys Gap site is likely to be low. Most Australian species are classified as only partial migrants (Dingle 2005), which vary their routes according to ephemerally available resources. Blade collisions are therefore expected to be rare. The Conroys Gap proposal is not considered likely to significantly affect waterbird species at the population level.

While the seasonal and diurnal migration routes for bird species at the site are not known, the subject site is not expected to present a significant migration corridor for waterbirds and woodland species. The site does not appear to lie between significant and localised habitat areas where large numbers of birds congregate. Migration patterns of waterbirds and other species over the site are likely to be

diffuse, reducing the risk of catastrophic or frequent collision events. Risks to local bird populations from altered migration patterns are assessed as low.

Terrestrial migratory and woodland birds

No migratory or threatened woodland bird species were assessed as being at moderate or high risk at either the individual or population level (refer Appendix F). The principal flight paths for woodland species are likely to follow valleys and lowland areas carrying remnant woodland and water sources. Birds moving at tree canopy height through the Black Range Road corridor and between other lowland remnants are unlikely to be affected by the wind turbines located on adjacent ridges.

BOX 5.2 WEDGE-TAILED EAGLE IMPACTS

Biology and behaviour

Wedge-tailed Eagles are sedentary and widely distributed in a range of habitats. They are monogamous and apparently mate for life. If one bird of a pair is killed, the survivor will find a new mate. Established pairs defend breeding territories around their nest sites from other Wedge-tailed Eagles. Nest density varies with food supply but nests are usually 2.5-4 kilometres apart (Australian Museum 2003a). Home ranges around the breeding territories may be shared by two or more breeding pairs and by non-breeding birds (Australian Museum 2003a).

Wedge-tailed Eagles have a relatively slow reproductive rate, mating at an advanced age, raising few chicks and having long incubation (42-45 days) and chick dependency periods (12 weeks-1 year). Eagles begin breeding at 5 years, have a usual lifespan is 20-25 years and a reproductive lifetime of 15-20 years. A clutch usually consists of two eggs. A breeding pair usually rears only one young per clutch, although in a good year, two chicks may fledge (Australian Museum 2003a). During drought periods, eagles may not breed at all for several years. Monitoring of breeding pairs at Lake Burrendong (Central West NSW) in a post-calicivirus environment showed an annual productivity of 1 chick per territory, with fledging success at 76% (Davey and Pech 2001).

Wedge-tailed Eagles feed on a range of small to medium sized fauna. In many areas, native prey, particularly kangaroo pouch young, have declined and eagles have become reliant on rabbits and carrion. They have been observed feeding after dark on a roadkill carcasse (Wren 2002).

Conservation status

Birds Australia surveys indicate that, Australia-wide, the Wedge-tailed Eagle has declined by 28% since the 1980s (Davey 2003). Some regions may produce regular eagle population surpluses ('population sources') which disperse to less productive regions ('population sinks') (Davey 2003). The Conroys Gap locality may form part of a population source upon which flatter, lower rainfall population sink areas to the west are dependent (C. Davey pers. comm.). The significance of the site to regional eagle populations hinges on whether the site forms part of a breeding territory, and hence contributes to the population source.

The Conroys Gap site

At Conroys Gap, eagles were observed singly, in a pair and as a loose group of five soaring over valleys and ridges, at 5-50 metres above ground level. The eagles were observed using ridgeline updrafts for soaring. The local rabbit population provides a likely food source. Eagles also occasionally take lambs (J. Payne pers. comm.) and are likely to scavenge paddock carcasses and roadkill. No nests were observed at the largely cleared Conroys Gap site.

Possible response scenarios

There are a range of possible scenarios regarding the response of local Wedge-tailed Eagles to the proposed wind turbines including:

1. Local birds habituate to the turbines and are able to continue to use local habitat with a low collision rate. **Bladestrike and habitat impacts are low.**
2. Local birds avoid the area of the wind turbines but continue to use surrounding habitat within their territory or home range. Habitat dependence at the site is low and breeding success is not significantly affected. **Bladestrike impacts are low, but habitat impacts are moderate.**

3. Local birds avoid the area of the wind turbines but continue to use surrounding habitat within their territory or home range. Habitat dependence at the site is high and breeding success is significantly affected. **Bladestrike impacts are low, but habitat impacts are high.**
4. Local birds experience high collision rates, retaining local a presence but negating the source population function. **Bladestrike impacts are high, habitat impacts may be low.**
5. Local birds experience very high collision rates, exceeding the reproductive rate of the local population and producing a continuing population sink and possibly regional species decline. **Bladestrike impacts are very high, habitat impacts may be low.**

Bladestrike risks

Raptors appear to have no difficulty avoiding turbines when simply flying or soaring (Canada Bird Studies 2001), but when hunting may focus intensely on prey beyond the turbine without perceiving the rotor blades (Thelander *et al.* 2003). Raptor eyes do however have two foveal regions allowing focusing on the horizon as well as downwards (Hodos *et al.* 2001 in Canada Bird Studies 2001).

Available data from existing wind farms in south-eastern Australia show that large raptors have the capacity to avoid wind turbines, and have a relatively low frequency of collision. However, two Wedge-tailed Eagle mortalities at the Starfish Hill wind farm in South Australia and one at Woolnorth (Tasmania) indicate that collision is possible. Risks may be higher during the period immediately following the installation of the turbines, before local birds have habituated. Risks may also be higher for inexperienced, juvenile birds, and during periods of heavy rain, fog or low cloud.

Experiences at other wind farms suggest that local Wedge-tailed Eagles would become habituated to the Conroys Gap wind farm over time. Resident Wedge-tailed Eagles have been observed to fly among turbines at wind farms at Codrington (Biosis Research Pty Ltd 2002, Wonthaggi EES Panel 2003) and Toora (Brett Lane and Associates 2005). A range of raptors continue to be present within one kilometre of the Crookwell I turbines (URS 2004). Wedge-tailed Eagles are also resident near the Woolnorth wind farm (Hydro Tasmania 2003).

At Codrington, Wedge-tailed Eagles were observed to avoid turbines by flying horizontally around them and turning and not entering the turbine area (Biosis Research 2002). Directly observed collision avoidance rates at this site have been documented as 100% (Meredith *et al.* 2002). The collision avoidance rate for the Tasmanian Wedge-tailed Eagle has been estimated to be 99% or higher (Biosis Research 2006).

Assuming breeding productivity of 1 chick/year and a conservative fledging success of 50% (accounting for drought years), a breeding pair of eagles at Conroys Gap would produce an average of one additional bird every two years. Based on the low frequency of collision at these existing wind farm sites, it is considered unlikely that the Conroys Gap wind farm would result in bladestrike impacts that would significantly affect the local or regional eagle population, or reduce the value of the region as an eagle population source.

Habitat impacts

In studies at Burrendong Dam, a typical eagle territory was found to consist of a high ridge sweeping down to a flat plain terminating in the waters of the dam (C. Davey pers. comm.). Nests would typically be found on the upper slope usually in a gully but with a dominant view of the countryside. The birds would spend most of their time soaring along the ridgeline making use of the updraft. Based on the time spent soaring along the ridgeline, this part of their territory must have been extremely important to them (C. Davey pers. comm.).

The Conroys Gap ridgelines, particularly the higher central ridge on the Linbrook property, support rabbit populations and provide updrafts used by eagles. Conroys Gap may be a population source area for the Wedge-tailed Eagle and, if so, the ridge-tops would be a critical part of their territory (C. Davey pers. comm.). The extent to which local eagles are dependent on these resources, and the abundance of similar resources on surrounding lands, are not known. The presence of the wind turbines may reduce the availability of both the rabbit and updraft resources at the Conroys Gap site, and may possibly reduce the reproductive success of a local breeding pair, if present (C. Davey pers. comm.).

These breeding success impacts would not be evidenced by any decline in local eagle numbers in the short term, but may change the area from being a population source to being a population sink. This may have ramifications for areas to the west which are dependent on the southern tablelands source populations. Survey and monitoring is required to determine the presence of breeding eagles and the extent of habitat impacts.

MICROCHIROPTERAN BAT IMPACTS

Bladestrike impacts

Three bat species were recorded at the subject site using the Anabat call detection system:

- White-striped Mastiff Bat (*Nyctinomus australis* syn. *Tadarida australis*);
 - forages on the ground for terrestrial insects and above the canopy, particularly along waterways for flying insects, including high-flying moths, roosts in tree holes.
 - this species has been recorded colliding with turbines elsewhere in Australia (refer below).
- Gould's Wattled-bat (*Chalinolobus gouldii*);
 - forages low, below the canopy, for slow-flying insects, particularly along waterways, roosts in tree holes, buildings.
 - seldom flies more than 20 metres above the ground (Strahan 1995).
 - this species is unlikely to be impacted by the proposal.
- a Forest Bat (*Vespadelus regulus/vulturnus*);
 - an agile fast-flying bat, and feeding on flying insects (especially moths), roosts in tree holes (Strahan 1995).

The proposed wind turbines have the potential to cause mortalities in local bat populations due to bladestrike. The risk of collision is influenced by the behavioural and possibly morphological characteristics of particular bat species, as well as site environmental factors.

Species risk factors

A range of hypotheses have been put forward to explain bat collisions, including echolocation failure, migration along linear corridors, the inability to perceive moving blades ('motion smear'), attraction to lights, attraction to the towers as potential roost sites, attraction to noises emitted by the turbine, curiosity about the blade movement, insect concentrations caused by insect attraction to turbines, and attraction to insect concentrations in rising warm air above ridgetops (Kunz *et al.* in prep. in Arnett 2005). There does not appear to be any published work which demonstrates the veracity or otherwise of any of these hypotheses.

Microbats are long-lived and have exceptionally low reproductive rates (Kunz 1982 in Arnett 2005). Population growth is slow and the ability to recover from population crashes is limited (Racey and Entwistle 2003 in Arnett 2005). Species characteristics which may affect collision risk include reproductive potential, migration behaviour, echolocation ability, flying manoeuvrability, foraging height, long-distance flying height and reaction to the new infrastructure.

The relative vulnerability of the various bat species in Australia to bladestrike is not well known. Bats niche partition within their foraging habitat; some forage low in the canopy, some within or just above the canopy and others hundreds of metres above the canopy. Wing morphology reflects the difference in manoeuvrability required in these different environments. Bats that fly rapidly but are not very manoeuvrable are suggested as being less able to avoid collisions with wind farms (Erickson *et al.* 2002). United States studies show that higher flying 'tree bats' were disproportionately affected by bladestrike (AusWEA 2004).

Vision, as well as manoeuvrability, affects the risk of collision. Erickson *et al.* (2002) suggest that individuals most at risk appear to be migrating bats; migrating bats may navigate without use of echolocation, depending on vision, rather than echolocation. Migratory bats comprise the majority of mortalities in all wind farm studies to date (Erickson *et al.* 2002, Arnett 2005).

Bat collision with wind turbines was first documented in Australia when 22 White-striped Freetail or White-striped Mastiff Bats (*Nyctinomus australis* syn *Tadarida australis*) collided with wind turbines over a 4-year period (Hall and Richards 1972, in Erickson *et al.* 2002.). This species may be uniquely vulnerable to wind turbine collisions due to its high flight and a low rate of echolocation call emission (Herr and Klomp 1997, in Rhodes 2001). White-striped Mastiff/Freetail Bats were recorded at the Conroys Gap site. Other high-flying species may also occur at the site and be at risk of bladestrike.

The functional range of echolocation in North American bats is typically 3-5 metres, giving a bat flying at 5 metres/second less than a second to respond to a wind turbine (Kunz *et al.* in prep. in Arnett 2005).

Environmental risk factors

Environmental factors which may affect the potential for collision include wind speeds and weather, proximity to foraging and roosting resources, linear vegetation features which may influence migration behaviour and proximity to other landscape features which may affect bat movements.

German studies have shown higher collision rates from turbines located near hedgerows (Australian Bat Society 2005). Many species use linear vegetation or topographic features while commuting (Limpens and Kapteyn 1991, in Erickson *et al.* 2002) and migrating (Humphrey and Cope 1976, Timm 1989, in Erickson *et al.* 2002). The Conroys Gap site is located in heavily cleared farmland. The nearest linear vegetation feature is remnant woodland beside Black Range Road, located some distance from the turbine ridges.

Although the association between man-made structures and bats is not well understood, evidence suggests that most bat collisions with structures occur during migration and that these are normally associated with inclement weather (Erickson *et al.* 2002). A feature of wind turbines is that in high wind speeds they shut down to protect themselves from damage, thereby also mitigating collision risks. Lights on turbines may increase the probability of bat collisions, as insect abundance is higher under lights (Erickson *et al.* 2002). This can also be mitigated by avoiding or reducing the use of lights on or near turbine towers, or by using red flashing lights that would be less likely to attract insects, which are generally not sensitive to the red end of the spectrum.

Experiences at existing wind farms

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

Other US studies show that bats tend to be killed on low wind nights, when blade speeds were at or close to full operational speed (17 rpm) (Arnett 2005). Fatalities tended to increase just before and just after the passage of storm fronts. This study also found that bat activity was greatest during the first two hours after sunset, which may also be a relatively high risk time for collisions. This study showed similar mortality rates at sites lit by aircraft lighting and sites which had no lights.

Erickson *et al.* (2002) in a North American study, state that based on available data bat collisions during the breeding season are virtually non-existent. Further, North American research has shown that most bat collisions have occurred with adult bats, hence collisions were not thought to be attributed to dispersing juveniles (ABS 2005).

Monitoring at Woolnorth recorded 11 bat collisions in 2003 (Hydro Tasmania 2003). Monitoring research at the three operational wind farms in Victoria has recorded no rare, threatened or endangered birds or bats killed by wind turbines to date. Searches conducted by Biosis Research for dead birds around seven turbines at Victoria's Codrington Wind farm (Victoria) showed one bat death (a White-striped Mastiff Bat) attributable to impact with turbines during the 2001-2003 monitoring period (AusWEA 2004). Incidental carcass finds showed a further White-striped Mastiff Bat death. Six bat mortalities were recorded at the Toora wind farm between 2002 and 2003; this impact was not considered to be of conservation significance (AusWEA 2004).

Bladestrike impact significance

Little research exists about collision or avoidance risks to bats in Australia. The limited and disparate survey effort generally completed for impact assessment prior to project developments is inadequate to answer broader research questions such as the locations and importance of migration paths, which species are most vulnerable and what deterrent options are available (ABS 2005).

Monitoring of wind farms to date has shown that bats investigate the blades and blade area of turbines and that while collisions do occur, they are able to avoid the blades on most occasions (ABS 2005).

The Anabat surveys at the Conroys Gap proposal site detected the high-flying White-striped Mastiff Bat. Based on known behaviour and mortalities at other wind farm sites, some level of mortality of this species caused by turbine collision is possible at the site.

The potential to impact migrating bats which use visual means over echolocation to navigate along linear features in the landscape, appears much higher. If these individuals are migrating to maternity sites, the potential to affect the local population may be greater still.

The location of larger remnant forest patches near the subject site is indicated on Figure 5.2. Bats moving between these remnants would not be required to pass over the proposed turbine ridges.

The risk of bladestrike to microbat species at the Conroys Gap site cannot be precisely determined. However, the relatively low level of recorded mortalities at existing wind farms in south-east Australia, the absence of recorded significant species mortalities, and the absence of woodland and forest habitat at the subject site combine to suggest that the proposal would not be likely to significantly affect local populations of microbats. The uncertainty would need to be managed using operational monitoring and adaptive management.

Bat habitat and habitat utilisation impacts

Most of the site offers marginal roosting habitat because of the scarcity of tree or cave habitat. Isolated paddock trees are present but uncommon, and small forest remnants are present, particularly near the southern turbine sites. Larger remnants are present outside the involved properties, but within foraging range of bat species. Rock outcrops on the trig ridge turbine site have cracks, but are unlikely to provide quality roosting habitat because of their limited size and the level of exposure.

The proposed wind farm would involve minimal tree clearing or branch trimming and is not expected to result in the loss of roosting habitat at the site.

Abundant insect activity was observed across the site during survey work, providing foraging resources for microbats, possibly related to warm updrafts. Microbats are known to forage over cleared paddocks with isolated paddock trees and this may have benefits in terms of regulating herbivorous insects on these trees (Lumsden and Bennett 2004). The presence of operating turbines may affect foraging behaviour through habitat avoidance or collision with rotor blades or powerlines. However, foraging habitat at the site is locally and regionally abundant. Some degree of localised habitat avoidance is in fact desirable to reduce collision risks.

Given the extent of habitat loss in the district, habitat utilisation could be expected to be broadly dispersed through the locality, with some focus on the larger forest/woodland remnants, which are generally located some distance from the subject site. The location of larger remnant forest patches near the subject site is indicated on Figure 5.2. The proposed turbines are unlikely to alienate these potential foraging and nesting habitat areas.

The proposal would not involve the removal of substantial maternity, over-wintering or roosting habitat. Given the heavily cleared nature of the site and the absence of linear vegetation features, any bat migration traffic over the site is probably more likely to be diffuse rather than concentrated.

There does not appear to be evidence that the subject site provides limiting or dependent habitat for microbats. The impacts on habitat or habitat utilisation are not expected to significantly affect local

populations of microbats. However, monitoring and an adaptive management approach would be required to account for the lack of information about these species.

5.3.3 Decommissioning impacts

Decommissioning impacts would be similar but not as extensive as construction impacts. The area of impact would be reduced because underground footings and cabling would not be removed from the site. The control building may also be retained on the site. Access tracks would be upgraded as required, and appropriate weed hygiene and rehabilitation measures would be implemented (refer EA). The decommissioning phase of the proposal may temporarily affect the use of habitat at the site by fauna, but is not expected to significantly affect local fauna populations in the medium-long term. Relevant mitigation measures implemented during the construction phase would also apply to decommissioning works.

5.3.4 Impact avoidance and mitigation

FURTHER SURVEY WORK

- Prior to the commencement of works, timbered areas within 2 kilometres of the turbines should be surveyed for the presence of Wedge-tailed Eagle nests, access permitting. Active nests should be monitored and breeding success recorded over the forthcoming breeding season (July-January). Both breeding success and habitat use behaviour at the subject site should be recorded to provide a baseline for operational monitoring.
- In conjunction with the above survey, the local abundance of ridgetop hunting habitat (exposed ridges with rabbit populations) should be reviewed to determine the importance of the subject site to the eagle population.

MICROSCALE SITE SELECTION

- Contractors and staff would be made aware of the significance and sensitivity of the Northern Valley/upper McCullums Creek valley area (potential threatened fauna habitat). The area would be protected from peripheral and indirect impacts and would not be used for site access or materials/equipment laydown.
- The southern turbines and access track should be sited to avoid the need to clear or trim remnant eucalypts to the west of the southern turbine sites.
- The powerline to the substation should be routed to avoid the need for clearing or trimming of the Long-leaved Box (*Eucalyptus goniocalyx*) forest remnant on the 'Ferndale' property.
- The Black Range Road crossing points for the proposed new tracks near the Ferndale residence should be sited in available gaps between mature Yellow Box and Blakely's Red Gum trees in the road reserve. The northern track crossing appears to be sited in such a gap; the southern crossing may need to be shifted slightly to the north (to AGD 658311 6141864) to avoid mature trees.
- At all sites, the clearing or trimming of mature and hollow-bearing trees and stags should be avoided.
- The turbines would be sited as far back from the edge of the ridgelines as possible to minimise disturbance to the use of updrafts by raptors.

DESIGN AND CONSTRUCTION MEASURES

- The turbine towers should be as widely spaced as possible to reduce bird collision risks.
- Where practicable, reticulation cabling between turbines would be installed underground to reduce bird collision risks and disturbance to habitat use patterns.
- To protect aquatic habitats, the concrete batching plant should be well bunded, silt fences should be used around all excavation works, the duration of works should be minimised, and

drainage line and creek crossings should be stabilised (consistent with Fisheries NSW guidelines).

- Where practicable, power poles and overhead powerlines should be bird-safe using flags or marker balls, large wire size and wire and conductor spacing.
- If lights are required to be fitted to the towers (eg for aircraft safety), they should be red flashing lights to reduce attractiveness to insects and possibly night-flying birds (subject to CASA requirements). For similar reasons, turbine paint should be non-reflective if practicable.
- Where possible, guy lines should not be fitted to towers or associated structures. Any guy lines which need to be used should be indicated with marker balls or flags.
- The turbine towers and associated structures should not provide perching opportunities.
- Rock and log habitat removed during the construction phase should be reinstated following the works.
- Any trench sections left open for greater than a day would be inspected daily, early in the morning and any trapped fauna removed.

OPERATIONAL MEASURES

Site management

- Sheep may be preferable to cattle as grazing stock on the turbine ridges (farm operational requirements permitting) to reduce the incidence of insects, which could provide prey for smaller raptors, owls, insectivorous passerines and bats.
- Vegetation at the turbine sites should be kept low to allow a high level of carcasse detectability. The use of dogs to find carcasses could improve search efficiency.

Operation phase monitoring

- The OEMP would contain details of a three-tiered monitoring program for bird and bat mortalities and habitat utilisation impacts:

1. First six months of operation

- a more intensive period of monitoring because birds and bats are in the process of habituating to the new development, and sensitive species may experience higher levels of mortality during this period.
- during this period all turbine sites would be surveyed to determine variation in impact over the study area. Surveys would include monthly dead bird and bat searches (with at least two scavenging trials), bird utilisation surveys, observation of bird avoidance/diversion behaviour and targeted surveys for species of concern.
- if practicable, a reference site located between 500 metres and 1,500 metres from the turbines should also be surveyed.

2. First three years of operation

- an extended period of monitoring to assess mortality rates and trends over successive seasons and longer term changes to local species abundance, habitat use patterns and possibly breeding success.
- the survey may be limited to representative or higher risk turbine sites, based on the results of the first six months of monitoring.
- surveys would include monthly dead bird and bat searches, bird utilisation surveys, observation of bird avoidance/diversion behaviour and targeted surveys for species of concern.

- dead bird and bat searches may be extended beyond three years if thresholds are exceeded and adaptive management responses are required to be implemented.
- if any active Wedge-tailed Eagle nest sites are located within 2 kilometres of the turbines, these nests should be monitored during breeding seasons (July-January) for **at least 5 years** following the commencement of operations to determine any impacts on breeding success caused by blade-strike mortality or habitat alienation. Ideally, breeding success at a comparable reference nest site not affected by the wind farm should also be monitored concurrently.

3. Ongoing monitoring

- mortality inspection and reporting would be continued for the life of the wind farm. The inspection regime would be linked to turbine inspection and maintenance cycles. Mortalities of any significant species (including threatened species and Wedge-tailed Eagles) would be reported to DEC.
- monitoring methods and data standards for dead bird searches, indirect disturbance impact assessment and habitat avoidance studies would be based on protocols in the Interim Standards for Assessing the Risks to Birds from Wind Farms in Australia (Brett Lane and Associates 2005).
- Given the concentration of operational and proposed wind farms in the Southern Tablelands region, monitoring of bird and bat impacts should ideally be coordinated and consistent with monitoring programs conducted at other wind farms, and the results of monitoring collected and published by AusWEA or government.

Adaptive Management

Mortality and habitat avoidance thresholds would be developed and used to trigger specific management responses to mitigate impacts.

Thresholds for mortality rates and habitat impacts for threatened or sensitive bird and bat species would be determined for each of the three monitoring periods during the development of the monitoring program, having regard to species reproductive potential, conservation status and experiences at other Australian wind farms.

Management responses to monitoring threshold exceedances would be dependant on the cause and the impact, but could include further research, detailed risk modelling and population assessments, adjustments or enhancements to turbine and associated infrastructure, the installation of flight diversion or deterrent structures, blade painting (refer Hodos *et al.* 2001), removing local food sources or insect attracting light sources, compensatory off-site habitat protection or enhancement, nest site protection, sponsoring the care of injured birds and the periodic shutdown of one or more turbines (on a daily or seasonal basis).

6 CONCLUSIONS

6.1 Flora

The subject site is located in a cleared agricultural setting, with a general loss of tree cover on the ridges and valleys of the involved properties, particularly north of Black Range Road. Remnant vegetation at the site is derived from dry shrub forest on ridges and grassy woodland in valley floor and lower slope areas. Ridgetops and one valley have retained a largely native grassy groundcover. A treeless example of the Endangered Ecological Community Box-Gum Woodland is present in the McCullums Creek valley, east of the northern turbine sites. The threatened Yass Daisy (*Ammobium craspedioides*) also occurs in this valley. Small and degraded dry shrub forest remnants are present at the subject site, most notably on the 'Ferndale' property. These remnants have local conservation value because of the extent of clearing in the region.

The proposal would remove a relatively small area of native and exotic pasture. Few trees and no forest remnants would need to be cleared. The Assessment of Significance indicates that, with the adoption of appropriate mitigation measures identified in section 4.3 of the Biodiversity Assessment, the proposal is not likely to significantly affect the life cycle or habitat of threatened plant species or communities at the subject site.

Mitigation measures identified in section 4.3 cover the finescale siting of the proposed developments to avoid key conservation values, rehabilitation and revegetation techniques, weed hygiene and control and pre-works site inspections for significant species as required.

6.2 Fauna

Six broad habitat types were identified in the study area; modified wetland areas and watercourses, exotic pasture on valley flats and lower slopes, cleared ridgetops and side slopes, dry shrub forest remnants, grassy woodland remnants (cleared) and grassy woodland remnants (with tree cover).

A range of methods were used to record species at the site, including Elliot and cage trapping, Anabat ultrasonic microbat call detection, owl call playback, spotlighting, active searching and observation transects. 46 fauna species were recorded during the field survey; including 7 terrestrial mammal species, 3 microbat species, 25 bird species, 8 reptile species and 6 frog species. Overall survey results suggest a low abundance and diversity of fauna at the subject site.

Bird fauna recorded in the cleared paddock and ridge areas of the subject site was restricted to a few species, most commonly Magpies, Richards Pipits and Wedge-tailed Eagles. The most abundant mammal at the site is the introduced rabbit, which is likely to be a principal food source for local Wedge-tailed Eagles. Wedge-tailed Eagles were observed at the site on each day of the survey, numbering 1 to 5 and usually soaring around 20 metres above the ground. Waterbirds such as the Australian Wood Duck, White Ibis and White-faced Heron were recorded at dams and small watercourses.

Parts of the survey area have at least moderate potential to provide habitat for nine threatened fauna species; two microbats, five birds (Barking Owl, Superb Parrot, Swift Parrot, Gang-gang Cockatoo, Diamond Firetail, Regent Honeyeater) and one invertebrate (Golden Sun Moth). The potential impact of the proposal on these species is assessed in an Assessment of Significance provided in Appendix D. The Assessment concludes that the proposal is not likely to significantly affect the life cycle or habitat of threatened fauna species at the subject site.

The subject site may also provide habitat to a range of migratory species protected under international agreements. A risk assessment for bird species which were recorded at the site or are potentially present at the site is presented in Appendix F. The assessment focuses on bird groups

which have been shown to be at particular risk in studies at other wind farms (raptors, waterbirds, migratory species), and rare, threatened or protected species. Blade collisions are expected to be rare and impacts would be within the recovery capacity of local and regional populations. Significant alterations to habitat utilisation in wetland, farmland and woodland areas surrounding the site are not expected. The proposal may reduce hunting opportunities for the Wedge-tailed Eagle and this may affect breeding success in the vicinity of the site. Specific survey, monitoring and adaptive management measures would be adopted to account for this possibility.

With the adoption of mitigation measures identified in the Biodiversity Assessment, the Conroys Gap proposal is not considered likely to significantly affect fauna species at the population level. These mitigation measures cover design issues such as powerline routing, the avoidance of turbine tower lighting, perch opportunities and guy lines, the marking of powerlines; construction measures such as protecting forest and aquatic habitats, reducing impacts to woodland understorey and rock and log habitat reinstatement; and operational measures including the removal of some bird and bat food sources from the turbine area and ongoing monitoring and adaptive management requirements.

7 ASSESSMENT PERSONNEL

Personnel	Role	Qualifications	Expertise and experience
Paul McPherson ngh environmental	Flora and site assessment Report writing and research	Bachelor of Applied Science (Natural Resources)	With ngh environmental since 1996 undertaking flora and fauna survey, planning assessment and environmental impact assessment. Prior to this, Commonwealth Government environmental policy, resource assessment and program delivery.
Kate Gillespie ngh environmental	Fauna survey	Bachelor of Science (Zoology) Honours	Kate has seven years experience in comprehensive fauna survey in Victoria and southern NSW. Kate has assisted in the preparation of biodiversity assessments (particularly threatened flora and fauna) as well as EIA reports for helipads, dam modification, telecommunications, water and sewerage works.
Nick Graham-Higgs Principal ngh environmental	Client liaison Editorial review	Bachelor of Applied Science	An environmental consultant specialising in environmental impact assessment and natural resource management since 1992. Much of the work undertaken has been within sensitive areas, including major infrastructure development works.

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APPENDIX A: FLORA SURVEY RESULTS

A total of 188 vascular plant species was recorded during the flora survey, including 80 exotic species. The flora survey area comprises:

- the ridgetop turbine sites (c. 350 hectares),
- 20 metre wide corridors centred on new access track and underground cable routes (c. 13 hectares),
- a 100 metre wide corridor centred on the proposed overhead powerline connecting the turbine sites to the substation and Transgrid system (c. 28 hectares).

The subject site was stratified into 7 broadly homogeneous survey zones based on habitat type, the extent of existing disturbance and the nature of proposed development impacts:

NT	Northern turbine site ridges and ridge-top turbine cable routes Approximate area: 172.5 ha
NV	Northern valley access track and cable route Approximate area: 2 ha
CT	Central turbine site ridges and turbine cable routes, and northern substation site Approximate area: 135 ha
BR	Black Range Road crossings (tracks and powerline) Approximate area: 0.1 ha
PV	Powerline corridor: cleared valley floor Approximate area: 18 ha
ST	Southern turbines, powerline corridor: cleared ridge and midslope, southern substation site Approximate area: 27 ha
SR	Southern turbine site and powerline corridor: forest remnants Approximate area: 18 ha

The survey zones are indicated on Figure 4.1 in the Biodiversity Assessment.

All native and introduced vascular plant species occurring at the subject site, and their relative abundances, were recorded. Cover/abundance assessments are based on visual estimates of foliage cover (after Carnahan 1997), scored using a modified Braun-Blanquet 6-point scale:

1	1 to a few individuals present, less than 5% cover
2	many individuals present, but still less than 5% cover
3	5 - <20% cover
4	20 - <50% cover
5	50 - <75% cover
6	75 - 100% cover.

Cover/abundance scores relate to general abundance over the relevant parts of the site, not to representative quadrats. Single-figure values are generalised over the study area or vegetation type. Where the abundance of a particular species varies markedly over the survey sector, a range of cover values is provided. Where a range of values is given, abundance is based on a standard 20 metre x 20 metre quadrat scale.

Species of conservation significance are bolded. Introduced species are denoted by an asterisk. Noxious weeds declared for the Southern Slopes County Council control area under the *Noxious Weeds Act 1993* are indicated with a 'Δ' symbol.

Where uncertainty exists due to the unavailability of mature reproductive material, the taxon is preceded by a question mark, or plants are identified to genus level only.

Botanical nomenclature follows G.J. Harden (ed) (1990-2002) Flora of New South Wales, UNSW Press, except where recent changes have occurred.

Scientific name	Common name	Family	Abundance						
			NT	NV	CT	BR	PV	ST	SR
TREES									
<i>Acacia implexa</i>	lightwood or hickory	Fabaceae	0-3	0-3		1			0-1
* <i>Ailanthus altissima</i>	tree-of-Heaven	Simaroubaceae						0-5	
<i>Brachychiton populneus</i>	kurrajong	Sterculiaceae							1
<i>Eucalyptus blakelyi</i>	Blakely's red gum	Myrtaceae				0-3			
<i>Eucalyptus bridgesiana</i>	apple box	Myrtaceae				0-1			
<i>Eucalyptus dives</i>	broad-leaved peppermint	Myrtaceae	0-3			0-1			0-3
<i>Eucalyptus goniocalyx</i>	long-leaved box	Myrtaceae			0-1	0-1	0-1		0-3
<i>Eucalyptus macrorhyncha</i>	red stringybark	Myrtaceae	0-1	0-1			0-3	0-3	0-3
<i>Eucalyptus mannifera</i>	red spotted gum	Myrtaceae						0-1	0-3
<i>Eucalyptus melliodora</i>	yellow box	Myrtaceae				0-3	0-1		
<i>Eucalyptus polyanthemus</i>	red box	Myrtaceae						0-3	0-3
<i>Eucalyptus radiata</i>	narrow-leaved peppermint	Myrtaceae							0-1
<i>Eucalyptus rossii</i>	white gum	Myrtaceae							0-3
<i>Exocarpos cupressiformis</i>	native cherry	Santalaceae							0-3
* <i>Ficus carica</i>	fig	Moraceae					0-1		
* <i>Prunus</i> sp.	plum/cherry	Amygdalaceae				1	0-1		
Δ* <i>Salix babylonica</i>	weeping willow	Salicaceae					0-4		
SHRUBS, SUB-SHRUBS									
<i>Acacia paradoxa</i>	kangaroo thorn	Fabaceae				0-2	0-3	0-3	0-3
<i>Acacia verniciflua</i>	varnish wattle	Fabaceae		0-1					
<i>Amyema pendulum</i>	a mistletoe	Loranthaceae	0-1				0-1	0-2	1
<i>Brachyloma daphnoides</i>	daphne heath	Epacridaceae		0-1					0-2
<i>Calytrix tetragona</i>	fringe-myrtle	Myrtaceae							0-1
<i>Cassinia longifolia</i>	dogwood	Asteraceae		0-1					
<i>Cryptandra amara</i>	bitter cryptandra	Rhamnaceae							0-3
<i>Dillwynia sericea</i>	showy parrot-pea	Fabaceae		0-1					
<i>Hibbertia obtusifolia</i>	guineaflower	Dilleniaceae	0-2	2			0-1	0-2	2
<i>Hovea heterophylla</i>	variable hovea	Fabaceae							0-1
<i>Leionema lamprophyllum</i> ssp <i>obovatum</i>	shiny phebalium	Rutaceae							0-3
<i>Leptospermum myrtifolium</i>	swamp teatree	Myrtaceae		0-1					
<i>Monotoca scoparia</i>	broom heath	Epacridaceae							0-1
<i>Phyllanthus hirtellus</i>	spurge	Euphorbiaceae							0-2
<i>Prostanthera decussata</i>	dense mint-bush	Lamiaceae							0-3
Δ* <i>Rosa rubiginosa</i>	sweet briar	Rosaceae	0-1						
Δ* <i>Rubus fruticosus</i> agg.	blackberry	Rosaceae	0-1	1		0-5	0-6		1
VINES AND TWINERS									
<i>Glycine clandestina</i>	twining glycine	Fabaceae		0-1					0-1
<i>Hardenbergia violaceae</i>	false sarsaparilla	Fabaceae		0-1					
FORBS									
<i>Acaena echinata</i>		Rosaceae	1	1					

Scientific name	Common name	Family	Abundance						
			NT	NV	CT	BR	PV	ST	SR
<i>Acaena novae-zealandiae</i>	bidgee widgee	Rosaceae	1	1			0-1		
<i>*Acetosella vulgaris</i>	sheep sorrel	Polygonaceae	0-3		0-2	1	0-2	2	2
<i>Ammobium craspedioides</i>	Yass daisy	Asteraceae	0-1						
<i>*Anagallis arvensis</i>	scarlet pimpernel	Primulaceae	0-1				0-1		
<i>*Aphanes arvensis</i>	parsley-piert	Rosaceae	0-1						
<i>*Arctotheca calendula</i>	capeweed	Asteraceae	1-3	1	1-3	2	2	0-2	0-2
<i>*Arenaria serpyllifolia</i>	thyme sandwort	Caryophyllaceae	0-2						
<i>Asperula conferta</i>	woodruff	Rubiaceae	1-2	0-1		0-2		0-1	
<i>Brachyscome ptychocarpa</i>		Asteraceae	0-1	1-2	0-1				
<i>Brachyscome rigidula</i>		Asteraceae	0-1	0-1	0-1				
<i>Bulbine bulbosa</i>	bulbine lily	Asphodelaceae	0-2	0-2					
<i>*Callitriche ?stagnalis</i>	common starwort	Callitrichaceae			0-2		0-3		
<i>*Capsella bursa-pastoris</i>	shepherd's purse	Brassicaceae					0-1	0-1	
<i>?Δ*Carduus nutans</i>	nodding thistle	Asteraceae					0-1		
<i>*Carduus pycnocephalus</i>	slender thistle	Asteraceae	1		?1		0-2	0-2	
<i>*Carduus tenuiflorus</i>	winged slender thistle	Asteraceae	2		1-3		1-2	0-2	1
<i>?*Carthamus sp.</i>		Asteraceae	0-1		0-2		1	1	
<i>*Centaurium erythraea</i>	centaury	Gentianaceae	1	1					
<i>*Cerastium glomeratus</i>	mouse-ear chickweed	Caryophyllaceae	1-2	0-1	1-2		0-2	0-2	2
<i>*Chondrilla juncea</i>	skeleton weed	Asteraceae							0-1
<i>Chrysocephalum apiculatum</i>	yellow buttons	Asteraceae							
<i>*Cirsium vulgare</i>	black or spear thistle	Asteraceae	0-2		0-1	1	0-1		
<i>Craspedia variabilis</i>	billy buttons	Asteraceae		0-2					
<i>Crassula sieberiana</i>	stonecrop	Crassulaceae	0-1					0-1	
<i>Cymbonotus priessianus</i>	bears ear	Asteraceae	1						
<i>Daucus glochidiatus</i>	native carrot	Apiaceae					0-1		1
<i>Desmodium varians</i>	southern tick trefoil	Fabaceae		0-1					
<i>Dianella revoluta</i>	flax lily	Phormiaceae							0-2
<i>Dichondra repens</i>	kidney weed	Convolvulaceae	0-1	0-1			0-2		
<i>Diuris sulphurea</i>	tiger orchid	Orchidaceae		0-2					
<i>Drosera peltata</i>	sundew	Droseraceae	0-2	0-3	0-2		0-2		
<i>Δ*Echium plantagineum</i>	Paterson's curse	Boraginaceae			0-1	1			
<i>Epilobium billardierianum</i> ssp cinereum	willow herb	Onagraceae	0-1	0-1					
<i>*Erodium cicutarium</i>	common storksbill	Geraniaceae	2		1		2		
<i>Euchiton gymnocephalus</i>	slender cudweed	Asteraceae	1					0-1	1
<i>Euchiton involucratus</i>	star cudweed	Asteraceae	1						
<i>*Galium aparine</i>	cleavers	Rubiaceae				0-2	0-3		
<i>Geranium potentilloides</i>		Geraniaceae	0-1					0-1	
<i>Geranium solanderi</i>	native geranium	Geraniaceae	0-2						?1
<i>*Gnaphalium coarctatum</i>	cudweed	Asteraceae							
<i>Gonocarpus elatus</i>	tall raspwort	Haloragaceae							0-2
<i>Gonocarpus tetragynus</i>	raspwort	Haloragaceae	0-2	2				0-2	2
<i>Goodenia hederacea</i>	ivy-leaved goodenia	Goodeniaceae							0-2
<i>Hydrocotyle laxiflora</i>	stinking pennywort	Apiaceae	0-2		1		0-2	0-2	2
<i>Hydrocotyle peduncularis</i>	shining pennywort	Apiaceae		0-3					
<i>Hypericum gramineum</i>	grassy St John's wort	Clusiaceae	0-2				0-2		
<i>Hypericum japonicum</i>	small St John's wort	Clusiaceae		0-2					
<i>*Hypochaeris glabra</i>	smooth catsear	Asteraceae	0-2				1-2	1	1
<i>*Hypochaeris radicata</i>	catsear, flatweed	Asteraceae	1	0-2	0-1	2	0-2		2
<i>Hypoxis hygrometrica</i>	golden weather-grass	Hypoxidaceae	0-2	0-2					

Scientific name	Common name	Family	Abundance						
			NT	NV	CT	BR	PV	ST	SR
<i>Hypoxis</i> sp.		Hypoxidaceae		0-1					
<i>Isotoma axillaris</i>	rock isotome	Lobeliaceae							0-2
<i>Isotoma fluviatilis</i>	swamp isotome	Lobeliaceae	0-2	0-2			0-2		
* <i>Linaria pelisserana</i>	Pelisser's toadflax	Scrophulariaceae	1-2				0-2	0-2	
<i>Lythrum hyssopifolia</i>	hyssop loosestrife	Lythraceae					0-1		
* <i>Malva parviflora</i>	mallow	Malvaceae			0-2				
* <i>Medicago arabica</i>	spotted burr-medic	Fabaceae					0-2		
<i>Mentha diemenica</i>	slender mint	Lamiaceae	0-2						
<i>Microtis unifolius</i>	onion orchid	Orchidaceae		0-2			0-2	0-1	1
* <i>Myosotis caespitosus</i>	forget-me-not	Boraginaceae					0-1		1
Δ* <i>Onopordum acanthium</i>	scotch thistle	Asteraceae					0-1		
<i>Oreomyrrhis eriopoda</i>	Australian carraway	Apiaceae	0-1						
<i>Oxalis perennans</i>	native oxalis	Oxalidaceae	0-2	0-2					
<i>Oxalis</i> sp.		Oxalidaceae	1			1		1	1
* <i>Parentucellia latifolia</i>	bartsia	Scrophulariaceae	1-2				0-2	0-2	
<i>Persicaria hydropiper</i>	knotweed	Polygonaceae					0-1		
* <i>Petrorhagia nanteulii</i>	proliferous pinks	Caryophyllaceae	2	2	0-2		1-2	2	2
* <i>Plantago lanceolata</i>	plantain	Plantaginaceae				1			
<i>Plantago varia</i>	variable plantain	Plantaginaceae				1			
<i>Pomax umbellata</i>		Rubiaceae							0-1
<i>Poranthera microphylla</i>		Euphorbiaceae						0-1	2
* <i>Ranunculus muricatus</i>	swamp buttercup	Ranunculaceae					0-2		
* <i>Rorippa nasturtium-aquaticum</i>	water cress	Brassicaceae					0-3		
* <i>Rorippa palustris</i>	yellow cress	Brassicaceae					0-1		
<i>Rumex brownii</i>	native dock	Polygonaceae		1	1		1		
* <i>Rumex crispus</i>	curly dock	Polygonaceae					0-2		
* <i>Salvia verbenaca</i>	wild sage	Lamiaceae	1	0-1					
* <i>Sanguisorba minor</i>	sheep's burnet	Rosaceae			0-1				
<i>Scutellaria humilis</i>	dwarf skullcap	Lamiaceae	0-2						
<i>Senecio hispidulus</i> var <i>dissectus</i>	hill fireweed	Asteraceae		0-1					
<i>Senecio quadridentatus</i>	cotton fireweed	Asteraceae							
<i>Senecio tenuiflorus</i>		Asteraceae					0-1		1
* <i>Silybum marianum</i>	variegated thistle	Asteraceae	0-1		0-1		0-1		
<i>Solenogyne dominii</i>		Asteraceae	0-2	1-2					
* <i>Soliva sessilis</i>	bindyi	Asteraceae					1	1	1
* <i>Sonchus asper</i>	prickly sow thistle	Asteraceae				1	0-2	1	
* <i>Sonchus oleraceus</i>	soft sow thistle	Asteraceae	0-1	1					
* <i>Spergularia rubra</i>	sand spurry	Caryophyllaceae					0-2	0-2	1
<i>Stackhousia monogyna</i>	scented candles	Stackhousiaceae	0-1						
<i>Stellaria pungens</i>	prickly starwort	Caryophyllaceae	0-2						
<i>Stuartina muelleri</i>	spoon cudweed	Asteraceae	1	1					1
<i>Stypandra glauca</i>	nodding blue lily	Phormiaceae		0-3					0-1
<i>Thelymitra nuda</i>	plain sun orchid	Orchidaceae		0-2					
<i>Thelymitra</i> sp.	sun orchid	Orchidaceae	0-1	0-2			0-1		
<i>Thysanotus tuberosus</i>	common fringe-lily	Anthericaceae		0-1					
* <i>Tolpis umbellata</i>		Asteraceae	0-2					0-1	
* <i>Tragopogon porrifolius</i>	salsify	Asteraceae	1						
* <i>Trifolium arvense</i>	haresfoot clover	Fabaceae	0-2			2	0-2	0-2	
* <i>Trifolium campestre</i>	hop clover	Fabaceae	0-2		1-2	2	0-2	0-2	1

Scientific name	Common name	Family	Abundance						
			NT	NV	CT	BR	PV	ST	SR
<i>*Trifolium dubium</i>	yellow suckling clover	Fabaceae	0-2		0-2	2	0-5	0-4	
<i>*Trifolium repens</i>	white clover	Fabaceae			1-3		0-2	0-2	
<i>*Trifolium subterraneum</i>	sub clover	Fabaceae	0-2		0-2		0-2	0-2	
<i>Triptilodiscus pygmaeus</i>	austral sunray	Asteraceae	0-2	0-2			0-2		
<i>Urtica incisa</i>	stinging nettle	Urticaceae					0-3		
<i>*Urtica urens</i>	small nettle	Urticaceae			0-2				
<i>Veronica calycina</i>	hairy speedwell	Scrophulariaceae	0-1						
<i>Viola betonicifolia</i>	swamp violet	Violaceae	0-2						
<i>Wahlenbergia communis</i>	tufted bluebell	Campanulaceae	1	1					
<i>Wahlenbergia gracilis</i>	sprawling bluebell	Campanulaceae	1	1	1		0-1		
<i>Wahlenbergia stricta</i>	tall bluebell	Campanulaceae	1-2	1-2			0-2		2
GRASSES									
<i>*Aira cupaniana</i>	silvery hairgrass	Poaceae	0-3	0-1	0-2	1	0-2	1-2	2
<i>Amphibromus nervosus</i>	swamp wallaby grass	Poaceae					0-2		
<i>*Anthoxanthum odoratum</i>	sweet vernal grass	Poaceae			0-1				
<i>Aristida ramosa</i> var <i>scaberula</i>	three awn grass	Poaceae	1	0-2			0-2	0-3	0-2
<i>Austrodanthonia auriculata</i>	lobed wallaby grass	Poaceae	0-3	0-2	0-1				
<i>Austrodanthonia carphoides</i>	short wallaby grass	Poaceae	0-3	0-2		1	0-2	0-3	2
<i>Austrodanthonia eriantha</i>	wallaby grass	Poaceae	0-3	0-2	0-1	1	0-1		
<i>Austrodanthonia laevis</i>	wallaby grass	Poaceae	0-1						
<i>Austrodanthonia racemosa</i>	wallaby grass	Poaceae	0-2	0-2	0-1	1	0-1	0-3	0-3
<i>Austrostipa scabra</i> ssp <i>falcata</i>	corkscrew grass	Poaceae	2-3	0-1	0-2		0-2	0-2	0-2
<i>*Avena fatua</i>	wild oats	Poaceae	1			0-2	0-1		
<i>?*Axonopus affinis</i>	carpet grass	Poaceae		0-2					
<i>Bothriochloa macra</i>	redleg grass	Poaceae		1			0-2		
<i>*Briza maxima</i>	quaking grass	Poaceae	0-1			0-2	0-1	0-1	
<i>*Briza minor</i>	shivery grass	Poaceae	0-2		0-2		0-2	0-2	1
<i>*Bromus molliformis</i>	soft brome	Poaceae	2-5	0-1	0-2	0-3	0-2		
<i>*Bromus rubens</i>	brome	Poaceae					0-2		
<i>*Bromus</i> sp.	brome	Poaceae	0-1		0-2	1	0-2	0-2	1-3
<i>*Cynosurus echinatus</i>	dogstail grass	Poaceae				0-2			
<i>Dichelachne micrantha</i>	plume grass	Poaceae	0-1					0-1	
<i>*Eleusine tristachya</i>	goose grass	Poaceae				1			
<i>Elymus scaber</i>	wheat grass	Poaceae	0-3					0-2	0-2
<i>Eragrostis brownii</i>	two-colour panic	Poaceae					0-2		
<i>*Festuca elatior</i>	tall fescue	Poaceae				0-1			
<i>*Festuca rubra</i>	red fescue	Poaceae			0-1				
<i>*Holcus lanatus</i>	Yorkshire fog	Poaceae	0-2	0-2	0-3	0-2	0-5		
<i>*Hordeum</i> spp.	barley grasses	Poaceae	0-3		1-3		0-2	0-2	0-2
<i>Joycea pallida</i>	robust wallaby grass	Poaceae		0-2		1			
<i>*Lolium perenne</i>	perennial ryegrass	Poaceae			0-2	1-4	0-2		
<i>Microlaena stipoides</i>	weeping grass	Poaceae	1-4	2-4	0-3	0-2	0-1	0-3	0-2
<i>Δ*Nassella trichotoma</i>	serrated tussock	Poaceae	1-2		0-1			0-1	
<i>Panicum effusum</i>	hairy panic	Poaceae	0-2				0-1		
<i>*Phalaris aquatica</i>	phalaris	Poaceae				0-4			
<i>*Poa annua</i>	wintergrass	Poaceae			0-3		0-2		
<i>Poa labillardieri</i>	silver tussock	Poaceae							
<i>Poa ?meionectes</i>		Poaceae	0-2					0-2	
<i>Poa sieberiana</i>	tussock grass	Poaceae	0-2	0-2		0-2			0-2

Scientific name	Common name	Family	Abundance						
			NT	NV	CT	BR	PV	ST	SR
<i>*Polypogon monspeliensis</i>	annual beard grass	Poaceae					0-2		
<i>Themeda triandra</i>	kangaroo grass	Poaceae	0-1	0-2		1			0-2
<i>*Vulpia bromoides</i>	squirrel-tail fescue	Poaceae	0-2	2		0-2	1	1-3	2
<i>*Vulpia myuros</i>	rat-tail fescue	Poaceae	1				?1		
GRAMINIDS									
<i>Carex inomitata</i>		Cyperaceae				1	0-1		
<i>Carex inversa</i>	knob sedge	Cyperaceae					0-2		
<i>Cyperus</i> sp.		Cyperaceae			0-2				
<i>Cyperus sphaeroideus</i>		Cyperaceae					0-2		
<i>Eleocharis acuta</i>	spike-rush	Cyperaceae		0-1	0-2				
<i>Isolepis</i> sp.		Cyperaceae		0-2	0-2		0-1		
<i>*Juncus articulatus</i>	jointed rush	Juncaceae		0-2	0-3		0-2		
<i>Juncus australis</i>	rush	Juncaceae			0-2		0-2		
<i>*Juncus bufonius</i>	toad rush	Juncaceae	0-2		0-2		0-1		
<i>Juncus filicaulis</i>	pinrush	Juncaceae	0-1	0-2	0-1	1	0-2		0-1
<i>Juncus homalocaulis</i>	rush	Juncaceae	0-1				0-1		
<i>Lepidosperma laterale</i>	sword sedge	Cyperaceae							0-2
<i>Lomandra filiformis</i> ssp. <i>coriacea</i>	wattle matrush	Lomandraceae				1			0-2
<i>Lomandra multiflora</i>	many-flowered matrush	Lomandraceae							0-1
<i>Luzula densiflora</i>	woodrush	Juncaceae	0-1	0-2			0-2		2
<i>Luzula flaccida</i>	woodrush	Juncaceae					0-1		1
<i>Schoenus apogon</i>	bog sedge	Cyperaceae	0-2	0-2	0-2		0-2		
<i>Typha</i> sp.	cumbungi, bullrush	Typhaceae			0-3		0-2		
FERNS									
<i>Asplenium flabellifolium</i>	necklace fern	Aspleniaceae	0-1						
<i>Blechnum nudum</i>	water fern	Blechnaceae		0-1					
<i>Cheilanthes austrotenuifolia</i>	rock or mulga fern	Sinopteridaceae	1-2	0-1				0-2	0-2
<i>Pteridium esculentum</i>	bracken	Dennstaedtiaceae	0-5	0-4			0-3	0-2	

APPENDIX B: FAUNA SURVEY RESULTS

1. Fauna species list

Common name	Scientific name
Mammals	
Swamp Wallaby	<i>Wallabia bicolor</i>
Common Brushtail Possum	<i>Trichosurus vulpecula</i>
Common Wombat	<i>Vombatus ursinus</i>
*European Rabbit	<i>Oryctolagus cuniculus</i>
*Red Fox	<i>Canis vulpes</i>
Bush Rat	<i>Rattus fuscipes</i>
Black Rat	<i>Rattus rattus</i>
White-striped Mastiff Bat	<i>Nyctinomus australis</i> syn <i>Tadarida australis</i>
Gould's Wattled-bat	<i>Chalinolobus gouldii</i>
a Forest Bat	<i>Vespadelus regulus/vulturnus</i>
Birds	
Australian Hobby	<i>Flaco longipennis</i>
Australian Magpie	<i>Gymnorhina tibicen</i>
Australian Raven	<i>Corvus coronoides</i>
Australian White Ibis	<i>Threskiornis molucca</i>
Australian Wood Duck	<i>Chenonetta jubata</i>
Brown Falcon	<i>Falco berigora</i>
Common Blackbird	<i>Turdus merula</i>
Common Starling	<i>Sturnus vulgaris</i>
Crimson Rosella	<i>Platycercus elegans</i>
Double-barred Finch	<i>Taeniopygia bichenovii</i>
Eastern Rosella	<i>Platycercus eximius</i>
Galah	<i>Cacatua roseicapilla</i>
Little Eagle	<i>Hieraaetus morphnoides</i>
Little Wattle-bird	<i>Anthochaera chrysoptera</i>
Magpie-lark	<i>Grallina cyanoleuca</i>
Nankeen Kestrel	<i>Falco cenchroides</i>
Richard's Pipit	<i>Anthus novaeseelandiae</i>
Spotted Harrier	<i>Circus assimilis</i>
Superb Fairy-wren	<i>Malurus cyaneus</i>
Tawny Frogmouth	<i>Podargus strigoides</i>
Tree Martin	<i>Hirundo nigricans</i>
Wedge-tailed Eagle	<i>Aquila audax</i>
Welcome Swallow	<i>Hirundo neoxena</i>
White-faced Heron	<i>Egretta novaehollandiae</i>
Willie Wagtail	<i>Rhipidura leucophrys</i>
Reptiles	

Common name	Scientific name
Blotched Blue-tongued Lizard	<i>Tiliqua nigrolutea</i>
Common Blue-tongued Lizard	<i>Tiliqua scincoides</i>
Cunningham's Skink	<i>Egernia cunninghami</i>
Delicate Skink	<i>Lampropholis delicata</i>
Eastern Bearded Dragon	<i>Pogona barbata</i>
Garden Skink	<i>Lampropholis guichenoti</i>
Red-bellied Black Snake	<i>Pseudechis porphyriacus</i>
Stumpy-tailed Lizard	<i>Tiliqua rugosa</i>
Frogs	
Common Froglet	<i>Crinia signifera</i>
Peron's Tree Frog	<i>Litoria peronii</i>
Plains Froglet	<i>Crinia parinsignifera</i>
Southern Bullfrog	<i>Limnodynastes dumerilii</i>
Spotted Marsh Frog	<i>Limnodynastes tasmaniensis</i>
Striped Marsh Frog	<i>Limnodynastes peronii</i>

2. Fauna data sheets

2.1 Survey site location, description and effort

Transect	Hrs	Start (AGD)		Finish (AGD)		Survey site habitat assessment/description	No. Elliot traps	No. cage traps	Date
		Eastings	Northings	Eastings	Northings				
A		657920	6145520	658012	6145076	Runs along the ridge south from the trig/telecom tower, it runs through poor quality habitat which consists of mostly grazed pasture (exotics predominantly) with scattered rocks and outcrops and fallen timber (from previous clearing of land).	20	2	9.11.05
B		658376	6145434	658505	6145067	runs along the ridge just east of Transect A where 3 turbines are proposed, again this transect goes through similar habitat to Transect A however at the end it does pass through a small patch of woodland with a ferny and grassy understorey.	20	4	9.11.05
C		658423	6145142	658444	6145034	Runs along the gully between Transects A and B, it passes close to the small running creek (fed by seepage points on the slopes). The transect goes through tall grass and a small patch of ferns which dominate the understorey/groundcover.	10	2	9.11.05
D		658411	6145442	658509	6145537	This is an extension of Transect B, it continues north over the knoll in amongst rocky outcrops.	9	1	9.11.05
Frog 1	0.5	658929	6143797			Small creek on main access track leading to trig/tower. Quite grassy/rocky creek with pasture all around, very open. Creek not flowing.			9.11.05
Frog 2	0.5	657998	6143747			Small dam near turbines on southern section. Dam was surrounded by exotic grasses (quite long). Due to recent rain the whole area was quite wet making it good for frogging and reasonable habitat			

Frog 3	0.5	658720	6142640			Creek crossing on Black Range Road where proposed transmission line would cross. Quite grassy road verge with a number of large eucalypts. Upstream there is a patch of rush/sedges in the creek providing reasonable habitat for frogs.			
Reptile 1	0.5	659761	6145469			Proposed site of the eastern most turbines, limited habitat for reptiles, habitat included rocks/outcrops, fallen timber/logs and grassy understorey/groundcover.			9.11.05
Reptile 2	1	658386	6145414			On top of ridge at the beginning of Transect B, habitat included rocky outcrops, fallen timber, and grassy patches (with patches of shrub/fern also).			9.11.05
Reptile 3		658431	6145365			similar to Reptile 2 transect/plot.			9.11.05
Reptile 4	1.5	658012	6145076			On top of ridge adjacent to Transect A. Poor habitat for small mammals. Habitat includes: scattered fallen dead trees (remnants of original woodland), rocky with large outcrops near top of ridge (near tower). Couple of large crevices that may provide potential habitat for bats, however no evidence of bat activity.			10.11.05
Reptile 5	0.5	658567	6143367			On knoll where 2 proposed turbines are located, mostly exotic grass however a couple of exposed rocky outcrops are present. Active search amongst rocks (mostly se facing side of hill out of wind).			
Anabat 1		658193	6145328			On top of the ridge adjacent to the road near Transect A			8-9.11.05
Anabat 2		658536	6143358			Anabat targetted a single paddock tree (euc) on top of the ridge on a rocky substrate.			9-10.11.05
Anabat 3		658601	6144144			Setup on agricultural land targetted at trees along a fence line. The data was recored the week after Anabat 1 and 2.			
Bird 1	1	659088	6145642			Along proposed access route/transmission cable to east most turbines. Mostly open pasture with			

						small creek and wet drainage lines along. Scattered paddock trees and fallen timber also present.			
Bird 2	1	658367	6145434			Poor to moderate quality habitat along the ridge top where Transect B runs. There is a small patch of eucalypts with a ferny understorey which provides refuge and shelter for small to medium mammals, birds, frogs and reptiles. Ridge top is again mostly open pasture with a number of rocky outcrops.			
Bird 3	1	658012	6145076			Along Transect A			
Bird 4	1	658267	6143787			Proposed substation location, adjacent or close to 2 small dams with limited vegetation present (rush), very grassy with mostly exotic species present. Very close to a drainage line which was quite wet.			
Bird 5	1	658567	6143367			Along track leading to Springvale homestead, reasonably open pasture with occasional windrows of trees (most of which were native trees). Occasional passock tree present providing limited reasources for most bird species.			
Spotlighting 1	0.5	658012	6145076			8.11.05 Along track leading to trig, along Transect A, spotlight by car therefore covered a large distance			
Spotlighting 2	0.5	658719	6142589	657495	6143215	10.11.05 Spotlight along Black Range Road beginning where the proposed power easement would pass. Mostly road verge strip with box woodland in sections, many large mature hollow bearing eucs present providng good potential nesting, roosting and den sites for bats, possums, owls.			

2.2 Survey results data

Date	Method	Start	End	Observer	Location	Transect	Trap no.	Species	Count	Height	Obs. type	Comment
9.11.05	Elliot trap	8am		KG	gully	B	3	<i>Rattus fuscipes</i>	1		Trapped	Very large
10.11.05	Elliot trap	8am		KG	gully	B	5	<i>Rattus rattus</i>	1		Trapped	
9.11.05	Frogging	9:40pm		KG	F1 small creek			<i>Crinia parinsignifera</i>			Heard	lots of activity, quite common
9.11.05	Frogging	9:40pm		KG	F1 small creek			<i>Limnodynastes peronii</i>			Heard	
9.11.05	Frogging	9:40pm		KG	F1 small creek			<i>Crinia signifera</i>				
9.11.05	Reptile	11:30am	12pm	KG	R1 eastern most turbine location on ridge top, also proposed powerline route			<i>Pogona barbata</i>	1		Seen	thin and inactive, few skinks/lizards in this area, little food available.
9.11.05	Reptile	11:30am	12pm	KG	as above			<i>Tiliqua rugosa</i>	2		Seen	two following each other most likely mating pair
9.11.05	Opportunistic	11:30am	12pm	KG	small gully with creek			<i>Corvus coronoides</i>				
9.11.05	Opportunistic	11:30am	12pm	KG	small gully with creek			<i>Egretta novaehollandiae</i>				
9.11.05	Reptile	1:30pm	2:30pm	KG	R2 on top of ridge near Transect B			<i>Egernia cunninhami</i>	4		Seen	searched amongst rocky outcrops. Moderate quality habitat for reptiles lot of rock cracks, long grass and fallen timber scattered along ridgetop.
9.11.05	Reptile	1:30pm	2:00pm	KG	R2 on top of ridge near			<i>Tiliqua scincoides</i>	1		Seen	basking on rocks

					Transect B							
10.11.05	Reptile	9:30am	11:00am	KG	R4			<i>Egernia cunninhami</i>	3		Seen	range of sizes basking on rocks
10.11.05	Reptile	9:30am	11:00am	KG	R4			<i>Tiliqua nigrolutea</i>	1		Seen	in rock crevice on NE side of hill
10.11.05	Reptile	9:30am	11:00am	KG	Along Transect C			<i>Lampropholis delicata</i>	1		Seen	
10.11.05	Reptile	9:30am	11:00am	KG	Along Transect C			<i>Lampropholis guichenoti</i>	2		Seen	
11.11.05	Reptile	10:30am	11:00am	KG	R5			<i>Egernia cunninhami</i>	2		Seen	basking in sun on rocks
11.11.05	Reptile	10:30am	11:00am	KG	R5			<i>Tiliqua rugosa</i>	1		Seen	in amongst grass
11.11.05	Reptile	10:30am	11:00am	KG	R5			<i>Pseudechis porphyriacus</i>	1		Seen	on main track leading to trig/tower from springvale house.
11.11.05	Opport.	10:30am	11:00am	KG	R5			<i>Gymnorhina tibicen</i>		0		
11.11.05	Opport.	10:30am	11:00am	KG	R5			<i>Aquila audax</i>		20		
11.11.05	Opport.	10:30am	11:00am	KG	R5			<i>Hirundo nigricans</i>		20		
9.11.05	Birding	10:30am		KG	B1			<i>Anthus novaeseelandiae</i>		0		
9.11.05	Birding	10:30am		KG	B1			<i>Cacatua roseicapilla</i>		20		
9.11.05	Birding	10:30am		KG	B1			<i>Gymnorhina tibicen</i>		0		
9.11.05	Birding	10:30am		KG	B1			<i>Aquila audax</i>		0-30		
9.11.05	Birding	10:30am		KG	B1			<i>Taeniopygia bichenovii</i>		0		
9.11.05	Birding	10:30am		KG	B1			<i>Corvus coronoides</i>		20		
9.11.05	Birding	10:30am		KG	B1			<i>Falco cenchroides</i>		20		
9.11.05	Birding	10:30am		KG	B1			<i>Falco berigora</i>		25		two observed

												foraging on ridge top
9.11.05	Birding	10:30am		KG	B1			<i>Oryctolagus cuniculus</i>	numerous		Seen	site seems to have an abundance of rabbits maybe due to the recent fox baiting (bait twice a year with the local area).
9.11.05	Birding	2pm		KG	B2			<i>Gymnorhina tibicen</i>			Seen	
9.11.05	Birding	2pm		KG	B2			<i>Anthus novaeseelandiae</i>			Seen	
9.11.05	Birding	2pm		KG	B2			<i>Egernia cunninghami</i>			Seen	
9.11.05	Birding	2pm		KG	B2			<i>Malurus cyaneus</i>			Seen	
9.11.05	Birding	2pm		KG	B2			<i>Aquila audax</i>			Seen	3 individuals soaring above the ridge line
9.11.05	Birding	2pm		KG	B2			<i>Falco berigora</i>			Seen	2 individuals soaring above the ridge line
9.11.05	Birding	2pm		KG	B2			<i>Vombatus ursinus</i>			scat, burrow	wombat burrows in amongst the ferny patches close to the gully and creek
9.11.05	Birding	2pm		KG	B2			<i>Wallabia bicolor</i>			Seen	amongst the ferny patches on the slopes of the gully
10.11.05	Birding	9am		KG	B3			<i>Aquila audax</i>		0-30	Seen	5 seen flying around
10.11.05	Birding	9am		KG	B3			<i>Cacatua</i>		0-20	Seen	large flock

								<i>roseicapilla</i>				seen moving close to ground
10.11.05	Birding	9am		KG	B3			<i>Gymnorhina tibicen</i>		0	Seen	
10.11.05	Birding	9am		KG	B3			<i>Hieraaetus morphnoides</i>		20	Seen	
10.11.05	Birding	9am		KG	B3			<i>Anthus novaeseelandiae</i>		0	Seen	
10.11.05	Birding	3:40pm		KG	B4			<i>Sturnus vulgaris</i>		10	Seen	large flock of approx. 15
10.11.05	Birding	3:40pm		KG	B4			<i>Turdus merula</i>		10	Seen	
10.11.05	Birding	3:40pm		KG	B4			<i>Gymnorhina tibicen</i>		0	Seen	
10.11.05	Birding	3:40pm		KG	B4			<i>Falco berigora</i>		10	Seen	
10.11.05	Birding	3:40pm		KG	B4			<i>Litoria peronii</i>			Seen	
10.11.05	Birding	3:40pm		KG	B4			<i>Limnodynastes peronii</i>			heard	
10.11.05	Birding	3:40pm		KG	B4			<i>Platycercus elegans</i>		10	seen	
10.11.05	Birding	3:40pm		KG	B4			<i>Hirundo neoxena</i>		10	Seen	
11.11.05	Birding	11am		KG	B5			<i>Hirundo nigricans</i>		10	Seen	
11.11.05	Birding	11am		KG	B5			<i>Gymnorhina tibicen</i>		10	Seen	
11.11.05	Birding	11am		KG	B5			<i>Aquila audax</i>		10	Seen	2 seen flying from the ground heading south quite low to the ground
11.11.05	Birding	11am		KG	B5			<i>Sturnus vulgaris</i>		10	Seen	
11.11.05	Birding	11am		KG	B5			<i>Turdus merula</i>		5	Seen	
11.11.05	Birding	11am		KG	B5			<i>Rhipidura leucophrys</i>		5	Seen	
11.11.05	Birding	11am		KG	B5			<i>Anthochaera chrysoptera</i>		5	Seen	

11.11.05	Birding	11am		KG	B5			<i>Chenonetta jubata</i>		0	Seen	
11.11.05	Birding	11am		KG	B5			<i>Platycercus eximius</i>		0	Seen	
10.11.05	incidental	3pm		KG	transmission easement (sth)			<i>Falco longipennis</i>		20	Seen	seen along proposed power easement
10.11.05	incidental	3pm		KG	transmission easement (sth)			<i>Circus assimilis</i>		20	Seen	seen along proposed power easement
10.11.05	Frogging	9:20pm		KG/BM	F2			<i>Crinia parinsignifera</i>			heard	
10.11.06	Frogging	9:20pm		KG/BM	F2			<i>Lymnodynastes tasmaniensis</i>			heard	
10.11.05	Frogging	10pm		KG/BM	F3			<i>Crinia parinsignifera</i>				
10.11.05	Frogging	10pm		KG/BM	F3			<i>Lymnodynastes tasmaniensis</i>				
8.11.05	Spotlighting	9:45pm		KG/BM	Spotlight 1			<i>Litoria peronii</i>				
8.11.05	Spotlighting	9:45pm		KG/BM	Spotlight 1			<i>Trichosurus vulpecula</i>				
8.11.05	Spotlighting	9:45pm		KG/BM	Spotlight 1			<i>Oryctolagus cuniculus</i>				
8.11.05	Spotlighting	9:45pm		KG/BM	Spotlight 1							
8.11.05	Spotlighting	9:45pm		KG/BM	Spotlight 1			<i>Crinia signifera</i>				
8.11.05	Spotlighting	9:45pm		KG/BM	Spotlight 1			<i>Crinia parinsignifera</i>				
10.11.05	Spotlighting	10am		KG/BM	Spotlight 2			<i>Limnodynastes dumerillii</i>				
10.11.05	Spotlighting	10am		KG/BM	Spotlight 2			<i>Trichosurus vulpecula</i>				
10.11.05	Spotlighting	10am		KG/BM	Spotlight 2			<i>Podargus strigoides</i>				
8.11.05	Opport.				Transect C			<i>Aquila audax</i>		20		3 seen gliding above ridge top

8.11.05	Opport.				Transect B and C			<i>Wallabia bicolor</i>			seen	in amongst the ferns in Transect B and C
8.11.05	Opport.				Transect B and C			<i>Gymnorhina tibicen</i>		20	seen	
8.11.05	Opport.				Transect B and C			<i>Malurus cyaneus</i>		0	seen	
8.11.05	Opport.				Transect B and C			<i>Anthus novaeseelandiae</i>		0	seen	
9.11.05	Opport.				small drainage line/creek near where proposed substation would be located			<i>Threskiornis molucca</i>				flushed from long grass besides the small creek it flew up the creek line towards where the substation would be located.
8-10.11.05	Anabat			KG				<i>Vespadelus regulus/vulturinus</i>				
8-10.11.05	Anabat			KG				<i>Chalinolobus gouldii</i>				
8-10.11.05	Anabat			KG				<i>Nyctinomus australis</i>				

2.3 Survey weather conditions

Date	Method	Start	End	Temp	Cloud	Precip	Moon	Wind	Observer
9.11.05	Elliot Trapping	8am		20	-	-		NW	KG
10.11.05	Elliot Trapping	8am		15	40%				KG
9.11.05	Frogging	9:40pm		22			0.5	NW	KG
9.11.05	Frogging	9:40pm		22			0.5	NW	KG
9.11.05	Frogging	9:40pm		22			0.5	NW	KG
9.11.05	Reptile	11:30am	12pm	25				NW Strong	KG
9.11.05	Reptile	11:30am	12pm	25				NW Strong	KG
9.11.05	Opportunistic	11:30am	12pm	25				NW Strong	KG
9.11.05	Opportunistic	11:30am	12pm	25				NW Strong	KG
9.11.05	Reptile	1:30pm	2:30pm	25	5%			NW Mod	KG
9.11.05	Reptile	1:30pm	2:00pm	25	5%			NW Mod	KG
10.11.05	Reptile	9:30am	11:00am	17	40%			NW Mod	KG
10.11.05	Reptile	9:30am	11:00am	17	40%			NW Mod	KG
10.11.05	Reptile	9:30am	11:00am	17	40%			NW Mod	KG
10.11.05	Reptile	9:30am	11:00am	17	40%			NW Mod	KG
11.11.05	Reptile	10:30am	11:00am	20	20%			NW Mod	KG
11.11.05	Reptile	10:30am	11:00am	20	20%			NW Mod	KG
11.11.05	Reptile	10:30am	11:00am	20	20%			NW Mod	KG
11.11.05	Opportunistic	10:30am	11:00am	20	20%			NW Mod	KG
11.11.05	Opportunistic	10:30am	11:00am	20	20%			NW Mod	KG
11.11.05	Opportunistic	10:30am	11:00am	20	20%			NW Mod	KG
9.11.05	Birding	10:30am		25				NW Mod	KG
9.11.05	Birding	10:30am		25				NW Mod	KG
9.11.05	Birding	10:30am		25				NW Mod	KG
9.11.05	Birding	10:30am		25				NW Mod	KG
9.11.05	Birding	10:30am		25				NW Mod	KG
9.11.05	Birding	10:30am		25				NW Mod	KG
9.11.05	Birding	10:30am		25				NW Mod	KG
9.11.05	Birding	10:30am		25				NW Mod	KG
9.11.05	Birding	10:30am		25				NW Mod	KG
9.11.05	Birding	2pm		25				NW Mod	KG
9.11.05	Birding	2pm		25				NW Mod	KG
9.11.05	Birding	2pm		25				NW Mod	KG
9.11.05	Birding	2pm		25				NW Mod	KG
9.11.05	Birding	2pm		25				NW Mod	KG

9.11.05	Birding	2pm		25				NW Mod	KG
9.11.05	Birding	2pm		25				NW Mod	KG
9.11.05	Birding	2pm		25				NW Mod	KG
10.11.05	Birding	9am		22				NW Mod	KG
10.11.05	Birding	9am		22				NW Mod	KG
10.11.05	Birding	9am		22				NW Mod	KG
10.11.05	Birding	9am		22				NW Mod	KG
10.11.05	Birding	9am		22				NW Mod	KG
10.11.05	Birding	3:40pm		20				NW Mod	KG
10.11.05	Birding	3:40pm		20				NW Mod	KG
10.11.05	Birding	3:40pm		20				NW Mod	KG
10.11.05	Birding	3:40pm		20				NW Mod	KG
10.11.05	Birding	3:40pm		20				NW Mod	KG
10.11.05	Birding	3:40pm		20				NW Mod	KG
10.11.05	Birding	3:40pm		20				NW Mod	KG
10.11.05	Birding	3:40pm		20				NW Mod	KG
10.11.05	Birding	3:40pm		20				NW Mod	KG
11.11.05	Birding	11am		20	20%			NW Mod	KG
11.11.05	Birding	11am		20	20%			NW Mod	KG
11.11.05	Birding	11am		20	20%			NW Mod	KG
11.11.05	Birding	11am		20	20%			NW Mod	KG
11.11.05	Birding	11am		20	20%			NW Mod	KG
11.11.05	Birding	11am		20	20%			NW Mod	KG
11.11.05	Birding	11am		20	20%			NW Mod	KG
11.11.05	Birding	11am		20	20%			NW Mod	KG
11.11.05	Birding	11am		20	20%			NW Mod	KG
10.11.05	incidental	3pm		20				NW Mod	KG
10.11.05	incidental	3pm		20				NW Mod	KG
10.11.05	Frogging	9:20pm		11			0.5	NW Mod	KG/BM
10.11.06	Frogging	9:20pm		11			0.5	NW Mod	KG/BM
10.11.05	Frogging	10pm		11			0.5	NW Mod	KG/BM
10.11.05	Frogging	10pm		11			0.5	NW Mod	KG/BM
8.11.05	Spotlighting	9:45pm		20	10%		0.5	NW Mod	KG/BM
8.11.05	Spotlighting	9:45pm		20	10%		0.5	NW Mod	KG/BM
8.11.05	Spotlighting	9:45pm		20	10%		0.5	NW Mod	KG/BM
8.11.05	Spotlighting	9:45pm		20	10%		0.5	NW Mod	KG/BM
8.11.05	Spotlighting	9:45pm		20	10%		0.5	NW Mod	KG/BM
8.11.05	Spotlighting	9:45pm		20	10%		0.6	NW Mod	KG/BM
10.11.05	Spotlighting	10am		11			0.5	NW Mod	KG/BM

10.11.05	Spotlighting	10am		11			0.5	NW Mod	KG/BM
10.11.05	Spotlighting	10am		11			0.5	NW Mod	KG/BM
8.11.05	Opportunistic								
8.11.05	Opportunistic								
8.11.05	Opportunistic								
8.11.05	Opportunistic								
8.11.05	Opportunistic								
9.11.05	Opportunistic								
8-10.11.05	Anabat								KG
8-10.11.05	Anabat								KG
8-10.11.05	Anabat								KG

APPENDIX C: THREATENED SPECIES EVALUATION

1. Threatened flora

A number of threatened flora species have potential distribution ranges covering the study area. These species, their known distribution and habitat requirements and their likelihood of being present at the subject site are identified in Table C1 below. The list is based on NPWS Atlas records, Bionet records, previous survey results and the Commonwealth Protected Matters search tool.

Table C1 Threatened flora recorded from the Yass 1:100,000 map sheet area or with potential ranges covering the study area

Species	Status*	Habitat and distribution	Potential to occur at site
<i>Ammobium craspedioides</i> Yass Daisy FABACEAE	V EPBCv	Perennial daisy growing in sclerophyll woodland, forest and roadsides, confined to Yass district. Numerous Atlas records in district including along Black Range Road, Burrinjuck Road and Hume Highway. Recorded at site in northern valley zone.	High Recorded at site
<i>Caladenia</i> sp Burrinjuck Burrinjuck Spider Orchid ORCHIDACEAE	V EPBCv	An undescribed terrestrial orchid recorded growing in dry open forest (including <i>E. goniocalyx</i> , <i>E. dives</i> , <i>E. macrorhyncha</i> , <i>E. mannifera</i> , <i>E. rossii</i>) with a shrubby understorey, in Burrinjuck Waters State Park and Nature Reserve, c. 15 km south-west of the site. Flowers late August-October. Potential habitat exists in remnant forest patches on the Ferndale property. Would not have been detectable during the survey.	Moderate
<i>Calotis glandulosa</i> Mauve Burr-daisy ASTERACEAE	V EPBCv	A low forb which grows in montane or subalpine grassland or grassy woodland on the tablelands and western slopes, including disturbed areas. The species is perennial and distinctive and should have been detectable if present.	Low
<i>Diuris pedunculata</i> Small Snake Orchid ORCHIDACEAE	E EPBCe	Terrestrial orchid favouring grassland, often in stony soils on low ridges or moist flats. Recorded in south-east tablelands at higher elevations (>1000m ASL) at Adaminaby, Bago State Forest and Snowy Plains. Flowers late November at Snowy Plains (J. Miles, pers. obs.).	Low
<i>Diuris tricolor</i> (syn. <i>D. sheaffiana</i>) ORCHIDACEAE	V EPBCv	Sporadically distributed from Narrandera across the western slopes to northern NSW, usually in grassy <i>Callitris</i> woodland on sandy soils in flat country or on top of small hills. Soils at the site are clay-loam and the usual range of this species is well to the west. There is a 1906 record from the Goulburn area.	Low
<i>Goodenia macbarronii</i> Narrow Goodenia GOODENIACEAE	V EPBCv	An annual herb growing in damp sandy soils on the tablelands and slopes, including disturbed sites such as grazed paddocks and roadside drains. Flowers Oct-Mar. Not recorded on clay-loam soils of the subject site.	Low
<i>Grevillea iaspicula</i> PROTEACEAE	E	Restricted to limestone outcrops. Recorded south of Burrinjuck reservoir c. 15 kilometres south of the site.	Low
<i>Leucochrysum albicans</i> ssp <i>albicans</i> var <i>tricolor</i> Hoary Sunray ASTERACEAE	EPBCe	A widespread perennial herb growing in a range of habitats from peaty upland to stony plains, including grassy woodlands, on the southern tablelands and central western slopes. Sensitive to grazing. Flowers	Moderate

Species	Status*	Habitat and distribution	Potential to occur at site
		spring-summer. Not recorded during survey.	
<i>Prasophyllum petilum</i> Tarengo Leek Orchid ORCHIDACEAE	E EPBCe	Recorded from grassy woodland in Hall cemetery, c. 50km south-east of the site, Booroowa 40km north of the site and Captains Flat. Grows in remnant <i>Themeda</i> grassland on silty clay-loam flats. The Hall and Captains Flat populations occur in areas with high watertables. Flowers Oct-Nov.	Low-moderate
<i>Rutidosia leptorhynchoidea</i> Button Wrinklewort ASTERACEAE	E EPBCe	A multi-stemmed perennial herb restricted to natural grassland and margins of grassy woodland. Recorded near Sutton, c. 30km SE of the site.	Low
<i>Senecio garlandii</i> ASTERACEAE	V	Largely restricted to dry forests on western slopes of NSW, growing on rocky outcrops and exposed ridges. Main distribution is well west of the site, but a record exists near Burrinjuck Dam c. 20 km south-west of the site.	Low
<i>Swainsona sericea</i> Silky Purple Pea FABACEAE	V	A declining small perennial pea recorded in grassland and grassy woodland from the northern to southern tablelands, and western slopes and plains. Flowers Oct-Dec. Not recorded during survey.	Moderate
<i>Swainsona recta</i> Small Purple Pea FABACEAE	E EPBCe	A declining small perennial pea recorded on the central and south west slopes and the ACT/Queanbeyan area. It occurs in grassy woodland on undulating terrain, often stony hillsides and flowers in spring (peaking Oct).	Low-moderate
<i>Thesium australe</i> Austral Toad-flax SANTALACEAE	V EPBCv	A sprawling perennial herb growing in grassland and woodland, semi- parasitic on grasses, particularly kangaroo grass. Shows a preference for moist areas. Isolated <i>Themeda</i> populations are present, but are sparse, small and heavily disturbed, and are not likely to provide suitable habitat.	Low

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

Based on the above analysis, four threatened species have a moderate or high potential of being present in the study area:

Yass Daisy (*Ammobium craspedioides*)

A sizeable a population (hundreds) was observed on the Waldren property, over the fence immediately north of the northern valley survey zone (NV), near McCullums Creek, north of a line between AGD 659024 6145691 and AGD 659335 6145635.

Two plants were recorded within the survey zone, at AGD 658901 6145625 and AGD 658889 6145630. The survey zone had lower and sparser groundcover than the Waldren property presumably due to greater grazing pressure. In surveys conducted in Booroowa Shire to the north, all of the occurrences of this species were on land characterised by a light grazing regime (NPWS 2002).

The species is also scattered in roadside remnants beside Black Range Road, east from AGD 660976 6143223. Some of these occurrences are recorded in the Wildlife Atlas and Bionet databases.

This species and its habitat at the site are shown on Photographs 9-10 and mapped on Figure 4.2.

Burrinjuck Spider Orchid (*Caladenia* sp Burrinjuck)

This species has potential habitat in small remnant stands of dry shrub forest on the Ferndale property, within the powerline survey area and west of the southern turbine sites (refer Photographs 19-24 and Figure 2.1). This community is broadly analogous to known habitats in Burrinjuck Nature Reserve to the south (NPWS 2003). The species flowers from late August to October and would not have been recordable at the time of the survey. The disturbance history, continuing grazing pressures and highly restricted distribution of the species reduces the likelihood of its presence at the site.

Hoary Sunray (*Leucochrysum albicans* ssp *albicans* var *tricolor*)

Hoary Sunray is widespread, though uncommon in the Southern Tablelands region and is not listed as threatened in NSW. The species is sensitive to grazing but persists on road verges in some areas. It is a large conspicuous daisy and the survey coincided with the flowering period for this species. It was not recorded during the survey, and is likely to have been detected if present at the subject site. The long grazing history of farmland in the study area further reduces the likelihood of its presence at the site.

Silky Purple Pea (*Swainsona sericea*)

Potential habitat for this species exists in remnant grassy woodland understorey in the northern valley (NV) and Black Range Road powerline (BR) survey zones. However, given the high level of disturbance at the sites, and the failure to record the species during the survey, the chances of the species being present at the site are greatly reduced. This species would have been flowering at the time of survey, and should have been visible in the low sward in the northern valley zone (NV), had it been present.

In addition, two species have low-moderate potential to occur at the site:

- Tarengo Leek Orchid (*Prasophyllum petilum*)
- Small Purple Pea (*Swainsona recta*)

The Tarengo Leek Orchid and Small Purple Pea may not have been flowering or obvious at the time of survey. The three known populations of *P. petilum* occur in areas which have not been subjected to long term or sustained grazing pressure (Hall and Captains Flat cemeteries and the Tarengo Travelling Stock Reserve near Booroowa). It is possible that this species persists on private land in the region which has not been heavily grazed (NPWS 2002).

At the Tarengo TSR, the Tarengo Leek Orchid grows in remnant *Themeda triandra*-*Bothriochloa macra* grassland (NPWS 2002). These grass species are present at the Northern Valley survey zone, but in low abundance. The site is dominated by *Microlaena stipoides* and *Austrodanthonia* species, consistent with a history of high grazing pressure. Given this grazing history, and the highly restricted known distribution of both *Prasophyllum petilum* and *Swainsona recta* it is considered unlikely that either of these species would occur at the site. Nonetheless, the presence of other grazing sensitive orchid species at the site leaves open the rather remote possibility that *P. petilum* and *S. recta* may persist. Safeguards have been identified in section 4.3 to account for this possibility. Photographs and descriptions of these species are included in Appendix H.

The Yass Daisy and Burrinjuck Spider Orchid have been included in the Assessment of Significance presented in Appendix D.

The Hoary Sunray and Silky Purple Pea have not been included because they were not detected at the subject site during the survey, despite their being perennial, reasonably conspicuous and with a flowering period coincident with the timing of the survey. The Tarengo Leek Orchid and Small Purple Pea are not included in the Assessment of Significance because of their low likelihood of being present at the site.

2. Threatened fauna

No fauna species that are listed as endangered or vulnerable on Schedule 1 or 2 of the *Threatened Species Conservation Act 1995* were recorded at the subject site during the survey. One species, the Superb Parrot, was recorded beside Black Range Road 3 kilometres to the east of the study area (AGD 662800 6145705), in remnant Box-Gum Woodland beside the road.

The threatened species known to occur in the region, their habitat requirements and the likelihood of their utilising habitat available at the subject site route are identified in Table C2. Habitat, ecology and distribution information is drawn from DEC (2005) except where otherwise cited. Local distribution records are sourced from the Wildlife Atlas, Bionet and survey fieldwork.

Table C2 Threatened fauna recorded in the Atlas or Bionet within the Yass 1:100,000 map sheet, identified by the EPBC search tool or whose range includes the study area

Species	Class*	Habitat requirements and study area suitability	Potential to occur at site
Squirrel Glider <i>Petaurus norfolcensis</i>	V	Inhabits dry sclerophyll forest and woodland, distributed largely along the east coast and immediate inland districts. Feeds on insects, nectar and exudates from leaves and trees (<i>Eucalyptus</i> and <i>Acacia</i>). Potential habitat is present at the site, although marginal due to loss of hollows and fragmentation. No local records. Not recorded at the site.	Low
Eastern Pygmy Possum <i>Cercartetus nanus</i>	V	Occurs at elevations of 300m to above 1,000m. In southern NSW, this species is principally recorded in drier forest and heath, often with a diverse shrubby ground cover. Myrtaceous trees, Banksia and hollows are potential resources for this species. Potential habitat is not present at the site. No local records. Not recorded at the site.	Low
Koala <i>Phascolarctos cinereus</i>	V	Consumes a diverse range of eucalypts. In Booroowa Shire to the north, koalas have been recorded at very low densities recorded in Scribbly Gum (<i>E. rossii</i>), Red Stringybark (<i>E. macrorhyncha</i>) and Bundy (<i>E. goniocalyx</i>) forest). Degraded and very small patches of these forests occur at the site, but habitat is generally isolated and heavily fragmented. Recorded east of Yass, c.25km E of the site, and Booroowa Shire to the north (Atlas), and 25km S of the site (Bionet). Not recorded at the site.	Low
Tiger or Spotted-tailed Quoll <i>Dasyurus maculatus</i>	V EPBCe	<i>Dasyurus maculatus</i> is found in a variety of forest types, although generally preferring moister environments such as rainforest and wet sclerophyll forest (Victorian Department of Conservation & Environment 1992). Large areas of undisturbed habitat which provide a variety of key food and other resources such as large hollow logs, or small caves at ground level for dens are required. Potential habitat is present at the site, but marginal due to clearing and fragmentation. Recorded near Yass (Bionet), and Burrinjuck NR, c.17km SW of the site (Atlas). Not recorded at the site.	Low
Smoky Mouse <i>Pseudomys fumeus</i>	E EPBCe	The Smoky Mouse appears to prefer heathy ridge tops and slopes within sclerophyll forests, heathland and open forest from the coast to sub-alpine regions. Habitats are characterised by a diverse array of shrub species predominantly from the pea and heath families. The site does not contain suitable habitat. No local records. Not recorded at the site.	Low

Species	Class*	Habitat requirements and study area suitability	Potential to occur at site
Great Pipistrelle <i>Falsistrellus tasmaniensis</i>	V	Roosts and breeds in large trees, in a range of habitats including dry and wet sclerophyll forest, appearing to prefer wet sclerophyll (Hall and Richards 1979). The site may contain potential foraging habitat, but unlikely to provide hollows for roosting/breeding. No close local records. Recorded in Mungongo SF c.40km SW of the site. Not recorded at the site.	Low
Little Pied Bat <i>Chalinolobus picatus</i>	V	Occurs in dry open forest, open woodland, mulga woodlands, chenopod shrublands, cypress-pine forest, mallee, bimbil box. Roosts in caves, rock outcrops, mine shafts, tunnels, tree hollows and buildings. Needs access to nearby open water. Feeds on moths and possibly other flying invertebrates. Potential habitat is present at the site, but may be marginal due to the ephemeral nature of water sources and the paucity of local roost habitat. Recorded near Bowning, c.13km NE of the site.	Moderate
Yellow-bellied Sheath-tail-bat <i>Saccolaimus flaviventris</i>	V	Little is known of the biology of this species other than that it roosts in tree hollows, and is presumed to forage above the tree canopy, since it is seldom trapped (Richards, in Strahan, 1983). The site is within its distribution and may provide foraging habitat, probably marginal due to the extent of clearing. Few tree hollows are present at the subject site. Recorded in Booroowa Shire to the north (NPWS 2002).	Low-moderate (foraging)
Large-footed Myotis <i>Myotis adversus</i>	V	This species roosts in small colonies in caves, mines, buildings and under bridges, and forages for aquatic invertebrates and small fish over water bodies ranging from small streams and dams to reservoirs (Richards, in Strahan 1983, Parnaby 1992). Water bodies are small and mostly ephemeral at the subject site. Recorded near Wee Jasper, c.30km S of the site (Bionet).	Low
Eastern Long-eared bat <i>Nyctophilus timoriensis</i>	V EPBCv	Inhabits a variety of vegetation types, including mallee, bullocke but more commonly box/ironbark/cypress-pine. Slow flying agile bat, utilising the understorey to hunt non-flying prey - especially caterpillars and beetles - and will even hunt on the ground. The species roosts in tree hollows, and under loose bark. Fissures are present in scattered live and dead trees at the site, but understorey is largely modified. No local records.	Low-moderate
Eastern Bent-wing Bat <i>Miniopterus schreibersii</i>	V EPBCcd	Found in a wide range of habitats, but is constrained by its requirement for caves, man-made tunnels or stormwater channels in which it breeds (Strahan et al. 1995). Typically, the species forages in well timbered habitats, above the tree canopy (Dwyer, in Strahan et al 1995). The area has rock crevices in ridge outcrops, but these are small and exposed and are unlikely to provide suitable roost sites. Marginal forage habitat may be present. Maternity caves located at Wee Jasper, 30 km to the south (ABS 2000). Karst areas are also present at Hattons Corner (3km SW of Yass and Deeringullen Creek (6km NW of Yass). Recorded south of Lake Burrinjuck, c.10km S of the site (Atlas), in Wee Jasper NR, Black Andrew NR and Booroowa Shire to the north (NPWS 2002).	Moderate
Square-tailed Kite <i>Lophoictinia isura</i>	V	Preferred habitat is open eucalypt forest and woodland (Schodde & Tiedemann 1986). The species hunts for passerine birds in the tree tops of the forest (Klippel 1992). Habitat at the site is marginal due to scarcity of forest cover. Recorded near Yass and Binalong (Bionet). Not recorded at the site.	Low-moderate

Species	Class*	Habitat requirements and study area suitability	Potential to occur at site
Grey Falcon <i>Falco hypoleucos</i>	V	This species inhabits open woodland in inland Australia, and occurs only sporadically east of the Great Dividing Range (Simpson & Day 1989). Most breeding now confined to arid parts of the range. Believed to be extinct in areas with more than 500mm rainfall in NSW. No local records. Not recorded at the site.	Low
Powerful Owl <i>Ninox strenua</i>	V	Breeding pairs defend large (up to 1000 ha), permanent territories in the coastal and montane eucalypt forests (Blakers et al. 1984), usually centred around gullies (Fleay 1968). Nests in large tree hollows (Emison et al. 1987). Arboreal mammals form about 80% of the diet of this species (birds form most of the rest), with the Common Ringtail Possum, Greater Glider and Sugar Glider being the most favoured species (Blakers et al. 1984). The local forest fragments are likely to be too small and the prey population too low to provide suitable habitat for this species. Recorded in Burrinjuck NR, c.17km SW of the site (Atlas). Not recorded at the site.	Low
Barking Owl <i>Ninox connivens</i>	V	Preys on mammals, birds and invertebrates, taking animals as large as rabbits (Schodde & Tideman 1986). Each pair occupies a 30-200 hectare territory, depending on habitat quality. Inhabits drier forest and woodland, and has been recorded persisting around human habitation. Requires large tree hollows for nesting and an abundance of prey species. Habitat is likely to be marginal at site due to paucity of natural woodland and forest habitat. Moderate potential in far south of site. Recorded in Black Andrew NR c.25km SW of the site. Not recorded at the site.	Moderate
Gang-gang Cockatoo <i>Callocephalon fimbriatum</i>	V	Feeds in pairs or small flocks on seeds of eucalypts and wattles, primarily in forest, but occasionally towns and farming areas for artificial food resources such as berry-bearing exotic shrubs. It is a seasonal altitudinal migrant. Nesting is in large tree hollows. Forage habitat is present in forest and woodland remnants in the study area, and nesting habitat may be present in surrounding areas. Recorded at Binalong, c. 10km NW of the site and Burrinjuck NR c.17km to the SW (Atlas). Not recorded at the site.	Moderate
Superb Parrot <i>Polytelis swainsonii</i>	V EPBCv	Nesting habitat on SW Slopes is often open Box-Gum Woodland or isolated paddock trees. Species known to be used are Blakely's Red Gum, Yellow Box, Apple Box and Red Box. Nest in small colonies, often with more than one nest in a single tree. Breed between September and January. May forage up to 10 km from nesting sites. Feed in trees and understorey shrubs and on the ground and their diet consists mainly of grass seeds and herbaceous plants. West of Yass forms part of core breeding population in region. Migrates north in winter to the upper Namoi and Gwydir Rivers. Numerous records exist north of the site, the closest are near Bookham, 7km to the W, and near the Hume Highway, 6km to the N (Atlas). Also recorded beside Black Range Road during survey, 3 km east of the site (AGD 662800 6145705). Not recorded at the site.	High

Species	Class*	Habitat requirements and study area suitability	Potential to occur at site
Swift Parrot <i>Lathamus discolor</i>	E EPBCe	A non-breeding winter migrant to southern and eastern NSW, where it inhabits eucalypt forests and woodlands (Blakers et al 1984). Feeds on eucalypt blossom and psyllids. Habitat is marginal over most of site due to clearing. Moderate potential in far south of site, where the winter-flowering Long-leaved Box provides a potential food source. Recorded in Booroowa Shire to the north (NPWS 2002). Not recorded at the site.	Moderate
Turquoise Parrot <i>Neophema pulchella</i>	V	Feeds on grass and herb seeds and nests in holes in trees or stumps. Normally occupies the edges of eucalypt woodland where it has access to grassy areas. Tends to prefer sheltered valleys amongst rocky hills (Klippel, 1992). Habitat is marginal at the site due to pasture improvement and paucity of nest habitat, but may be better in surrounding areas. No local records. Not recorded at the site.	Low-moderate
Olive Whistler <i>Pachycephala olivacea</i>	V	Strongly favours dense closed habitats, particularly riparian tea tree thickets (Blakers et al. 1984, Emison et al. 1987). In NSW, the species occurs in sub-alpine, montane and coastal areas (Blakers et al 1984). Suitable habitat is not present at the site. No local records. Not recorded at the site.	Low
Diamond Firetail <i>Stagonopleura guttata</i>	V	In NSW, occurs predominantly west of the Great Dividing Range, although populations are known from drier coastal areas (Blakers et al. 1984, Schodde & Mason 1999). Feeds predominantly on the ground on grass seeds, in groups from 5 to 150 individuals (Schodde & Tidemann 1986), nesting in pairs or communally in shrubs and small trees. Restricted largely to ungrazed or lightly grazed woodland remnants of grassy eucalypt woodlands, including Box-Gum and Snow Gum Woodlands, and grassland and riparian areas, and sometimes lightly wooded farmland. May form large flocks during winter and autumn. Recorded c.14km NE of the site (Atlas) and Wee Jasper (Bionet). Not recorded at the site.	Moderate
Hooded Robin <i>Melanodryas cucullata</i>	V	Widespread, occurring in pairs or solitary in lightly timbered country (Schodde & Tidemann 1986). Spends much of its time on the ground in woodland foraging for insects. It frequents places with dead trees and fallen timber (Schodde and Tidemann 1986), nesting on dead limbs or stumps. Established pairs keep to their territory of 10-20 hectares. Populations are unable to survive in remnants smaller than 100-200 hectares (NPWS 2004b). Habitat is unlikely to be suitable at the site due to understorey disturbance, scarcity fallen timber over most of the site and loss of woodland and forest cover. Recorded in Booroowa Shire to the north (NPWS 2002). Not recorded at the site.	Low
Speckled Warbler <i>Chthonicola sagittata</i>	V	Inhabits woodlands and dry forests, generally in inland Australia, particularly those with grassy understorey, often on ridges or gullies. Sedentary, living in pairs or trios and nests on the ground in grass tussocks, dense litter and fallen branches. Forage on the ground and in the understorey for arthropods and seeds. Occupy small remnants, but are yet to be recorded breeding in revegetated areas (Greening Australia in NPWS 2002). Requires relatively intact woodland areas with litter and fallen timber. The cleared and fragmented habitat at the site is unlikely to be suitable. Recorded in Booroowa Shire to the north (NPWS 2002). Not recorded at the site.	Low

Species	Class*	Habitat requirements and study area suitability	Potential to occur at site
Brown Treecreeper <i>Climacterus picumnus</i>	V	Occurs in eucalypt woodlands, mallee and drier open forest of eastern Australia, preferring woodlands lacking dense understorey (Schodde & Tidemann 1986). Feeds on insects in the leaf litter and trunks of trees. Nests in tree hollows, stumps or rotted fence posts. Requires relatively intact woodland areas, nesting in a tree hollow. The cleared and fragmented habitat at the site is unlikely to be suitable. Recorded in Black Andrew NR c.25km SW of the site (Bionet) and Booroowa Shire to the north (NPWS 2002). Not recorded at the site.	Low
Grey-crowned Babbler <i>Pomatostomus temporalis</i>	V	Inhabits grassy woodland, open forest and scrublands. Forages and breeds in family groups with large territories, building several characteristic football sized nests in low branches and tall shrubs. Modified habitats at the site may be suitable but are likely to be marginal given the range of this species. Recorded in Booroowa Shire to the north (NPWS 2002). Not recorded at the site.	Low
Black-chinned Honeyeater <i>Melithreptus brevirostris</i>	V	Rare and declining, occupying taller drier eucalypt woodlands and forests and timber along watercourses, often without understorey, typically in ironbark forests Pizzey 1985). Feeding territories are large making the species locally nomadic. Tends to occur in the largest woodland patches in the landscape as birds forage over large home ranges of at least 5 hectares. The cleared and fragmented habitat at the site is unlikely to be suitable. Recorded in Booroowa Shire to the north (NPWS 2002). Not recorded at the site.	Low
Painted Honey-eater <i>Grantiella picta</i>	V	Rare and declining, occupies open eucalypt forest and woodland, and timber along watercourses. Specialist feeder on mistletoe fruit, prefers genus <i>Amyema</i> . Inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. Habitat at the site may be suitable, but very marginal given the level of clearing and fragmentation. No local records. Not recorded at the site.	Low
Regent Honeyeater <i>Xanthomyza phrygia</i>	E EPBCe	Distributed through the eastern third of New South Wales, where it inhabits eucalypt forests and woodlands (Blakers et al. 1984). A generalist forager, feeding mainly on the nectar from a wide range of eucalypts (particularly prolifically flowering box and ironbark species) and mistletoes but also eats invertebrates and exotic fruits (Blakers et al. 1984). Key eucalypt species include Yellow Box and Blakely's Red Gum, Red Box and Red Stringybark, which occur locally. Nectar and fruit from <i>Amyema</i> mistletoes are also eaten during the breeding season. Potential habitat is present at the site, although confined to remnant woodland/forest areas. Recorded at Binalong, c.10km NW of the site (Atlas), in Wee Jasper NR 30km S of the site and east of Yass c.33km E of the site (Bionet). Not recorded at the site.	Moderate
Blue-billed Duck <i>Oxyura australis</i>	V	Requires wetland habitats, preferring well vegetated freshwater swamps, large dams, lakes (Pizzey & Knight 1997). Recorded south of Murrumbateman (Bionet). Not recorded at the site.	Low
Australian Painted Snipe <i>Rostratula benghalensis australis</i>	E EPBCv	Little is known of the behaviour of this cryptic waterbird. May be nomadic as it has been observed occupying ephemeral wetlands. Seeds and invertebrates are foraged for on the waters edge. Habitat may be marginal given the small and modified nature of the wetland communities. No local records. Not recorded at the site.	Low-moderate

Species	Class*	Habitat requirements and study area suitability	Potential to occur at site
Magpie Goose <i>Anseranas semipalmata</i>	V	A wetland species, only vagrant in southern NSW. Suitable habitat does not occur on the site. No local records. Not recorded at the site.	Low
Little Whip Snake <i>Suta flagellum</i>	V	Known distribution is bounded by Crookwell in the north, Cooma in the south, Tumbarumba to the west and Braidwood to the east. Most of the records of the species come from near the eastern edge of Lake George. Inhabits grasslands and eucalypt woodlands, particularly well drained stony hillsides. Nocturnally active, feeds on small skinks and invertebrates. Shelters under rocks or logs laying on the soil. Potential habitat may be present at the site, although habitat is likely to be marginal due to general clearing and habitat loss throughout the district. No local records. Not recorded at the site.	Low-moderate
Eastern Earless Dragon <i>Tympanocryptis pinguicolla</i>	E EPBCe	Found in naturally treeless native tussock grassland on black clay, brown clay loams, and podzolic soils (Cogger et al. 1993). It prefers ungrazed or lightly grazed grasslands on gentle slopes dominated by wallaby grasses, spear grasses, Snow Grass, and Kangaroo grass. Recorded from the ACT, Cooma, Bathurst, SE Qld. The disturbed secondary grasslands at the site are unlikely to provide suitable habitat. No local records. Not recorded at the site.	Low
Pink-tailed Legless Lizard <i>Aprasia parapulchella</i>	V EPBCv	Inhabits open grassland habitats that have a substantial cover of small rocks (Osborne & Jones 1995). Show a preference for sunny aspects, avoiding S facing slopes, only at sites with good numbers of invertebrates under rocks (Barrer 1992). Most sites have relatively open vegetation (Osborne & McKergow 1993), including grassland sites supporting no native grasses. Shelters under small rocks which are exposed to sunlight and shallowly embedded in the soil. Known from four sites in eastern Australia: near Canberra in the ACT, Tarcutta and Bathurst in NSW, and near Bendigo in Vic. The disturbed secondary grasslands at the site are unlikely to provide suitable habitat. No local records. Not recorded at the site.	Low
Striped Legless Lizard <i>Delma impar</i>	V EPBCv	Inhabits temperate lowland grasslands and secondary grasslands, including some areas dominated by introduced species (such as <i>Phalaris aquatica</i> , <i>Nasella trichotoma</i> and <i>Hypochaeris radicata</i>), and sites with a history of grazing and pasture improvement (Coulson 1995; Dorrough 1995; Smith & Robertson 1999). Shelters in grass tussocks, thick ground cover, soil cracks, under rocks, spider burrows, and under ground debris such as timber. Feeds on arthropods, most commonly wolf spiders, jumping spiders, crickets, grasshoppers, Lepidopteran larvae and cockroaches. Suitable habitat may be present at the site, although habitat is may be marginal due to low levels of vegetation cover, steep topography and history of heavy grazing. Recorded near Yass, c. 18 km E of the site (Atlas). Not recorded at the site.	Low-moderate
Booroolong Frog <i>Litoria booroolongensis</i>	E	Typically inhabits rocky western-flowing creeks and their headwaters, although a small number of animals have also been recorded in eastern-flowing streams. Suitable habitat is not present at the site. Recorded in Black Andrew NR c.25km SW of the site (Bionet). Not recorded at the site.	Low

Species	Class*	Habitat requirements and study area suitability	Potential to occur at site
Yellow-spotted Bell-frog <i>Litoria castanea</i>	E EPBCe	Requires large permanent ponds or slow flowing streams with plenty of emergent vegetation such as bulrushes. Not recorded in the wild since the 1970s. Suitable habitat is not present at the site. Recorded near Gundaroo, c.45km SE of site (Bionet). Not recorded at the site.	Low
Golden Sun Moth <i>Synemon plana</i>	E EPBCce	A day-flying moth inhabiting native grasslands and Box-Gum Woodlands. Populations separated by distances of greater than 200m are effectively isolated. Larvae are thought to feed almost exclusively on Wallaby grass (<i>Austrodanthonia</i> spp.) roots. Bare ground between the tussocks is thought to be an important microhabitat feature. Distributed between Queanbeyan, Gunning, Young and Tumut. Suitable habitat appears to be present at the Northern Valley site. Recorded in Booroowa Shire, to the north (NPWS 2002). Not recorded at the site.	Moderate

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

The assessment presented in Table C2 has identified that parts of the subject site have at least moderate potential to provide habitat for eight threatened fauna species:

Mammals

Little Pied Bat

Eastern Bent-wing Bat

Invertebrates

Golden Sun Moth

Birds

Barking Owl

Superb Parrot

Swift Parrot

Gang-gang Cockatoo

Diamond Firetail

Regent Honeyeater.

The potential impact of the proposal on these species is assessed in an Assessment of Significance presented in Appendix D.

APPENDIX D: ASSESSMENT OF SIGNIFICANCE (NSW)

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

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

Endangered ecological communities

The Endangered Ecological Community White Box Yellow Box Blakely's Red Gum Woodland (Box-Gum Woodland) was recorded at one location during the flora survey undertaken for the Conroys Gap wind farm project.

Threatened flora species

One threatened species was recorded during the flora survey; the Yass Daisy (*Ammobium craspedioides*) listed as vulnerable under the TSC Act.

Three further threatened species were assessed as having moderate or high potential to be present in the study area; the Burrinjuck Spider Orchid (*Caladenia* sp Burrinjuck), the Silky Purple Pea (*Swainsona sericea*) and the Hoary Sunray (*Leucochrysum albicans* ssp *albicans* var *tricolor*).

The Hoary Sunray and Silky Purple Pea were not detected at the subject site during the survey, despite their being perennial, reasonably conspicuous and with a flowering period coincident with the timing of the survey. For this reason, they have not been included in the Assessment of Significance.

An additional two species have low-moderate potential to occur at the site; the Tarengo Leek Orchid (*Prasophyllum petilum*) and the Small Purple Pea (*Swainsona recta*). Although these species are unlikely to be present, measures to account for the possibility of their presence have been identified in section 4.3 of the Biodiversity Assessment. Photographs and descriptions of these species are provided in Appendix H.

Threatened fauna species

The assessment of habitat requirements of threatened fauna species and habitat values present in the study area identified nine threatened fauna species which have at least a moderate potential of being present in habitat at the subject site. These species include 2 microchiropteran bat species, six bird species and one invertebrate.

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

THREATENED FLORA SPECIES

Yass Daisy (*Ammobium craspedioides*)

Distribution and conservation

The Yass Daisy is a rare perennial herb, 30-60 centimetres high, inhabiting sclerophyll woodland, forest and roadsides (Harden 1992). It bears yellow button-like flowers in spring, and early summer in wet years. The Yass district is the centre of distribution for this species (Fallding 2002), and most records are confined to the district. Other records exist from near Crookwell (DEC 2005) and in Livingstone State Forest, 20 kilometres south of Wagga Wagga (Burrows 1999).



The species has been recorded in dry forest, Box-Gum Woodland and secondary grassland derived from clearing of these communities. Associated eucalypts include *Eucalyptus blakelyi*, *E. bridgesiana*, *E. dives*, *E. goniocalyx*, *E. macrorhyncha*, *E. mannifera*, *E. melliodora*, *E. polyanthemos* and *E. rubida*. It appears to be unaffected by light grazing, with some populations persisting in grazed sites (DEC 2005). In surveys conducted in the Booroowa Shire to the north, all of the occurrences of this species were on land characterised by a light grazing regime (NPWS 2002).

West of Yass, the species is scattered in less disturbed roadside remnants beside Black Range Road, east from AGD 660976 6143223. Local records from the Bionet database (which combines NSW Herbarium and NPWS Wildlife Atlas records) are shown in Figure D1. These records include some of the occurrences observed beside Black Range Road between the study area and Yass, a further concentration to the south-west near Burrinjuck Road, and an occurrence near the Hume Highway to the north of the subject site.

Current threats to the species include agricultural developments, intensification of grazing regimes, invasion of weeds, road works (particularly widening or re-routing) and inappropriate mowing or slashing in cemetery sites (DEC 2005). The principal recovery actions required involve:

- the protection known populations from changes to land use, road works, pasture modification, increased grazing pressures, weeds and inappropriate mowing regimes;
- marking sites and potential habitat onto maps used for farm, development and conservation planning and management; and
- searching for new populations in potential habitat (after DEC 2005).

Survey area occurrences

Two individuals of the vulnerable Yass Daisy (*Ammobium craspedioides*) were recorded within the Northern Valley survey zone, in the McCullums Creek catchment. The plants were recorded at AGD 658901 6145625 and AGD 658889 6145630, growing in a moist area of remnant Box-Gum Woodland understorey dominated by the grasses *Microlaena stipoides* and *Austrodanthonia* spp. The graminoid *Schoenus apogon*, and the herbs *Drosera peltata*, *Isotoma fluviatilis*, *Craspedia variabilis*, *Brachyscome ptychocarpa*, *Hydrocotyle peduncularis*,



Figure D2 Distribution of the Yass Daisy in the survey area

Bulbine bulbosa and *Thelymitra nuda* are patchily abundant, particularly in seepage areas. The Yass Daisy and its habitat at the site are shown on Photographs 9-10 and mapped on Figure 4.2 in the Biodiversity Assessment, and its local distribution in the study area is shown on Figure D2.

A sizeable Yass Daisy population (hundreds) was also observed on the Waldren property, over the fence to the immediate north of the above site, occupying the lower slopes of the McCullums Creek valley north of a line between AGD 659024 6145691 and AGD 659335 6145635. The occurrences of the Yass Daisy at the site in relation to the proposed overhead cable route are shown on Figure D2.

The Box-Gum Woodland habitat at the site has been degraded by grazing over a long period. An extended period of drought preceded the spring of the flora survey, which would have resulted in a progressive loss of vegetation cover and exposed soils to erosion. There remain moderate levels of soil exposure in some areas and evidence of extensive sheet erosion, particularly on steeper eastern slopes. The watercourse and tributary drainage lines have been incised, with active nick points close to the recorded Yass Daisy locations (refer Photograph 9).

The two Yass Daisy plants at the subject site may be relict from a former colony covering the site, or more likely have dispersed from the parent population on the Waldren property, around 50 metres to the north. The security of the species is probably tenuous at the subject site, which is more degraded and has apparently experienced greater grazing pressure than the property to the north (at least in recent times).

Proposal impacts

The proposal would not directly affect the northern valley (McCullums Creek) Yass Daisy occurrences. This area was removed from the proposal in light of the results of biodiversity, visual and noise assessments. Measures would be adopted to protect this area from the peripheral and indirect impacts of the development. The proposal would not adversely affect the

life cycle of this species such that a viable local population is likely to be placed at risk of extinction.

BURRINJUCK SPIDER ORCHID (*CALADENIA* SP BURRINJUCK)

This species has potential habitat in small remnant stands of dry shrub forest on the 'Ferndale' property, within the powerline survey zone and west of the proposed southern turbine sites. This forest community is broadly analogous to known habitats in Burrinjuck Nature Reserve to the south (NPWS 2003). The species flowers from late August to October and would not have been recordable at the time of the survey. The disturbance history, continuing grazing pressures and highly restricted distribution of the species reduces the likelihood of its presence at the site.

The powerline would be positioned to avoid the remnant stand of Long-leaved Box forest at AGD 658540 6140095 (Photograph 19). The southern turbines would also be sited to avoid the need to clear or trim trees in remnants to the immediate west. Safeguards have been included in section 4.3 to ensure that peripheral or indirect impacts do not adversely affect potential habitat for the Burrinjuck Spider Orchid in these remnants. The proposal would not adversely affect the life cycle of this species such that a viable local population is likely to be placed at risk of extinction.

THREATENED FAUNA SPECIES

MICROCHIROPTERAN BATS

Habitat and ecology	Potential life cycle impacts
Little Pied Bat Occurs in dry open forest, open woodland, mulga woodlands, chenopod shrublands, cypress-pine forest, mallee, Bimbil box. Roosts in caves, rock outcrops, mine shafts, tunnels, buildings and possibly tree hollows. Roost together in small groups of 20 to 40 bats. Needs access to nearby open water. Feeds on moths and possibly other flying invertebrates. Potential habitat is present at the site, but may be marginal due to the ephemeral nature of water sources and the paucity of local roost habitat. Recorded near Bowning, c.13km NE of the site.	The proposal has the potential to remove roosting habitat (tree hollows and fissures) and introduce a threat from bladestrike. It is also possible that the noise and turbulence around turbines may preclude species from using adjacent areas or may interfere with the echolocation used to navigate. Risks would increase if prey species fly at blade height, if prey is attracted to lights or reflection on the turbine structure and if the foraging range from roost sites is large. Measures to reduce the attractiveness of the site to prey are included in section 5.3. Susceptibility to collision with blades appears to vary with microbat species. The specific vulnerability of this species to collision is not known. The proposal would not involve the removal of maternity, over-wintering or roosting habitat. Given the extent of habitat loss in the district, utilisation of the study area by any local population could be expected to be low and concentrated around larger forest/woodland remnants. For these reasons, the proposal is not expected to significantly affect this species.
Eastern Bent-wing Bat Found in a wide range of habitats, but is constrained by its requirement for caves, man-made tunnels or stormwater channels in which it breeds (Strahan et al. 1995). In Australia, virtually always roost in caves. Each population uses a single maternity site. Other caves extending for several hundred kilometres from the maternity site are used the rest of the year (ABS 2000). Typically, the species forages in well timbered habitats, above the tree canopy (Dwyer, in Strahan et al 1995). The area has rock crevices in ridge outcrops, but these are small and exposed and are unlikely to provide suitable roost sites. Marginal forage habitat may be present. Maternity caves located at Wee Jasper, 30km to the south (ABS	The proposal has the potential to introduce a threat from bladestrike. Risks would increase if prey species fly at blade height, if prey is attracted to lights or reflection on the turbine structure and if the foraging range from roost sites is large. Risks would increase if prey species fly at blade height, if prey is attracted to lights or reflection on the turbine structure and if the foraging range from roost sites is large. Measures to reduce the attractiveness of the site to prey are included in section 5.3. Susceptibility to collision with blades may vary with species. The specific vulnerability of this species to collision is not known. The proposal would not involve the removal of maternity, over-wintering or roosting habitat. Given the extent of habitat loss in

Habitat and ecology	Potential life cycle impacts
2000). Recorded south of Lake Burrinjuck, c.10km S of the site (Atlas) and Booroowa Shire to the north (NPWS 2002).	the district, utilisation of the study area by any local population could be expected to be low and concentrated around larger forest/woodland remnants. For these reasons, the proposal is not expected to significantly affect this species.

BIRDS

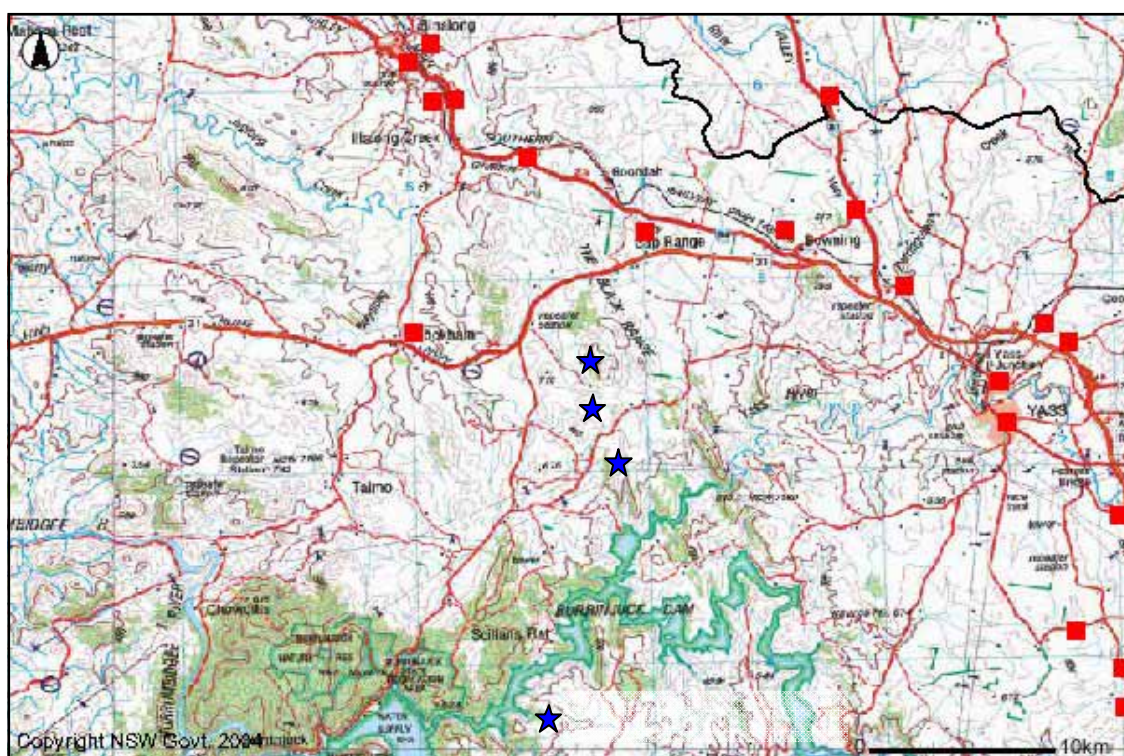
Species and ecology	Potential life cycle impacts
Barking Owl A top order predator with a varied diet and large home range. Preys on mammals, birds and invertebrates, taking animals as large as rabbits (Schodde & Tideman 1986). Each pair occupies a 30-200 hectare territory, depending on habitat quality (Blakers et al. 1984), although this remains speculative (NPWS 2003b). Inhabits drier forest and woodland, and has been recorded persisting around human habitation. Requires large tree hollows for nesting and an abundance of prey species. Declining in NSW (NPWS 2003b). Recorded in Black Andrew NR c.25km SW of the site. Not recorded at the site.	The species may forage and nest in remnant forest near the south of the subject site, although habitat is likely to be marginal for breeding because of a paucity of hollow-bearing trees. There is a risk of bladestrike. The species hunts for arboreal mammals and birds within the tree canopy and for rabbits and other prey on the ground (NPWS 2003b). The canopy height of forest and woodland remnants around the site range from 5 to 15 metres, well below the potential bladeswept zone of 34-126 metres. The species is unlikely to enter the bladeswept zone during these hunting flights. The Bird Risk Assessment concludes that the proposal would not significantly affect this species at the population level (Appendix F). Adaptive measures would be adopted if mortalities or nest disturbances are found to occur following construction.
Superb Parrot Nesting habitat on SW Slopes is often open Box-Gum Woodland or isolated paddock trees. Species known to be used are Blakely's Red Gum, Yellow Box, Apple Box and Red Box. Nest in small colonies, often with more than one nest in a single tree. West of Yass forms part of core breeding population in region. Breed between September and January. Migrates north in winter to the upper Namoi and Gwydir Rivers. Little is known about seasonal migration routes; it is assumed that they move west and then north after the breeding season (A. Manning, CRES, pers. comm.). Feeds in trees and understorey shrubs and on the ground and their diet consists mainly of grass seeds and herbaceous plants. May forage up to 10 km from nesting sites although at some sites, including those north of Canberra, the nesting and foraging areas coincide and the birds move very little distance at all during breeding (Webster and Ahern 1992, Martin 1996, Davey 1997 in Act Government 1999). The Superb Parrot avoids open areas on foraging flights, hence simple fragmentation of the habitat can be devastating (DNRE 1992). While Superb Parrots use woodland remnants as corridors, they rarely cross extensive open ground (Webster 1988, Davidson and Chamber 1992, Webster and Ahern 1992, Higgins 1999). Numerous records exist north of the site, the closest are near Bookham, 7km to the W, and near the Hume Highway, 6km to the N (Atlas) (refer Figure C3). Recorded beside Black Range Road, 3 km east of site (AGD 662800 6145705).	This species may forage for seeds and plant material at the subject site, or fly over ridges between habitat areas. Feeding areas and flying routes are however more likely to correspond with valleys and low hills with tree cover and the remnant woodland strip along Black Range Road. Three individuals were observed beside Black Range Road several kilometres east of the study area during the survey period; none were observed in the vicinity of the turbine sites. Winter migration routes are also likely to follow woodland remnants in valleys and on low hills. The proposal site is one of the most extensively cleared areas in the district. Because of the extent of clearing, the turbine sites are unlikely to provide quality foraging habitat for the Superb Parrot. The proposal site is the most extensively cleared area in the district. Because of the extent of clearing, the turbine sites are unlikely to provide quality foraging habitat for the Superb Parrot. Superb Parrots have been observed flying high over open areas in the South-West Slopes. However, they do tend to occur more in the lower elevation/relief parts of the landscape where the Box-Gum Woodlands, including scattered paddock trees, are located - this is where nest trees and food is likely to occur (A. Manning, CRES, pers. comm.). No flight height data is available for this species; a variety of other parrot species are known to fly at turbine blade height at times, although the great majority of recorded flights are from below that zone (Biosis Research 2006). The frequency of flights high over the turbine ridgetops is likely to be low. The absence of intact woodland vegetation with hollow-bearing trees and watercourses in close proximity to the turbines would mean that the risk of nest abandonment due to visual or noise disturbance would be low. The Bird Risk Assessment concludes that the proposal would not significantly affect this species at the population level

Species and ecology	Potential life cycle impacts
	(Appendix F). Adaptive measures would be adopted if mortalities or nest disturbances are found to occur following construction.
Swift Parrot A small fast-flying nectarivorous parrot. It is a non-breeding winter migrant to southern and eastern NSW, where it inhabits eucalypt forests and woodlands (Blakers et al 1984). Feeds on eucalypt blossom and psyllids, particularly large prolifically flowering trees. Favours box-ironbark and box-gum woodland habitats, White Box, Mugga Ironbark and Grey Box woodland on NSW western slopes (Swift Parrot Recovery Team 2001). Migratory routes and durations of residency are likely to be variable depending on food supplies. Habitat is marginal over most of site due to clearing. Moderate potential in far south of site, where the winter-flowering Long-leaved Box provides a potential food source. Recorded in Booroowa Shire (NPWS 2002). Not recorded at the site.	The species may use habitat in the far south of the site, although Long-leaved Box stands are generally regrowth and heavily fragmented. Better habitat is likely to be present in timbered lowland areas. No flight height data is available for this species; a variety of other parrot species are known to fly at turbine blade height at times, although the great majority of recorded flights are from below that zone (Biosis Research 2006). Flights between roost and foraging areas are likely to be at tree canopy level. The Bird Risk Assessment concludes that the proposal would not significantly affect this species at the population level (Appendix F). Adaptive measures would be adopted if mortalities or nest disturbances are found to occur following construction.
Gang-gang Cockatoo Feeds in pairs or small flocks on fruits, and seeds of eucalypts and wattles, primarily in forest, but occasionally towns and farming areas for artificial food resources such as berry-bearing exotic shrubs. It is a seasonal altitudinal migrant, inhabiting tall montane forests and woodlands in summer, particularly in heavily timbered and mature wet sclerophyll forests (Frith 1969). In winter, the species occurs at lower altitudes in drier, more open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas (Shields and Crome 1992). Nesting is between October and January in large tree hollows, usually in tall mature sclerophyll forests that have a dense understorey, and occasionally in coastal forests. Nests are most commonly recorded in eucalypt hollows in live trees close to water (Beruldsen 1980). The species has declined dramatically in NSW, possibly due to reduction in hollows (Scientific Committee). Marginal forage habitat is present in forest and woodland remnants in the study area, and nesting habitat may be present in surrounding areas. Recorded at Binalong, c. 10km NW of the site and Burrinjuck NR c.17km to the SW (Atlas).	This species is unlikely to frequent the turbine ridges for foraging due to scarcity of eucalypts. Gang-gangs may pass over ridgelines at blade height on longer-distance flights. Frequency of visit to the turbine sites likely to be low. The Bird Risk Assessment concludes that the proposal would not significantly affect this species at the population level (Appendix F).
Diamond Firetail In NSW, occurs predominantly west of the Great Dividing Range, although populations are known from drier coastal areas (Blakers et al. 1984, Schodde & Mason 1999). Feeds predominantly on the ground on grass seeds, in groups from 5 to 150 individuals (Schodde & Tidemann 1986), nesting in pairs or communally in shrubs and small trees. Ground foraging woodland birds like the Diamond Firetail are highly selective with respect to microhabitat and preferred foraging sites (Antos 2001). Restricted largely to ungrazed or lightly grazed	The proposal would not significantly affect nesting or foraging habitat for this species. While most time is spent foraging on or close to the ground, the tendency of the Diamond Firetail to flock when dispersing may place local populations, if they occur at the site, at risk of collision with wind turbines. Winter and autumn would be times where greatest risk is posed by turbines as individuals tend to amalgamate that this time and therefore flocks are at their largest. The species is unlikely to regularly or frequently use cleared ridgetop habitat for foraging. Nest predators, such as Currawongs and Ravens are present at the site. The works would not involve tree clearing and

Species and ecology	Potential life cycle impacts
woodland remnants of grassy eucalypt woodlands, including Box-Gum and Snow Gum Woodlands, and grassland and riparian areas, and sometimes lightly wooded farmland. May form large flocks during winter and autumn. Resources required by this species include adequate areas of native grasses which are not prevented from seeding by grazing pressure, and remnant trees or shrubs in which the nest of grasses can be placed, usually in a tall shrub, eucalypt sapling, mistletoe clump or in the canopy of a larger tree (Beruldsen 1980). Research in grazing landscapes in southern NSW suggests that granivores prefer to move along densely vegetated areas (Fischer and Lindenmayer 2002a). Diamond Firetails are considered to have poor dispersal abilities and are likely to be less common away from tree cover. The treeless, exposed habitat at the turbine ridges is marginal. Recorded c.14km NE of the site (Atlas) and Wee Jasper (Bionet).	would not affect the survivorship of Diamond Firetails by increasing predator access. The Bird Risk Assessment concludes that the proposal would not significantly affect this species at the population level (Appendix F).
Regent Honeyeater Distributed through the eastern third of New South Wales, where it inhabits eucalypt forests and woodlands (Blakers et al. 1984). It is migratory or nomadic, following the flowering of its principal feed species. A generalist forager, feeding mainly on the nectar from a wide range of eucalypts (particularly prolifically flowering box and ironbark species) and mistletoes but also eats invertebrates and exotic fruits (Blakers et al. 1984). Key eucalypt species include Yellow Box and Blakely's Red Gum, Red Box and Red Stringybark, which occur locally. Nectar and fruit from <i>Amyema</i> mistletoes are also eaten during the breeding season. Research in grazing landscapes in southern NSW showed a pronounced trend for nectarivores to move along densely vegetated areas, and using the same route for return journeys (Fischer and Lindenmayer 2002a). Potential habitat is present at the site, although confined to remnant woodland/forest areas. Recorded at Binalong, c.10km NW of the site (Atlas) and east of Yass c.33km E of the site (Bionet).	The proposal would not affect nesting or feeding habitat for this species. This species may be placed at risk of bladestrike, although flight paths are more likely to be along valleys, roadside remnant corridors and over low hills than the high ridges of the proposed turbine sites. The Bird Risk Assessment concludes that the proposal would not significantly affect this species at the population level (Appendix F).

INVERTEBRATES

Species and ecology	Potential life cycle impacts
Golden Sun Moth A day-flying moth inhabiting native grasslands and Box-Gum Woodlands. A poor disperser, populations separated by distances of greater than 200m are effectively isolated. Larvae are thought to feed almost exclusively on Wallaby grass (<i>Austrodanthonia</i> spp.) roots. Bare ground between the tussocks is thought to be an important microhabitat feature. Distributed between Queanbeyan, Gunning, Young and Tumut. Suitable habitat appears to be present at the Northern Valley site. Recorded in Booroowa Shire, to the north (NPWS 2002).	This species may be present in remnant grassy Box-Gum Woodland understorey in the Northern Valley flora survey area. This area would not be directly impacted by the works and measures would be adopted to prevent indirect or peripheral impacts to Golden Sun Moth habitat in the study area. If present, the impact on the Golden Sun Moth or its habitat is unlikely to be significant in terms of nature or extent.



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

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

- c) *In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:***
- (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or***
 - (ii) Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.***

The Endangered Ecological Community White Box Yellow Box Blakely's Red Gum Woodland (Box-Gum Woodland) was recorded at one location in the survey area; the valley floor and lower slopes comprising the Northern Valley survey zone (refer Figure 4.2 in the Biodiversity Assessment). The structure and floristic composition of the community has been modified by the clearing of tree cover and grazing over a long period, but remains dominated by native grassy woodland species characteristic of the EEC. The presence of several disturbance-sensitive species suggests that the soil seed bank may be intact and the site may have good understorey recovery potential. The community is shown in Photographs 9-10.

The full extent of the EEC was not determined during the survey, but possibly includes the upper valley extending north from the subject site onto the neighbouring Waldren property and south to a narrowing of the valley. This upper valley area occupies around 40 hectares. South (downstream) of this area, the community would eventually be replaced by the largely exotic pasture which dominates the more fertile lowland areas on the properties.

The proposal would not be directly affect this EEC area, and measures would be adopted to prevent indirect or peripheral impacts. The proposal is not likely to adversely affect the EEC such that its local occurrence is likely to be placed at risk of extinction.

- d) *In relation to the habitat of a threatened species, population or ecological community:***
- (i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and***
 - (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and***
 - (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.***

YASS DAISY

The proposal would not be directly affect the northern valley Yass Daisy population or potential habitat, and measures would be adopted to prevent indirect or peripheral impacts. No adverse habitats impacts are anticipated.

BOX-GUM WOODLAND EEC

The proposal would not be directly affect the northern valley Box-Gum Woodland EEC or potential habitat, and measures would be adopted to prevent indirect or peripheral impacts. No adverse habitats impacts are anticipated.

THREATENED FAUNA

Key threatened fauna habitat features in the study area include mature woodland and forest tree cover, remnant Box-Gum Woodland understorey and modified wetland habitats. The proposal would not result in the removal of a significant area of these potential threatened fauna habitat

features. Specific measures would be implemented to protect remnant forest and woodland vegetation and hollow-bearing trees.

The operation of the wind turbines has the potential to create a barrier between habitat areas, exacerbating existing levels of habitat fragmentation. The threatened bird and invertebrate fauna species which have potential to be present at the site are dependent on remnant woodland habitats, and are unlikely to use the cleared high ridge habitats occupied by the turbines for foraging or dispersal. Precise bird and microbat migration routes at the site are not known, but woodland species dependent on tree cover (such as the Diamond Firetail, Regent Honeyeater, Gang-gang Cockatoo and Superb Parrot) could be expected to use scattered trees and remnant patches as 'stepping stones'.

The proposal is unlikely to result in the loss or fragmentation of threatened fauna habitat.

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

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

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

A draft recovery plan has been prepared for the Burrinjuck Spider Orchid (*Caladenia* sp Burrinjuck) (NPWS 2003). Proposed recovery objectives and actions include the rehabilitation and protection of known populations, monitoring and researching known populations, and surveying for additional populations in the Burrinjuck reserves and adjacent private property. The proposal would not conflict with these objectives and actions.

A draft recovery plan has also been prepared for the Tarengo Leek Orchid (*Prasophyllum petilum*) (NPWS 2003), which is assessed as having a low to moderate potential of being present in the survey area. The plan actions include surveys for additional populations, monitoring, researching, protecting and extending known populations, and evaluating approaches to establish ex-situ populations. The proposal would not conflict with these objectives and actions.

A draft Recovery Plan has been prepared for the Barking Owl (NPWS 2003b). The plan assumes that all cases of individual mortality and nest failure are significant for the population. Actions in the plan include survey and research, vegetation management and nest site protection. The proposal, the assessment process and mitigation measures are consistent with the objectives and actions contained in this plan.

A national recovery plan has been prepared for the Swift Parrot (Swift Parrot Recovery Team 2001). Among other things, the plan aims to reduce the incidence of collisions with man-made structures.

Collisions with chain-link fences, cars and windows are a significant cause of mortality during the breeding season (Swift Parrot Recovery Team 2001). These collisions occur mainly in urban areas where concentrated foraging occurs at native and introduced flowering eucalypts, particularly when natural food supplies are low because of drought or other factors. These conditions would not apply at the proposed wind farm site, where foraging would occur well below blade height and foraging resources would not be so concentrated. To date, no wind farms have been implicated in Swift Parrot collisions (Biosis Research 2006). The proposal would not conflict with this or other elements of the recovery plan.

No current Threat Abatement Plans are relevant to the proposal.

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

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

The power powerline passing over Black Range Road and through the 'Ferndale' property would be located to avoid patches of remnant forest and woodland. The turbine sites and proposed substation/control building sites are largely cleared of trees. The construction of the turbines and substation/control building would require the removal of pasture dominated by native grasses; these assemblages are depauperate, are likely to be abundant on ridges and slopes elsewhere in the district and have relatively low conservation value. The proposal is not likely to contribute significantly to the operation of clearing as a threatening process at the local or regional level.

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

The invasion of native vegetation by exotic perennial grass is a further Key Threatening Process relevant to this proposal. The Box-Gum Woodland EEC in particular is vulnerable to the introduction and spread of perennial grasses such as African Love Grass, Serrated Tussock, Couch, Kikuyu, Whisky Grass, Cocksfoot, Yorkshire Fog, Sweet Vernal Grass, Carpet Grass, Parramatta Grass and Paspalum. Section 4.3 identifies safeguards to minimise risks from these weed species, and the proposal is not expected to significantly increase the impact of this Key Threatening Process in the study area.

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

Conclusion

An Endangered Ecological Community and habitat for one threatened flora species, potential habitat for nine threatened fauna species and potential habitat for a range of wind farm-sensitive bird species occur in the area surveyed for the wind farm proposal.

Specific safeguards have been incorporated into sections 4.3 and 5.3 to avoid and minimise impacts to these values, including the finescale siting of components, the protection of forest remnants and hollow-bearing trees, weed hygiene and control, soil and water quality protection, appropriate rehabilitation measures, and structural and operational measures to reduce risks to birds and bats.

The Assessment of Significance has concluded that the proposal is not likely to significantly affect threatened species or communities, either directly or indirectly. Specifically, the proposal would not be likely to:

- reduce the long-term viability of a local population of threatened species, populations or ecological communities;
- accelerate the extinction of the species, population or ecological community or place it at risk of extinction; or
- adversely affect critical habitat.

APPENDIX E: ASSESSMENT OF SIGNIFICANCE (COMMONWEALTH)

E 1. Matters of National Environmental Significance search report (biodiversity components)

- based on 30km buffer around proposal site
- report generated November 2005

Wetlands of International Significance (Ramsar Sites)

Fivebough and Tuckerbil Swamps Within same catchment as Ramsar site

Threatened Ecological Communities	Status	Type of Presence
Grassy White Box Woodlands	Endangered	Community may occur within area
Natural Temperate Grassland of the Southern Tablelands of NSW and the Australian Capital Territory	Endangered	Species or species habitat likely to occur within area

Threatened Species	Status	Type of Presence
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Birds

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

Fishes

Maccullochella peelii peelii* Murray Cod, Cod, Goodoo	Vulnerable	Species or species habitat may occur within area
Macquaria australasica * Macquarie Perch	Endangered	Species or species habitat may occur within area

Insects

Synemon plana * Golden Sun Moth	Critically Endangered	Species or species habitat likely to occur within area
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Mammals

Dasyurus maculatus maculatus (SE mainland population)	Endangered	Species or species habitat likely to occur within area
Nyctophilus timoriensis (South-eastern form) Eastern Long-eared Bat	Vulnerable	Species or species habitat may occur within area
Pseudomys fumeus * Koonoom, Smoky Mouse	Endangered	Species or species habitat may occur within area

Reptiles

Aprasia parapulchella * Pink-tailed Worm-lizard	Vulnerable	Species or species habitat likely to occur within area
Delma impar * Striped Legless Lizard	Vulnerable	Species or species habitat likely to occur within area

Plants

Ammobium craspedioides * Yass Daisy	Vulnerable	Species or species habitat likely to occur within area
Caladenia concolor * Crimson Spider-orchid, Maroon Spider-orchid	Vulnerable	Species or species habitat likely to occur within area
Diuris sheaffiana * Tricolour Diuris	Vulnerable	Species or species habitat may occur within area
Goodenia macbarronii * Narrow Goodenia	Vulnerable	Species or species habitat likely to occur within area
Grevillea iaspicula * Wee Jasper Grevillea	Endangered	Species or species habitat likely to occur within area
Thesium australe * Austral Toadflax, Toadflax	Vulnerable	Species or species habitat likely to occur within area

Migratory Species Status Type of Presence

Migratory Terrestrial Species

Birds

Haliaeetus leucogaster White-bellied Sea-Eagle	Migratory	Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail	Migratory	Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher	Migratory	Breeding likely to occur within area
Xanthomyza phrygia Regent Honeyeater	Migratory	Species or species habitat likely to occur within area

Migratory Wetland Species

Birds

Gallinago hardwickii Latham's Snipe, Japanese Snipe	Migratory	Species or species habitat may occur within area
Rostratula benghalensis s. lat. Painted Snipe	Migratory	Species or species habitat may occur within area

Listed Marine Species Status Type of Presence

Birds

Apus pacificus Fork-tailed Swift	Listed - overfly marine area	Species or species habitat may occur within area
Ardea alba Great Egret, White Egret	Listed - overfly marine area	Species or species habitat may occur within area
Ardea ibis Cattle Egret	Listed - overfly marine area	Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe	Listed - overfly marine area	Species or species habitat may occur within area

Haliaeetus leucogaster White-bellied Sea-Eagle	Listed	Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail	Listed - overfly marine area	Species or species habitat may occur within area
Lathamus discolor Swift Parrot	Listed - overfly marine area	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater	Listed - overfly marine area	Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher	Listed - overfly marine area	Breeding likely to occur within area
Rostratula benghalensis s. lat. Painted Snipe	Listed - overfly marine area	Species or species habitat may occur within area

Places on the RNE

Note that not all Indigenous sites may be listed.

Natural

Derringullen Creek Area NSW

Hattons Corner Area NSW

Lake Burrinjuck Grevillea iaspicula Site 1 NSW

Lake Burrinjuck Grevillea iaspicula Site 2 NSW

Upper Lake Burrinjuck Area NSW

E2. EPBC Act Assessment of Significance

A proponent must refer a proposal to the Commonwealth Minister for the Environment if they believe that the proposal will have, or is likely to have, a significant impact on a matter of national environmental significance, unless the proposal is covered by an exemption specified in the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The EPBC Act Principal Significant Impact Guidelines (DEH 2005a) identify a series of criteria to be taken into account in deciding whether a development is likely to significantly affect threatened species and communities, and migratory species listed in the Act. The Draft Supplementary Significant Impact Guidelines 2.1.3 (DEH 2005b) provide additional guidance in relation to wind farm proposals.

The following assessment is based on the requirements of the EPBC Act and relevant policy guidelines. The assessment should be read in conjunction with the Assessment of Significance under the NSW EP&A Act (Appendix D), and the Bird Impact Risk Assessment (Appendix F) which contain background in relation to species ecology, species and community distribution and scale, specific development impacts, and impact risks.

The Threatened Species Evaluation in Appendix C assesses the potential for threatened species to be present at the proposal site, based on available habitat, known ecological requirements and local distribution records. Species which have at least a moderate potential to occur at the proposal site are included in the Assessment of Significance.

Endangered ecological communities (EECs)

The flora survey recorded remnant vegetation attributable to the Endangered Ecological Community Grassy White Box Woodland (referred to in the Biodiversity Assessment as 'Box-Gum Woodland') in the McCullums Creek valley to the east of the subject site. This area has been

removed from the proposal development area in light of biodiversity, visual and noise assessments. The proposal would not directly affect the Box-Gum Woodland EEC area. Indirect impacts from works on the ridgeline to the west would be avoided using a range of mitigation measures including soil erosion and sedimentation control measures, weed hygiene and control and the restriction of vehicle access and materials laydown.

Areas under the proposed powerline and track crossing points on Black Range Road would have originally carried Box-Gum Woodland, but have lost tree cover and are now dominated by exotic species.

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

a) reduce the extent of a community,

The development would not be sited in the Box-Gum Woodland community and would not reduce the extent of the community in the study area.

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

The Box-Gum Woodland community is heavily fragmented and degraded in the locality. The minor clearing of non-EEC ridgetop pasture required for the proposal would not add significantly to the existing level of fragmentation. The powerline and turbines have been sited to avoid the need for tree clearing.

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

The development would not produce direct or indirect impacts to Box-Gum Woodland located near the proposal area. The proposal would not significantly affect any fauna species which perform critical ecological functions for the EEC.

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

The ridgetop turbine excavations have potential to cause soil erosion and sedimentation and chemical pollution in the McCullums Creek valley Box-Gum Woodland EEC. Specific erosion and sedimentation control measures, hazardous spill procedures and site rehabilitation would be used to ensure that soil movement and turbid runoff is contained within the development zone. It is noted that groundwater hydrology and surface flow patterns are already highly modified in the EEC area (refer EAR).

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

The development would not affect species composition in the EEC, including through clearing, harvesting, disease infection, weed invasion or alteration to grazing, burning or flooding regimes.

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

The construction phase of the proposal has the potential to introduce or assist the spread of invasive weed species. These risks would be reduced to acceptable levels through weed hygiene protocols, pre and post works weed control, soil erosion and sedimentation control, effective and timely site rehabilitation and the avoidance of fertiliser use in areas adjacent to the EEC.

Chemical pollution risks would be reduced using chemical spill kits, site sediment control structures and permanent bunding of the turbine sites. The works are not expected to result in significant impacts from weeds or chemical pollution.

g) interfere with the recovery of an ecological community.

The Box-Gum Woodland EEC in McCullums Creek valley adjacent to the site is heavily degraded could be expected to continue to decline under the current management regime. The proposal would not exacerbate existing threatening processes affecting the EEC (including heavy grazing, weed invasion, soil and streambank erosion).

Threatened flora and fauna species

Threatened flora species

One threatened species was recorded in the study area during the flora survey; the Yass Daisy (*Ammobium craspedioides*) listed as vulnerable under the EPBC Act. The Yass Daisy (2 individuals) was recorded in treeless Box-Gum Woodland in the McCullums Creek valley to the east of the development area. The core population, comprising hundreds of plants, is located on neighbouring property to the immediate north of the two recorded plants.

Two further EPBC Act listed threatened species were assessed as having moderate or high potential to be present in the study area (refer Appendix C); the Burrinjuck Spider Orchid (*Caladenia* sp Burrinjuck), and the Hoary Sunray (*Leucochrysum albicans* ssp *albicans* var *tricolor*).

The Burrinjuck Spider Orchid may be present in remnant dry shrub forest on the Ferndale property, near the proposed powerline route and southern turbine sites site. Much of this forest is regrowth and grazing pressures are continuing, reducing the potential for the orchid to occur at the site.

The Hoary Sunray was not detected at the subject site during the survey, despite its being perennial, reasonably conspicuous and with a flowering period coincident with the timing of the survey. For this reason, and because of the heavily degraded nature of potential habitat, it is assumed that this species is not present at the subject site. (The listed Small Purple Pea (*Swainsona recta*) and Tarengo Leek Orchid (*Prasophyllum petilum*) are also considered unlikely to be present, but may not have been flowering or detectable during the survey; measures to account for the possibility of their presence have been included in section 4.3 of the Biodiversity Assessment, with photographs and a description of both species provided in Appendix H).

Threatened fauna species

The assessment of habitat requirements of threatened fauna species and habitat values identified four threatened fauna species listed in the EPBC Act which have at least a moderate potential of being present in habitat in the survey area (refer Appendix C). These species are the:

- Golden Sun Moth;
- Superb Parrot;
- Swift Parrot; and
- Regent Honeyeater.

Potential Golden Sun Moth habitat exists in the Box-Gum Woodland remnant understorey in the McCullums Creek valley, east of the development area. This habitat would not be directly or indirectly affected by the proposal.

Woodland bird species such as the Superb Parrot and Regent Honeyeater may be present in woodland areas with some tree cover in the Conroys Gap locality, but are unlikely to utilise the cleared ridgetop turbine development sites. The winter migrant Swift Parrot may use Long-leaved Box habitat in the far south of the site, but this habitat is marginal due to the regrowth age class and highly fragmented nature of the stands.

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

Threatened flora

The proposal would not affect any threatened flora population directly. Measures would be employed to ensure that indirect and peripheral impacts such as sedimentation and weed introduction do not adversely affect the Yass Daisy plants or habitat in the McCullums Creek valley. No other threatened flora is expected to be present at the subject site.

Similarly, potential Burrinjuck Spider Orchid habitat near the proposed powerline route and southern turbine sites would not be directly affected by the proposal, and would be protected from peripheral or indirect impacts during the construction and operational phases.

Threatened fauna

Golden Sun Moth

The Golden Sun Moth has poor dispersal abilities and is not likely to be affected by the proposal, which is located well outside the potential moth habitat area.

Regent Honeyeater

There is a potential risk that a Regent Honeyeater population may be affected by collisions with turbines and associated infrastructure. The Regent Honeyeater feeds mainly on the eucalypt nectar (particularly prolifically flowering box and ironbark species), but also eats invertebrates and exotic fruits (Blakers *et al.* 1984). Local feed species include Yellow Box, Blakely's Red Gum, Red Box and Red Stringybark. Potential foraging habitat in the study area is confined to remnant woodland/forest areas, and is unlikely to include the largely treeless ridges of the northern turbine sites. Red Box trees are scattered near the southern turbine sites on the Ferndale property, but habitat quality is likely to be poorer than lowland woodland stands carrying a wider range of feed species.

Research in grazing landscapes in southern NSW showed a pronounced trend for nectarivores to move along densely vegetated areas, and using the same route for return journeys (Fischer and Lindenmayer 2002a). On current knowledge, the Regent Honeyeater is considered unlikely to fly high above the turbine ridges, and therefore the risk of blade-strike would be low.

Superb Parrot

There is a potential risk that a local Superb Parrot population may be affected by collisions with turbines and associated infrastructure. West of Yass forms part of the core breeding population of the Superb Parrot. This species nests in September-January in small colonies, using tree hollows in open Box-Gum Woodland or isolated paddock trees. Blakely's Red Gum is the main source of nesting hollows (Davey 1997). Superb Parrot nest trees tend to be close to watercourses (Webster 1988).

The Superb Parrot disperses north in winter to the upper Namoi and Gwydir Rivers (DNRE 1992). Local migration routes are not known.

The species feeds in trees and understorey shrubs and on the ground. Food items are mainly flowers, fruits and seeds, including Yellow Box (*E. melliodora*), Box Mistletoe (*Amyema miquelii*), insect parasites such as lerps, grasses such as Common Wallaby-grass (*Austrodanthonia caespitosa*), numerous wattle species, and introduced plants including cereal grains, barley-grasses (DNRE 1992). Most records in the Yass region are of single birds or pairs. The species may forage up to 10 kilometres from nesting sites (Webster 1988; Garnett 1992a), although north of Canberra the nesting and foraging areas coincide and the birds move very little distance at all during breeding (Webster and Ahern 1992, Martin 1996, Davey 1997 in ACT Government 1999).

The Superb Parrot avoids open areas on foraging flights (DNRE 1992). While Superb Parrots use woodland remnants as corridors, they rarely cross extensive open ground (Webster 1988, Davidson and Chamber 1992, Webster and Ahern 1992, Higgins 1999).

A variety of other parrot species are known to fly at turbine blade height at times, although the great majority of recorded flights are from below that zone (Biosis Research 2006). Superb Parrots have been observed flying high over open areas in the South-West Slopes. However, they do tend to occur more in the lower elevation/relief parts of the landscape where the Box-Gum Woodlands, including scattered paddock trees, are located - this is where nest trees and food are likely to occur (A. Manning, CRES, pers. comm.).

The proposal site is one of the most extensively cleared areas in the district. Because of the extent of clearing, the turbine sites are unlikely to provide quality foraging or migration habitat for the Superb Parrot. The frequency of parrots flying high over the turbine ridgetops, and the risk of blade-strike, are likely to be low.

The absence of intact woodland vegetation with hollow-bearing trees in close proximity to the turbines would mean that the risk of nest abandonment due to visual or noise disturbance would be low.

Swift Parrot

There is a potential risk that a Swift Parrot population may be affected by collisions with turbines and associated infrastructure. The Swift Parrot breeds in Tasmania and Furneaux Group islands, migrating to the mainland in Feb-April, where it becomes nomadic in response to the availability of blossoms and other food (Pizzey 1985). In southern and eastern NSW, it inhabits eucalypt forests and woodlands (Blakers *et al* 1984), feeding on eucalypt blossom and psyllids, particularly large prolifically flowering trees. Food sources and distribution varies year to year. Marginal habitat is present in the far south of the site, where the winter-flowering Long-leaved Box provides a potential food source. The species has been recorded in Booroowa Shire to the north (NPWS 2002).

The species may use habitat in the far south of the site, although Long-leaved Box stands are generally regrowth and heavily fragmented. Better habitat is likely to be present in timbered lowland areas.

No flight height data is available for this species; a variety of other parrot species are known to fly at turbine blade height at times, although the great majority of recorded flights are from below that zone (Biosis Research 2006). Migratory routes and durations of residency are likely to be variable depending on food supplies. Flights between roost and foraging areas are likely to be at tree canopy level. The frequency of flights over the turbine ridges is likely to be low.

A recent cumulative assessment of 39 wind farms located in the distribution range of the Swift Parrot concluded that the combined blade-strike impact of all of these wind farms would not be significant (Biosis Research 2006).

General

A monitoring and adaptive management program would be implemented to provide timely and appropriate responses to any mortality of threatened fauna (refer section 5.3).

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

Threatened flora species

The proposal would not reduce the area of occupancy of any threatened species, including the McCullums Creek valley Yass Daisy population.

Threatened fauna

The proposal would not remove local threatened fauna habitats, including Box-Gum Woodland understorey or hollow-bearing trees. In view of the distance between the turbine sites and potential woodland bird habitats, the proposal is considered unlikely to alienate or fragment woodland habitats, or alter natural life cycle behaviours of woodland fauna species.

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

The proposal would not add to the existing level of fragmentation of threatened flora populations.

If a Golden Sun Moth population persists in the McCullums Creek woodland understorey remnant, it is likely to be isolated from other populations by ridges and improved pastures. The proposal would not divide this population or add to its current level of isolation.

The wind turbines have the potential to create a barrier between habitat areas for bird species, exacerbating existing levels of habitat fragmentation. Woodland habitat of varying quality exists north, east and west of the proposal site.

The Regent Honeyeater, Superb Parrot and Swift Parrot are highly mobile, but dependent on remnant forest and woodland habitat. Precise migration routes at the site are not known, but woodland species dependent on tree cover (such as the Regent Honeyeater and Superb Parrot) could be expected to use scattered trees and remnant patches as 'stepping stones' during migratory or foraging movements.

There are valley areas with scattered trees providing east-west and north-south connectivity within 5 kilometres of the site. Black Range Road provides a linear remnant with tree cover that may be used for woodland bird foraging and dispersal. The proposed powerline and road crossing of Black Range Road would be sited in existing gaps in tree cover. The heavily cleared nature of the involved properties, and the turbine ridges in particular, would appear to make their use for bird migration unlikely.

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

The habitats affected by the proposal are not critical to the survival of any threatened flora or fauna species.

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

The proposal would not affect the reproductive or pollination processes of threatened flora species.

The potential for blade-strike and habitat impacts to affect bird populations is addressed in Appendix F. The assessment concludes that the proposal is not likely to significantly affect local bird species at the population level.

The visual and noise impact of the wind turbines has the potential to disrupt nesting behaviour. Given the distance of the turbines from potential nesting habitats for woodland bird species, the risks of nest abandonment are considered low.

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

The proposal would not remove, degrade, isolate or reduce the availability of threatened species habitat. Specific measures would be implemented to protect the Box-Gum Woodland remnant understorey located downslope of one of the northern turbine ridges. The powerline and southern turbines have been sited to avoid potential threatened species habitat.

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

The proposed works have the potential to introduce or assist the spread of invasive exotic flora, such as Serrated Tussock. These risks would be reduced to acceptable levels through weed hygiene protocols, pre and post works weed control and monitoring, soil erosion and sedimentation control, effective and timely site rehabilitation and the avoidance of fertiliser use in areas adjacent to the EEC.

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

The proposal would not exacerbate threatening processes affecting threatened species potentially present at the site, including habitat loss, degradation, alienation or fragmentation.

The recovery plan has been prepared for the Regent Honeyeater lists the main causes for concern regarding this species:

- specialised habitat requirements,
- significant reductions in extent of habitat,
- demonstrable reduction in habitat quality throughout its range,
- apparent reliance on a small number of favoured sites,
- clear reduction in range in recent decades,
- low population level
- low population densities over a large proportion of the range with aggregations occurring for breeding.

The Plan states that only long-term changes to land management, on both public and private land, will lead to a significant improvement in the status of this species.

The development would not exacerbate known risks or be detrimental to recovery actions. Habitat suitable to the Regent Honeyeater would not be significantly removed or altered by the development.

A national recovery plan has been prepared for the Swift Parrot (Swift Parrot Recovery Team 2001). Among other things, the plan aims to reduce the incidence of collisions with man-made structures.

Collisions with chain-link fences, cars and windows are a significant cause of mortality during the breeding season (Swift Parrot Recovery Team 2001). These collisions occur mainly in urban areas where concentrated foraging occurs at native and introduced flowering eucalypts, particularly when natural food supplies are low because of drought or other factors. These conditions would not apply at the proposed wind farm site, where

foraging would occur well below blade height and foraging resources would not be so concentrated. To date, no wind farms have been implicated in Swift Parrot collisions (Biosis Research 2006). The proposal would not conflict with this or other elements of the recovery plan.

MIGRATORY SPECIES

Of the four migratory terrestrial species indicated as having potential to be present within 30 kilometres of the proposal site by the Search Tool report, the White-throated Needle-tail (*Hirundapus caudacutus*) and Regent Honeyeater (*Xanthomyza phrygia*), have at least moderate potential to use aerial habitat at the proposal site. The significance of potential impacts to the Regent Honeyeater has been addressed above.

The White-throated Needle-tail is a summer migrant to Australia from Asia. It feeds on flying insects, and is frequently sighted over cities. Roosting habits and local migration routes are not known. The species has been recorded in Wee Jasper Nature Reserve, 30 kilometres to the south of the proposal site.

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

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

The development would not substantially modify, destroy or isolate an area of important migratory bird habitat, including White-throated Needle-tail habitat.

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

The development would not result in the introduction or spread of any exotic species harmful to migratory species. Weed hygiene and control and monitoring would ensure that wetland areas are not degraded by weed species introduced during the works.

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

There is potential for the wind turbine collisions to affect local populations of the White-throated Needle-tail. The risk of population level impact is heightened by the flocking behaviour in migrating birds. This species appears readily capable of habituating to artificial structures and humanised landscapes. Mortality rates affecting the lifecycle of a significant proportion of the population are not anticipated.

A monitoring and adaptive management program would be developed and implemented to respond to any unforeseen impacts on this species, and other significant fauna (refer section 5.3).

Conclusion

One Endangered Ecological Community (Box-Gum Woodland) and one threatened flora species (Yass Daisy) were recorded in the survey area, but outside the revised wind farm development zone. There is at least moderate potential for a further two threatened flora species, three threatened fauna species and two migratory species within or close to the proposal site (refer Appendix C).

The proposed works would occur outside the potential terrestrial habitat of threatened flora and fauna species. Threatened species habitat and the EEC located adjacent to the works would be protected from indirect or peripheral impacts.

The proposal has the potential to introduce a hazard to aerial habitat, in the form of blade-strike risk for threatened and migratory bird species. Blade-strike and habitat impact risks for birds have been assessed in detail in Appendix F. In view of the assessed likelihood of these species being present at the site, their likely responses to the wind turbines and the experiences of existing wind farms elsewhere in Australia, the potential for unacceptable mortality rates or habitat impacts is considered low.

A monitoring and adaptive management program would be developed and implemented to ensure appropriate and timely responses to unforeseen mortalities or habitat impacts (refer section 5.3).

APPENDIX F: BIRD IMPACT RISK ASSESSMENT

Introduction

This risk assessment identifies and evaluates risk of significant impact posed by the proposed wind farm development at Conroys Gap in terms of:

- collision with wind turbines, or 'bladestrike'. For these purposes, 'bladestrike' refers to mortality caused by direct collision with turbine blades and by birds being swept down by the wake behind a turbine blade; and
- habitat loss or avoidance caused by the presence of the turbines and associated infrastructure.

The risk assessment is qualitative, combining assessments of likelihood and consequence to produce a final risk assessment of low, moderate or high risk for selected species. Likelihood incorporates biological, behavioural and environmental risk factors. Consequence includes the significance of habitat loss and bladestrike in terms of habitat rarity and importance, population impacts, recovery potential and species conservation status. The risk rating assumes the implementation of relevant mitigation measures described in section 5.3.

The assessment draws on the Interim Standards for Risk Assessment relating to birds and wind farms (Brett Lane and Associates 2005) and the Australian Standards for Risk Assessment (AS/NZS 4360) and Environmental Risk Management (HB203:2000).

The impacts of the proposal on habitat and habitat utilisation are further addressed in section 5.3 of the Biodiversity Assessment. Section 5.3 also presents a review of experiences at wind farms in Australia and overseas and the bird fauna likely to be present at the Conroys Gap site.

A number of factors may operate which affect risk by contributing to either the likelihood of collision with blades, or the significance of the consequence of bladestrike. These factors may be related to particular species, sites or development designs. Some biological/behavioural, population, environmental and development design risk factors are outlined in Box 5.1 in the Biodiversity Assessment.

The risk assessment focuses on bird groups which have been shown to be at particular risk in studies at other wind farms (raptors, waterbirds, migratory species), and rare, threatened or protected species which have potential to be present in the study area (Superb Parrot, Swift Parrot, Diamond Firetail, Regent Honeyeater and the Gang-gang Cockatoo).

Conroys Gap bird impact risk assessment

RAPTORS, OWLS AND FROGMOUTHS

Wedge-tailed Eagle (<i>Aquila audax</i>)		
Risk factors: Observed at site Forages in open country at blade height Large home range Male diving displays Prey source present at turbine sites Low reproductive rate Limited agility		
Behaviour and ecology: Widely distributed in a range of forest and plain habitats, sedentary. Constructs large stick nests in trees. Observed singly, in a pair and as a loose group of five soaring over valleys and ridges at subject site, at 5-50 metres above ground level. Feeds on birds, rabbits, small mammals. Rabbits and lambs are local food sources. Rabbit warrens are present on the turbine ridges. Mortalities for the related Golden Eagle in US due to presence of prey around turbines (Thelander <i>et al.</i> 2003). Turbines with lower blade reaches were most deadly to Golden Eagles. Summer and winter had highest mortality rates (Thelander <i>et al.</i> 2003). Wedge-tailed Eagles have collided with turbines in Tasmania, South Australia and Victoria. Raptors continue to be present within 1 km of the Crookwell I turbines (URS 2004). At Toora (Vic.), Wedge-tailed eagles were regularly observed before and after operations began at this site. Eagles were observed to avoid the turbines by flying around or between them, but not into them (Brett Lane and Associates 2005). During bird behaviour surveys at Codrington, Wedge-tailed eagles were observed to avoid turbines by flying horizontally around them (twice) and turning and not entering the turbine area (Biosis Research 2002). The species has also been observed flying safely between turbines at the Toora wind farm (Wonthaggi EES Panel 2003). Collisions are possible but are not expected to be frequent or in excess of the reproductive and dispersal capacity of the regional population.		
Likelihood of habitat avoidance: possible		Habitat importance: moderate-high
Collision likelihood: rare		Collision consequence: minor-moderate
Overall risk levels	Individuals	moderate
	Population	moderate-high

Little Eagle (<i>Hieraaetus morphnoides</i>)		
Risk factors: Forages in open country at blade height Diving display flights Prey source present at turbine sites		
Behaviour and ecology: Inhabits plains, open woodlands, usually near water, timber along watercourses and lakes (Pizzey 1985). Soars in tight circles. Builds stick nests in trees. Uncommon but widespread. Diet includes carrion and small mammals. Like the Wedge-tailed Eagle, has become dependent on rabbits in many areas. Observed at the subject site soaring c. 20 metres above the ground.		
Likelihood of habitat avoidance: possible		Habitat importance: moderate
Collision likelihood: possible		Collision consequence: minor-moderate
Overall risk levels	Individuals	moderate
	Population	moderate

White-bellied Sea-eagle (<i>Haliaeetus leucogaster</i>)		
Risk factors: Forages at blade height		
Behaviour and ecology: Sedentary or nomadic. Soars in slow majestic circles, rests on prominent trees over rivers, lakes shores. Occurs singly, in pairs or family parties. Hovers low and drops to take fish and waterfowl (Pizzey 1985). Likely habitat occurs well south of the site on Lake Burrinjuck and Yass River. May visit site but frequency is expected to be low.		
Likelihood of habitat avoidance: rare		Habitat importance: insignificant
Collision likelihood: rare		Collision consequence: minor
Overall risk levels	Individuals	low
	Population	low

Australian Kestrel (<i>Falco cenchroides</i>)		
Risk factors: Forages in open country at blade height Family parties play in air currents		
Behaviour and ecology: Sedentary or nomadic. Soars around city buildings and spires (Pizzey 1985). Nests in tree hollows; few hollow-bearing trees are present on the turbine properties, but are scattered in farmland and remnant patches in the district. Have been known to collide with aircraft when hunting at airports, but have a relatively rapid reproductive rate (URS 2004). The species is relatively common at the Woolnorth and Codrington wind farm sites and no collisions have been recorded at those sites. Should have the capacity to habituate to turbines over time.		
Likelihood of habitat avoidance: possible		Habitat importance: minor
Collision likelihood: rare		Collision consequence: minor
Overall risk levels	Individuals	low-moderate
	Population	low

Brown Falcon (<i>Falco berigora</i>)		
Risk factors: Performs tumbling and diving flight displays Soars on thermals		
Behaviour and ecology: Nests in nest of crow or hawk, makes own stick nest or uses tree hollows. Makes sloping descent to catch prey on ground (Pizzey 1985). This species appears able to adapt and habituate to human developments. A Brown Falcon mortality has been reported from the Codrington wind farm (Biosis Research 2002). Observed at the subject site soaring c. 10 metres above the ground.		
Likelihood of habitat avoidance: possible		Habitat importance: minor
Collision likelihood: possible		Collision consequence: minor
Overall risk levels	Individuals	moderate
	Population	low-moderate

Peregrine Falcon (<i>Falco peregrinus</i>)		
Risk factors: Chases prey and dives at high speed		
Behaviour and ecology: Habitat most commonly gorges and timbered watercourses, generally near rivers and swamps. Nests on rock crevice, bare ledge, tree hollow or old corvid nest, also on spires and tall buildings (Pizzey 1985). This species appears able to adapt and habituate to human developments. Habitat at the site may be marginal for this species.		
Likelihood of habitat avoidance: rare		Habitat importance: minor
Collision likelihood: rare		Collision consequence: minor
Overall risk levels	Individuals	low-moderate
	Population	low

Australian Hobby, Little Falcon (<i>Falco longipennis</i>)		
Risk factors: Forages in open country at blade height Fast determined pursuit of flying birds and insects		
Behaviour and ecology: Range of open habitats, typically woodland with large trees and timbered watercourses. Often seen over cities (Pizzey 1985). Builds stick nest in top of tall trees. Hunts small and medium sized birds (including ducks and herons) and flying insects. Appears able to adapt and habituate to developed environments.		
Likelihood of habitat avoidance: possible		Habitat importance: minor
Collision likelihood: possible		Collision consequence: minor
Overall risk levels	Individuals	moderate
	Population	low

Spotted Harrier (<i>Circus assimilis</i>)		
Risk factors: Forages in open country at blade height		
Behaviour and ecology: Nomadic or migratory. Soars high and very low over open country. Constructs large stick nest in eucalypts. Observed at the subject site soaring c. 20 metres above the ground.		
Likelihood of habitat avoidance: possible		Habitat importance: minor
Collision likelihood: possible		Collision consequence: minor
Overall risk levels	Individuals	moderate
	Population	low

Barking Owl (<i>Ninox connivens</i>), Barn Owl (<i>Tyto alba</i>) and other owl species		
Risk factors: Night-flying Forages in open country		
Behaviour and ecology: The Barking owl is a top order predator with a varied diet and large home range. The species hunts for arboreal mammals and birds within the tree canopy and for rabbits and other prey on the ground (NPWS 2003b). Each pair occupies a 30-200 hectare territory, depending on habitat quality (Blakers et al. 1984), although this remains speculative (NPWS 2003b). Inhabits drier forest and woodland, and has been recorded persisting around human habitation. Requires large tree hollows for nesting and an abundance of prey species.		

Barking Owl (<i>Ninox connivens</i>), Barn Owl (<i>Tyto alba</i>) and other owl species		
Declining in NSW (NPWS 2003b). Recorded in Black Andrew NR c.25km SW of the site. Not recorded at the site during call playback. The species may forage and nest in remnant forest near the south of the subject site, although habitat is likely to be marginal for breeding because of a paucity of hollow-bearing trees. The Barn Owl inhabits open forests, woodlands and grasslands with stands of timber, including farmlands. Nests in tree hollows. Local populations fluctuate with mice and native rodent prey populations (Pizzey 1985). In the arid pastoral zone of north-eastern South Australia, the diet of the Barn Owl consisted of 82 per cent mammals (74% rodents), 8 per cent birds, 10 per cent lizards and less than 1 per cent insects by biomass. The introduced House Mouse was the predominant mammal, and only rodent, recorded (Debus et al 2004). Occasionally roosts or nests in buildings, forages in cities. Rodent populations on the turbine site are expected to be small, reflected in the survey trapping results. Barn owls are not expected to use the turbine for foraging on a regular or frequent basis. Forest owls are generally confined to areas with tree cover, although dispersing juveniles may fly over open country. This is expected to be a rare event at the northern turbine sites, and infrequent at the southern turbine sites. There is some risk of blade strike. Hunting flights are likely to be at ground and canopy level. The canopy height of forest and woodland remnants around the site range from 5 to 15 metres, well below the potential bladeswept zone of 34-126 metres. These species are unlikely to enter the bladeswept zone during hunting flights.		
Likelihood of habitat avoidance: rare		Habitat importance: minor
Collision likelihood: rare		Collision consequence: minor
Overall risk levels	Individuals	low-moderate
	Population	low-moderate

Tawny Frogmouth (<i>Podargus strigoides</i>)		
Risk factors: Night-flying		
Behaviour and ecology: Inhabits heavy forests to open woodlands, timber along watercourses in inland areas Nests in flimsy stick platforms on branches 5-10m high. Sedentary (Pizzey 1985). Active at dusk, takes prey from sitting position from ground surfaces such as roads. Feeding activities are more likely of the site in timbered lowlands, and would generally occur below blade height.		
Likelihood of habitat avoidance: rare		Habitat importance: insignificant
Collision likelihood: rare		Collision consequence: minor
Overall risk levels	Individuals	low
	Population	low

THREATENED SPECIES (PASSERINES AND PARROTS)

Diamond Firetail (<i>Emblema guttata</i>)		
Risk factors: Seasonal flock aggregations Declining		
Behaviour and ecology: Sedentary. Restricted largely to ungrazed or lightly grazed woodland remnants of grassy eucalypt woodlands and sometimes lightly wooded farmland. Feeds predominantly on the ground on grass seeds, in groups from 5 to 150 individuals (Schodde & Tidemann 1986), nesting in pairs or communally in shrubs and small trees. May form large flocks during winter and autumn. Recorded c. 14km NE of the site (Atlas) and Wee Jasper (Bionet). Research in grazing landscapes in southern NSW suggests that granivores prefer to move along densely vegetated areas (Fischer and Lindenmayer 2002a). Diamond Firetails are considered to have poor dispersal abilities and are likely to be less common away from tree cover. The cleared, exposed habitat at the turbine ridges is marginal.		
Likelihood of habitat avoidance: rare		Habitat importance: insignificant
Collision likelihood: rare		Collision consequence: minor
Overall risk levels	Individuals	low
	Population	low

Regent Honeyeater (<i>Xanthomyza phrygia</i>)		
Risk factors: Flocking Declining		
Behaviour and ecology: Forms breeding colonies or nomadic flocks of dozens (Pizzey 1985). Inhabits eucalypt forests and woodlands (Blakers et al. 1984), timber along watercourses, shelterbelts, gardens, mostly coastal and sub-coastal (Pizzey 1985). A generalist forager, feeding mainly on the nectar from a wide range of eucalypts (particularly prolifically flowering box and ironbark species) and mistletoes but also eats invertebrates and exotic fruits (Blakers et al. 1984). Key eucalypt species include Yellow Box and Blakely's Red Gum, Red Box and Red Stringybark, which occur locally. Nectar and fruit from <i>Amyema</i> mistletoes are also eaten during the breeding season. Potential habitat is present at the site, although confined to remnant woodland/forest areas. Recorded at Binalong, c. 10km NW of the site (Atlas) and east of Yass c. 33km E of the site (Bionet). Research in grazing landscapes in southern NSW showed a pronounced trend for nectarivores to move along densely vegetated areas, and using the same route for return journeys (Fischer and Lindenmayer 2002a).		
Likelihood of habitat avoidance: rare		Habitat importance: insignificant
Collision likelihood: rare		Collision consequence: minor-moderate
Overall risk levels	Individuals	low-moderate
	Population	low-moderate

Superb Parrot (<i>Polytelis swainsonii</i>)
Risk factors: Migratory (seasonal) Limited flocking Declining
Behaviour and ecology: Nesting habitat on SW Slopes is often open Box-Gum Woodland or isolated paddock trees. Species known to be used are Blakely's Red Gum, Yellow Box, Apple Box and Red Box. Nests in tree hollows September-January in small colonies, often with more than one nest in a single tree. Blakely's Red Gum is the main source of nesting hollows (Davey 1997). At the microscale, distribution and abundance is influenced by tree cover and species composition. Nest trees tended to be older, often affected by dieback with little regeneration (Manning 2004). A general dispersal north from Victoria after the breeding season (DNRE 1992). Migrates north in winter to the upper Namoi and Gwydir Rivers. Local migration routes are not known. If disturbed by human activity near the nest, the Superb Parrot may display agitation and avoid entering the nest hollow (Webster 1988). It is therefore important to avoid disturbance at known nest sites during the breeding season. Egg incubation appears to be highly synchronised amongst the population, suggesting that any disruption to breeding is unlikely to be compensated by the production of a second clutch. The species is faithful to traditional nest sites (Webster 1988). Superb Parrot nest trees tend to be close to watercourses (Webster 1988). West of Yass forms part of core breeding population in region. Numerous records exist north of the site, the closest are near Bookham, 7km to the W, and near the Hume Highway, 6km to the N (Atlas). Also recorded beside Black Range Road during survey, 3 kilometres to the east of the study area (AGD 662800 6145705). In a recent survey of road verges on the NSW south-western slopes, there were 2.5 possible nesting trees per kilometre whilst just prior to the start of the breeding season there were 0.62 birds per kilometre (Davey, C. and Purchase, D. 2004). The species feeds in trees and understorey shrubs and on the ground. Food items are mainly flowers, fruits and seeds. Forage species include Yellow Box (<i>E. melliodora</i>), Box Mistletoe (<i>Amyema miquelii</i>) and insect parasites such as lerps. Understorey food species include Common Wallaby-grass (<i>Austrodanthonia caespitosa</i>), numerous wattle species, and introduced plants including cereal grains, barley-grasses (DNRE 1992). Records of flocks of between 20 and 50 birds were made in the Yass region only three times during spring and early summer of 1998; most records were of single birds or pairs (ACT Government 1999). The total breeding population is estimated to be less than 5000 pairs. Loose nesting colonies are often found, and form around clusters of nest trees (ACT Government 1999). The species may forage up to 10 km from nesting sites (Webster 1988; Garnett 1992a), although at some sites, including those north of Canberra, the nesting and foraging areas coincide and the birds move very little distance at all during breeding (Webster and Ahern 1992, Martin 1996, Davey 1997 in Act Government 1999). The Superb Parrot avoids open areas on foraging flights, hence simple fragmentation of the habitat can be devastating (DNRE 1992). While Superb Parrots use woodland remnants as corridors, they rarely cross extensive open ground (Webster 1988, Davidson and Chamber 1992, Webster and Ahern 1992, Higgins 1999). The proposal site is the most extensively cleared area in the district (see Fig D1). Because of the extent of clearing, the turbine sites are unlikely to provide quality foraging habitat for the Superb Parrot. Numerous records exist north of the site, the closest are near Bookham, 7km to the W, and near the Hume Highway, 6km to the N (Atlas) (refer Figure C3). Also recorded beside Black Range Road during survey, 3 km east of the site (AGD 662800 6145705). Little is known about seasonal migration routes; it is assumed that they move west and then north after the breeding season (A. Manning, CRES, pers. comm.). No flight height data is available for this species; a variety of other parrot species are known to fly at turbine blade height at times, although the great majority of recorded flights are from below that zone (Biosis Research 2006). Flights between roost/nest and foraging areas are likely to be at tree canopy level. Superb Parrots have been observed flying high over open areas in the South-West Slopes. However, they do tend to

occur more in the lower elevation/relief parts of the landscape where the Box-Gum Woodlands, including scattered paddock trees, are located - this is where nest trees and food is likely to occur (A. Manning, CRES, pers. comm.). The frequency of parrots flying high over the turbine ridgetops is likely to be low. The absence of intact woodland vegetation with hollow-bearing trees and watercourses in close proximity to the turbines would mean that the risk of nest abandonment due to visual or noise disturbance would be low.		
Likelihood of habitat avoidance: rare		Habitat importance: insignificant
Collision likelihood: rare		Collision consequence: moderate
Overall risk levels	Individuals	low-moderate
	Population	low-moderate

Swift Parrot (<i>Lathamus discolor</i>)		
Risk factors: Migratory (seasonal) Flocking Fast flying Declining		
Behaviour and ecology: Breeds in Tasmania and Furneaux Group islands, migrating to mainland in Feb-April, where it becomes nomadic in response to the availability of blossoms and other food (Pizzey 1985). Wintering flocks may remain in a district for weeks, returning as a flock to the same tree each night for roosting. A non-breeding winter migrant to southern and eastern NSW, where it inhabits eucalypt forests and woodlands (Blakers et al 1984). Feeds on eucalypt blossom and psyllids, particularly large prolifically flowering trees. Food sources and distribution varies year to year. Habitat is marginal over most of site due to clearing. Moderate potential in far south of site, where the winter-flowering Long-leaved Box provides a potential food source. Recorded in Booroowa Shire to the north (NPWS 2002). The species may use habitat in the far south of the site, although Long-leaved Box stands are generally regrowth and heavily fragmented. Better habitat is likely to be present in timbered lowland areas. No flight height data is available for this species; a variety of other parrot species are known to fly at turbine blade height at times, although the great majority of recorded flights are from below that zone (Biosis Research 2006). Flights between roost and foraging areas are likely to be at tree canopy level. The frequency of flights over the turbine ridges is likely to be low. A recent cumulative assessment of 39 wind farms located in the distribution range of the Swift Parrot concluded that the combined bladestrike impact of all of these wind farms would not be significant (Biosis Research 2006).		
Likelihood of habitat avoidance: rare		Habitat importance: insignificant
Collision likelihood: rare		Collision consequence: moderate
Overall risk levels	Individuals	low-moderate
	Population	low-moderate

Gang-gang Cockatoo (<i>Callocephalon fimbriatum</i>)		
Risk factors: Declining		
Behaviour and ecology: Feeds in pairs or small flocks on seeds of eucalypts and wattles, primarily in forest, but occasionally towns and farming areas for artificial food resources such as berry-bearing exotic shrubs. It is a seasonal altitudinal migrant. Nesting is in large tree hollows. Marginal forage habitat is present in forest and woodland remnants in the study area, and nesting habitat may be present in surrounding areas. Recorded at Binalong, c. 10km NW of the site and Burrinjuck NR c.17km to the SW (Atlas). Unlikely to use the turbine ridges for foraging due to scarcity of eucalypts. May pass over ridgelines at blade height on longer-distance flights. Frequency of visit to site likely to be low.		
Likelihood of habitat avoidance: rare		Habitat importance: insignificant
Collision likelihood: rare		Collision consequence: moderate

Overall risk levels	Individuals	low-moderate
	Population	low-moderate

WATERBIRDS AND MIGRATORY SPECIES

Painted Snipe (<i>Rostratula benghalensis</i>)		
Risk factors: Migratory Potential habitat adjacent to site		
Behaviour and ecology: Little is known of the behaviour of this cryptic waterbird. Possibly nomadic; has been observed occupying ephemeral wetlands. Seeds and invertebrates are foraged for on the waters edge. Breeding is thought to occur in response to local conditions between September and December (Pringle 1987). A recent assessment of collision risk on 34 bird species present at five operational and planned wind farm sites in Gippsland, Victoria, including migratory wetland species concluded that potential impacts are likely to be negligible or low for these species (Biosis Research 2006). Habitat may be marginal at the site given the small and modified nature of the wetland communities. There are no local records. This species does not appear to congregate in large numbers and spends most of its time foraging on the water's edge. Hence, the risk of population level impacts from collision or resource avoidance impacts would not be expected to be high for this species. Local migration routes are not known. Possible flight paths between ephemeral habitats are shown on Figure 5.2, following watercourses, drainage lines and lowland pastures.		
Likelihood of habitat avoidance: rare		Habitat importance: minor
Collision likelihood: rare		Collision consequence: minor
Overall risk levels	Individuals	low
	Population	low

Latham's Snipe, Japanese Snipe (<i>Gallinago hardwickii</i>)		
Risk factors: Migratory Potential habitat adjacent to site		
Behaviour and ecology: This species nests annually in northern Japan, where it congregates in large numbers on the shores of local lakes (Schodde & Tideman 1995). Favoured habitats during the non-breeding season include wet paddocks or shallow water with good covering of tussocks or other growth, seepage below dams, from sea level to 2000m (Pizzey 1985), where they probe for aquatic invertebrate and seed (Green & Osborne 1994). A recent assessment of collision risk on 34 bird species present at five operational and planned wind farm sites in Gippsland, Victoria, including migratory wetland species such as Latham's Snipe, concluded that potential impacts are likely to be negligible or low for these species (Biosis Research 2006). Habitat may be marginal at the site given the small, modified and ephemeral nature of the wetland communities and the species is not expected to be a regular inhabitant. There are no local records. Local migration routes are not known. Possible flight paths are shown on Figure 5.2, following watercourses, drainage lines and lowland pastures.		
Likelihood of habitat avoidance: rare		Habitat importance: minor
Collision likelihood: rare		Collision consequence: minor
Overall risk levels	Individuals	low
	Population	low

White Ibis (<i>Threskiornis molucca</i>)		
Risk factors: Nomadic or migratory Night-flying		
Behaviour and ecology: Occurs singly or in large flocks, typically in pastures and swamps. Flies in lines or v formations with quick wing beats and glides. Nests over water in dense trees or swamp growth. Highly nomadic, migratory or dispersive (Pizzey 1985). Australian White Ibises and other waterbird species demonstrate crepuscular peaks of abundance (Hamilton et al. 2004). In the Hunter Valley, the White Ibis was found to be one of the species most at risk of colliding with powerlines at night (Hunter Wetlands Research 1996 in URS 2004). In daytime bird behavioural studies at Codrington Wind Farm, where Straw-necked Ibises are abundant, 517 Ibises were observed. 476 birds adopted avoidance strategies of weaving between the turbines and 39 flew in a straight line through the site in a path that kept them well away from the turbines. There were no observed Ibis collisions and no Ibis carcasses have been found (Biosis Research 2002). A recent assessment of collision risk on 34 bird species present at five operational and planned wind farm sites in Gippsland, Victoria, including migratory wetland species concluded that potential impacts are likely to be negligible or low for these species (Biosis Research 2006). White Ibises used Lake Burrinjuck, south of the site, for breeding until the recent drought (pers. comm. C. Davey 4/11/2005). With the breaking of the drought, breeding would be expected to resume and Ibis numbers in the study area may increase. Ibis and other waterbirds may travel between Lake Burrinjuck and the large waterbodies in Canberra. They would also be expected to disperse to forage in farmland north of Lake Burrinjuck, including the study area. A single Ibis was recorded from a wet drainage line at the subject site during the survey; when disturbed the bird flew low along the drainage line. Possible short-range flight paths are shown on Figure 5.2, following watercourses, drainage lines and lowland pastures. Birds moving during the day are likely to use avoidance behaviours. Because of low local habitat utilisation rates, the distance of prime habitats, and the widespread and common status of the White Ibis, the risk of night collisions is considered low.		
Likelihood of habitat avoidance: rare		Habitat importance: minor
Collision likelihood: rare		Collision consequence: minor
Overall risk levels	Individuals	low-moderate
	Population	low

Australian Wood Duck (<i>Checonetta jubata</i>)		
Risk factors: Swift flight, possibly with poor manoeuvrability		
Behaviour and ecology: Typically in better-watered lightly timbered pastoral country with plentiful dams. Follows courses of creeks through timber. Nests in hollow of live tree (Pizzey 1985). Regionally abundant, recorded in valley dams near the turbine ridges. Possible flight paths are shown on Figure 5.2, following watercourses, drainage lines and low pastures between dams. Unlikely to pass through the bladeswept area.		
Likelihood of habitat avoidance: rare		Habitat importance: minor
Collision likelihood: rare		Collision consequence: minor
Overall risk levels	Individuals	low-moderate
	Population	low

White-faced Heron (<i>Ardea novaehollandiae</i>)		
Risk factors: May form winter flocks Tendency to perch on high trees or posts		
Behaviour and ecology: Common, sedentary and nomadic, found almost wherever there is shallow water, including dams. Builds stick nest in tree (5-12 m above ground), usually near water or some distance away. May perch on dead trees and telephone posts (Pizzey 1985). Possible flight paths are shown on Figure 5.2, following watercourses, drainage lines and low pastures between dams. A recent assessment of collision risk on 34 bird species present at five operational and planned wind farm sites in Gippsland, Victoria, including migratory and wetland species concluded that potential impacts are likely to be negligible or low for these species (Biosis Research 2006).		
Likelihood of habitat avoidance: rare		Habitat importance: minor
Collision likelihood: rare		Collision consequence: minor
Overall risk levels	Individuals	low-moderate
	Population	low

White-throated Needle-tail, Spine-tailed Swift (<i>Hirundapus caudacutus</i>)		
Risk factors: Migratory High-flying Vertical flight and diving displays May form large flocks		
Behaviour and ecology: Summer migrant to Australia from Asia, mid-October to mid-April. Feed on flying insects. Occurs over cities. Roosting habits not known. Risk is lessened by limited time spent at the site and capacity to habituate to humanised landscapes. Local migration routes are not known. Recorded in Wee Jasper Nature Reserve, 30 kilometres to the south. A recent assessment of collision risk on 34 bird species present at five operational and planned wind farm sites in Gippsland, Victoria, including migratory species such as the White-throated Needle-tail, concluded that potential impacts are likely to be negligible or low for these species (Biosis Research 2006).		
Likelihood of habitat avoidance: rare-possible		Habitat importance: minor
Collision likelihood: rare		Collision consequence: minor-moderate
Overall risk levels	Individuals	low-moderate
	Population	low

Satin Flycatcher (<i>Myiagra cyanoleuca</i>)		
Risk factors: Migratory High-flying Vertical flight and diving displays May form large flocks		
Behaviour and ecology: Occurs singly or in pairs, usually in tops of taller trees. Breeds in SE Australia arriving from NG Aug-Oct, departing Feb-April. When breeding favours heavily vegetated gullies and taller woodlands. During migration, uses coastal forests, woodlands, scrubs, trees in open country (Pizzey 1985). Habitat is likely to be marginal at the site due to the extent of clearing.		
Likelihood of habitat avoidance: rare		Habitat importance: minor
Collision likelihood: rare		Collision consequence: minor

Overall risk levels	Individuals	low
	Population	low

Conclusion

The Conroys Gap subject site is located in a cleared agricultural setting and has low diversity and low abundance of bird fauna. No rare or threatened bird species were recorded at the subject site during the survey. Threatened passerine and parrot species are likely to use lowland woodland in the surrounding district (including the Superb Parrot) for nesting and foraging. The use of the largely cleared, high-relief turbine ridge habitat by these species is expected to be infrequent.

All species recorded at the site and most likely to be affected by the proposal are widespread and not considered threatened. Five raptor species are considered to be at moderate or moderate-high risk; Wedge-tailed eagle, Little Eagle, Brown Falcon, Australian Hobby and the Spotted Harrier. No threatened or migratory species or waterbirds were considered to be at moderate or high risk.

Experience elsewhere in Australia suggests that Wedge-tailed Eagle mortality is a possibility, although there are examples of this species habituating to, and co-existing with wind turbines. Of greater concern may be the alienation of hunting habitat, and the longer term affect on Wedge-tailed Eagle breeding success. This issue is further discussed in section 5, with recommended monitoring, mitigation measures and adaptive management procedures.

Night-flying waterbirds are another risk group for wind farm developments. Small numbers of waterbirds were recorded at the site, in dams and wet drainage lines. Short-range foraging journeys by these species may follow chains of small wetland habitats scattered over the lowland areas of the district. Major migration routes for these species are not known. Longer range migrations may involve crossing high ridges at blade height, but the frequency of this occurring at the Conroys Gap site is likely to be low.

These assessments are provisional, and based on available information. In particular, knowledge is incomplete regarding the migration behaviour and routes of local bird species, the importance of raptor habitat at the turbine sites to breeding success and the short and long term responses to the wind turbines.

APPENDIX G: BOX-GUM WOODLAND EEC DETERMINATION

White box yellow box Blakely's red gum woodland - endangered ecological community listing (DEC 2005)

NSW Scientific Committee - final determination

The Scientific Committee, established by the Threatened Species Conservation Act, has made a Final Determination to list the White Box Yellow Box Blakely's Red Gum Woodland as an ENDANGERED ECOLOGICAL COMMUNITY on Part 3 of Schedule 1 of the Act. The listing of Endangered Ecological Communities is provided for by Part 2 of the Act. The Scientific Committee previously made a Preliminary Determination to support the proposal to list the White Box-Yellow Box Woodland. The Scientific Committee considers that the White Box Yellow Box Blakely's Red Gum Woodland is a more appropriate name for this Community.

The Scientific Committee has found that:

1. White Box Yellow Box Blakely's Red Gum Woodland is the name given to the ecological community characterised by the assemblage of species listed in paragraph 3. White Box Yellow Box Blakely's Red Gum Woodland is found on relatively fertile soils on the tablelands and western slopes of NSW and generally occurs between the 400 and 800 mm isohyets extending from the western slopes, at an altitude of c. 170m to c. 1200 m, on the northern tablelands (Beadle 1981). The community occurs within the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands and NSW South Western Slopes Bioregions.
2. White Box Yellow Box Blakely's Red Gum Woodland includes those woodlands where the characteristic tree species include one or more of the following species in varying proportions and combinations - *Eucalyptus albens* (White Box), *Eucalyptus melliodora* (Yellow Box) or *Eucalyptus blakelyi* (Blakely's Red Gum). Grass and herbaceous species generally characterise the ground layer. In some locations, the tree overstorey may be absent as a result of past clearing or thinning and at these locations only an understorey may be present. Shrubs are generally sparse or absent, though they may be locally common.
3. White Box Yellow Box Blakely's Red Gum Woodland is characterised by the following assemblage of species.

<i>Acacia buxifolia</i>	<i>Eucalyptus bridgesiana</i>
<i>Acacia implexa</i>	<i>Eucalyptus conica</i>
<i>Acacia paradoxa</i>	<i>Eucalyptus goniocalyx</i>
<i>Allocasuarina verticillata</i>	<i>Eucalyptus melliodora</i>
<i>Alectryon oleifolius</i>	<i>Eucalyptus microcarpa</i>
<i>Aristida behriana</i>	<i>Eucalyptus nortonii</i>
<i>Aristida ramosa</i>	<i>Eulalia aurea</i>
<i>Asperula conferta</i>	<i>Exocarpos cupressiformis</i>
<i>Atalaya hemiglauca</i>	<i>Geijera parviflora</i>
<i>Austrodanthonia auriculata</i>	<i>Geranium solanderi</i>
<i>Austrodanthonia bipartita</i>	<i>Glycine clandestina</i>
<i>Austrodanthonia racemosa</i>	<i>Glycine tabacina</i>
<i>Austrodanthonia richardsonii</i>	<i>Glycine tomentella</i>
<i>Austrostipa aristiglumis</i>	<i>Gonocarpus elatus</i>
<i>Austrostipa blackii</i>	<i>Goodenia pinnatifida</i>
<i>Austrostipa nodosa</i>	<i>Hibbertia linearis</i>
<i>Austrostipa scabra</i>	<i>Hibbertia obtusifolia</i>

<i>Bothriochloa macra</i>	<i>Hypericum gramineum</i>
<i>Brachychiton populneus</i>	<i>Jacksonia scoparia</i>
<i>Brachyloma daphnoides</i>	<i>Jasminum lineare</i>
<i>Bracteantha viscosa</i>	<i>Jasminum suavissimum</i>
<i>Brunoniella australis</i>	<i>Leptorhynchos squamatus</i>
<i>Bulbine bulbosa</i>	<i>Lissanthe strigosa</i>
<i>Bursaria spinosa</i>	<i>Lomandra filiformis</i>
<i>Callitris endlicheri</i>	<i>Melichrus urceolatus</i>
<i>Callitris glaucophylla</i>	<i>Microseris lanceolata</i>
<i>Capparis mitchellii</i>	<i>Notelaea microcarpa</i>
<i>Cassinia longifolia</i>	<i>Olearia elliptica</i>
<i>Cassinia quinquefaria</i>	<i>Olearia viscidula</i>
<i>Cheilanthes sieberi</i>	<i>Oxalis perennans</i>
<i>Chloris truncata</i>	<i>Pandorea pandorana</i>
<i>Chloris ventricosa</i>	<i>Panicum queenslandicum</i>
<i>Chrysocephalum apiculatum</i>	<i>Parsonsia eucalyptophylla</i>
<i>Cymbopogon refractus</i>	<i>Pimelea curviflora</i>
<i>Dianella longifolia</i>	<i>Plantago debilis</i>
<i>Dianella revoluta</i>	<i>Plantago gaudichaudii</i>
<i>Dichanthium sericeum</i>	<i>Poa labillardieri</i>
<i>Dichelachne micrantha</i>	<i>Poa sieberiana</i>
<i>Dichelachne sciurea</i>	<i>Rostellularia adscendens</i>
<i>Diuris dendrobioides</i>	<i>Rumex brownii</i>
<i>Dodonaea viscosa</i>	<i>Sida corrugata</i>
<i>Echinopogon caespitosus</i>	<i>Sorghum leiocladum</i>
<i>Ehretia membranifolia</i>	<i>Stackhousia monogyna</i>
<i>Elymus scaber</i>	<i>Stackhousia viminea</i>
<i>Eremophila mitchellii</i>	<i>Swainsona galegifolia</i>
<i>Eucalyptus blakelyi</i>	<i>Templetonia stenophylla</i>
<i>Eucalyptus albens</i>	<i>Themeda australis</i>
	<i>Wahlenbergia communis</i>

The total flora and fauna species list for the community is considerably larger than that given above, with many species present in only some sites or in very small quantity. In any particular site not all of the assemblage listed above may be present. At any one time, seeds of some species may only be present in the soil seed bank with no above-ground individuals present. The species composition of the site will be influenced by the size of the site, recent rainfall or drought conditions, its disturbance history and geographic and topographic location. The community is an important habitat for a diverse fauna (vertebrates and invertebrates), but detailed records are not available from most stands and the invertebrate fauna is poorly known.

4. Woodlands with *Eucalyptus albens* are most common on the undulating country of the slopes region while *Eucalyptus blakelyi* and *Eucalyptus melliodora* predominate in grassy woodlands on the tablelands. Drier woodland areas dominated by *Eucalyptus albens* often form mosaics with areas dominated by *Eucalyptus blakelyi* and *Eucalyptus melliodora* occurring in more moist situations, while areas subject to waterlogging may be treeless. *E. microcarpa* is often found in association with *E. melliodora* and *E. albens* on the south western slopes. Woodlands including *Eucalyptus crebra*, *Eucalyptus dawsonii* and *Eucalyptus moluccana* (and intergrades with *Eucalyptus albens*), for example in the Merriwa plateau, Goulburn River National Park and western Wollemi National Park, are also included. Intergrades between *Eucalyptus blakelyi* and *Eucalyptus tereticornis* may also occur here.

5. Latitudinal and climatic gradients in the patterns of species present are found across the range of the community (eg. see Prober 1996 for variation in White Box). This is reflected in a gradual change in herb and grass species from northern to southern NSW (eg. Prober 1996). Within White Box Yellow Box *Blakely's Red Gum* Woodland, species such as *Rostellularia adscendens*, *Chloris ventricosa*, *Austrodanthonia racemosa*, *Brunoniella*

australis, *Cymbopogon refractus*, *Swainsona galegifolia*, *Notelaea microcarpa*, *Stackhousia viminea*, *Olearia elliptica*, *Jasminum suavisissimum*, *Plantago gaudichaudii*, *Dichanthium sericeum*, *Plantago debilis* and *Wahlenbergia communis* are generally more restricted to more northern areas (eg. Prober 1996). Some other species in White Box Yellow Box Blakely's Red Gum Woodland were generally restricted to southern areas. These include *Gonocarpus elatus*, *Austrostipa blackii*, *Aristida behriana*, *Bracteantha viscosa*, *Austrodanthonia auriculata* and *Austrostipa nodosa* (Prober 1996).

6. White Box Yellow Box Blakely's Red Gum Woodland includes vegetation described as *Eucalyptus albens* alliance and *E. melliodora* / *E. blakelyi* alliance in Beadle (1981), the *Eucalyptus albens* alliance in Moore (1953a,b), the grassy white box woodlands of Prober and Thiele (1993,1995) and Prober (1996) and the Grassy white box woodland of the Commonwealth Environmental Protection and Biodiversity Conservation Act 1999. In the southern tablelands and parts of the southwest slopes, White Box Yellow Box Blakely's Red Gum Woodland are described in Thomas et al. (2000).

7. Related communities are the *Eucalyptus microcarpa*, *Eucalyptus pilligaensis* Grey Box/*Eucalyptus populnea* Poplar Box communities of the western slopes and plains and the *Eucalyptus moluccana*, Grey Box, communities of the Clarence, lower Hunter Valley and Western Sydney. These are not covered by this Determination. Similarly the natural temperate grasslands and the *Eucalyptus pauciflora* grassy woodlands of the cooler parts of the southern tablelands are not covered by this Determination.

8. White Box Yellow Box Blakely's Red Gum Woodland has been drastically reduced in area and highly fragmented because of clearance for cropping and pasture improvement. Austin et al. (2000) found the community had been reduced to less than 1% of its pre-European extent in the Central Lachlan region. Comparable degrees of reduction have been documented for NSW south western slopes and southern Tablelands (estimated <4% remaining, Thomas et. al. 2000), and for the Holbrook area (estimated <7% remaining, Gibbons and Boak (2000). Gibbons and Boak (2000) found remnants of woodlands dominated by *Eucalyptus albens*, *E. melliodora* and *E. blakelyi* were severely fragmented. Further remnants of the community are degraded as a consequence of their disturbance history. Some remnants of these communities survive with the trees partly or wholly removed by post European activities, and conversely, often remnants of these communities survive with these tree species largely intact but with the shrub or ground layers degraded to varying degrees through grazing or pasture modification. Remnants are subject to varying degrees of threat that jeopardise their viability. These threats include: further clearing (for cropping, pasture improvement or other development); deterioration of remnant condition (caused by firewood cutting, increased livestock grazing, weed invasion, inappropriate fire regimes, soil disturbance and increased nutrient loads); degradation of the landscape in which remnants occur (including soil acidification, salinity, and loss of connectivity between remnants).

9. The understorey may be highly modified by grazing history and disturbance. A number of native species appear not to tolerate grazing by domestic stock and are confined to the least disturbed remnants (*Dianella revoluta*, *Diuris dendrobioides*, *Microseris lanceolata*, *Pimelea curviflora*, *Templetonia stenophylla* (Prober & Thiele 1995). Dominant pasture species typically change from *Themeda australis*, *Austrostipa aristiglumis* and *Poa* spp. to *Austrostipa falcata*, *Austrodanthonia* spp. and *Bothriochla macra* as grazing intensity increases (Moore 1953a). This may reflect differences in palatability of these species and their ability to tolerate grazing pressure. Light grazing and burning may also be a problem and lead to *Aristida ramosa* dominance (Lodge & Whalley 1989).

10. The condition of remnants ranges from relatively good to highly degraded, such as paddock remnants with weedy understoreies and only a few hardy natives left. A number of less degraded remnants have survived in Travelling Stock Routes, cemeteries and reserves, although because of past and present management practices understorey species composition may differ between the two land uses. Some remnants of the community may

consist of only an intact overstorey or an intact understorey, but may still have high conservation value due to the flora and fauna they support. Other sites may be important faunal habitat, have significant occurrences of particular species, form part of corridors or have the potential for recovery. The conservation value of remnants may be independent of remnant size.

11. Disturbed remnants are still considered to form part of the community including remnants where the vegetation, either understorey, overstorey or both, would, under appropriate management, respond to assisted natural regeneration, such as where the natural soil and associated seed bank are still at least partially intact.

12. The community is poorly represented in conservation reserves. There are small occurrences of White Box Yellow Box Blakely's Red Gum Woodland in Border Ranges National Park, Goobang National Park, Goulburn River National Park, Manobalai Nature Reserve, Mt Kaputar National Park, Oxley Wild Rivers National Park, Queanbeyan Nature Reserve, Towari National Park, Warrumbungle National Park, Wingen Maid Nature Reserve and Wollemi National Park. The community also occurs in the following State Conservation Areas, Copeton State Conservation Area, Lake Glenbawn State Conservation Area and Lake Keepit State Conservation Area.

13. Fauna species of conservation significance found in some stands of White Box Yellow Box Blakely's Red Gum Woodland include,

Aprasia parapulchella - Pink-tailed Legless Lizard
Burhinus grallarius - Bush Stone-curlew
Cacatua leadbeateri - Major Mitchell's Cockatoo
Climacteris picumnus victoriae - Brown Treecreeper
Dasyurus maculatus - Spotted-tailed Quoll
Delma impar - Striped Legless Lizard
Grantiella picta - Painted Honeyeater
Hoplocephalus bitorquatus - Pale-headed Snake
Lathamus discolor - Swift Parrot
Lophoictinia isura - Square-tailed Kite
Melanodryas cucullata cucullata - Hooded Robin
Melithreptus gularis gularis - Black-chinned Honeyeater
Neophema pulchella - Turquoise Parrot
Ninox connivens - Barking Owl
Petaurus norfolcensis - Squirrel Glider
Phascogale cinereus - Koala
Polytelis swainsonii - Superb Parrot
Pomatostomus temporalis temporalis - Grey-crowned Babbler
Pyrrholaemus sagittata - Speckled Warbler
Saccolaimus flaviventris - Yellow-bellied Sheath-tail-bat
Stagonopleura guttata - Diamond Firetail
Synemon plana - Golden Sun Moth
Tyto novaehollandiae - Masked Owl
Varanus rosenbergi - Rosenberg's Goanna
Xanthomyza phrygia - Regent Honeyeater
A number of plant species of conservation significance are likely to occur in White Box Yellow Box Blakely's Red Gum Woodland
Ammobium craspedioides
Bothriochloa biloba
Dichanthium setosum
Discaria pubescens
Diuris spp.
Prasophyllum petilum
Pterostylis spp.

Rutidosia leptorhynchoides
Swainsona spp.

A number of key threatening processes also occur in White Box Yellow Box Blakely's Red Gum Woodland. These include: Clearing of native vegetation, Predation by the European Red Fox *Vulpes vulpes*, Predation by the Feral Cat, *Felis catus*.

14. In view of the small size of existing remnants, and the threat of further clearing, disturbance and degradation, the Scientific Committee is of the opinion that White Box Yellow Box Blakely's Red Gum Woodland is likely to become extinct in nature in New South Wales unless the circumstances and factors threatening its survival or evolutionary development cease to operate and that listing as an endangered ecological community is warranted.

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APPENDIX H: THREATENED FLORA SPECIES PROFILES

H1. Yass Daisy – DEC species profile (DEC 2005)

Scientific name: *Ammobium craspedioides*

Conservation status in NSW: Vulnerable

National conservation status: Vulnerable

Description

The Yass Daisy is a rosette-forming perennial. Leaves are spoon-shaped, to 12 cm long and 17 mm wide, hairy on top and white and woolly underneath. The spring flowerheads are hemispherical buttons, to 20 mm wide, and surrounded at the base by papery leaf-like structures (bracts). The solitary flowerheads are borne on unbranched stems to 60 cm tall; the stems are sparsely leafed, and edged with narrow "wings". Rosettes die off after fruiting.

Location and habitat

Distribution

Found from near Crookwell on the Southern Tablelands to near Wagga Wagga on the South Western Slopes. Most populations are in the Yass region.

Habitat and ecology

Found in dry forest, Box-Gum Woodland and secondary grassland derived from clearing of these communities.

Grows in association with a large range of eucalypts (*Eucalyptus blakelyi*, *E. bridgesiana*, *E. dives*, *E. gonicalyx*, *E. macrorhyncha*, *E. mannifera*, *E. melliodora*, *E. polyanthemos*, *E. rubida*).

Apparently unaffected by light grazing, as populations persist in some grazed sites.

Found in a number of cemeteries in the region.

Threats

Agricultural developments, intensification of grazing regimes, invasion of weeds, road works (particularly widening or re-routing), inappropriate mowing or slashing in the cemetery sites where species occurs.

Management actions

Protect known populations from changes to land use.

Do not undertake road works, pasture modification or other changes in land use that may affect populations.

Do not increase grazing pressures on sites where populations persist - reduce grazing pressures where possible.

Undertake weed control in and adjacent to populations, taking care



Foliage and buds,
Image: John Briggs
© John Briggs



Flower, Yass Daisy
Image: Colin Totterdell
© Colin Totterdell



Habitat during flowering, Yass
Daisy

to spray or dig out only target weeds.

Maintain traditional cemetery mowing regimes, taking care not to mow during the species' active period in spring and summer.

Mark sites and potential habitat onto maps (of the farm, shire, region, etc) used for planning (e.g. road works, residential and infrastructure developments, remnant protection, rehabilitation).

Search for new populations in potential habitat.

Image: Colin Totterdell

© Colin

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H2. Tarengo Leek Orchid (*Prasophyllum petilum*)

Excerpt from the Recovery Plan for the Tarengo Leek Orchid (NPWS 2003a)



The Tarengo Leek Orchid (*Prasophyllum petilum*) is a terrestrial tuberous herb with a single cylindrical leaf. Flowers are borne on a spike that emerges from the leaf midway along its length. Leaves grow to 25 centimetres long, flowering spikes to 30 centimetres, with 5-18 flowers. Flowers are green to pinkish mauve, 5-7 millimetres across and sweetly scented.

The Tarengo Leek Orchid flowers from **October to November**.

The species is known from three locations in the Canberra-Booroowa region. Potential habitat occurs in the Northern valley survey zone (upper McCullums Creek), although the occurrence of the Tarengo Leek Orchid is unlikely given the disturbance history of the site.

H3. Small Purple Pea (*Swainsona recta*)



Small Purple Pea (*Swainsona recta*) is a slender, erect and ascending perennial up to 20cm high. Leaves are pinnate, 3-6 centimetres long. The pea flowers are 5-8 millimetres long. 6-25 flowers are borne on erect spikes.

The Small Purple Pea flowers in spring, peaking in **October**.

This species appears superficially similar to other small purple-flowered grassland *Swainsona* species, including *S. monticola*, *S. behriana* and the threatened *S. sericea* (flowers October-December). All have declined with the widespread loss of grassland and grassy woodland habitat. Any occurrence of *Swainsona* at the site should be identified by a botanist.

APPENDIX I: PHOTOGRAPHS OF THE SITE



Photograph 1. Central ridge with trig station, Northern Turbine survey zone (NT)



Photograph 2. Far northern turbine site, NT survey zone



Photograph 3. Eastern view of turbine ridges, NT survey zone



Photograph 4. View from central ridge over Northern Valley (NV) survey zone and McCullums Creek in middle ground



Photograph 5. View north from trig in northern turbine zone, Paynes Road and active quarry in middle distance



Photograph 6. Broad-leaved Peppermint-bracken fern patch, central ridge, NT survey zone



Photograph 7. McCullums Creek valley, Yass Daisy population to right, NV survey zone



Photograph 8. Central turbine site, CT survey zone



Photograph 9. Box-Gum Woodland understorey and Yass Daisy habitat, NV survey zone



Photograph 10. Yass Daisy, NV survey zone



Photograph 11. Proposed powerline crossing point, BR survey zone



Photograph 12. New track northern crossing point (gap between trees), BR survey zone



Photograph 13. New track southern crossing point on Black Range Road (gap between trees)



Photograph 14. Drainage line on proposed powerline route, north of road crossing, PV survey zone



Photograph 15. Powerline valley route, Ferndale property, PV survey zone



Photograph 16. Southern turbine zone – northern end looking south, ST survey zone



Photograph 17. Extensive Tree-of-Heaven thicket near southern turbine sites



Photograph 18. Instream pool in valley section of proposed powerline route, PV survey zone



Photograph 19. Powerline route, Long-leaved Box remnant, SR survey zone



Photograph 20. Remnant trees in southern turbine site envelope (658295 6140489)



Photograph 21. Red Stringybark remnant in southern turbine site envelope, SR survey zone



Photograph 22. White Gum (*E. rossii*) remnant near southern turbine sites (658230 6139850)



Photograph 23. Granite rock face west of southern turbine sites, SR survey zone



Photograph 24. Regrowth White Gum (*E. rossii*) remnant near southern turbine site (658230 6139850), SR survey zone



Photograph 25. Southern end of southern turbine site envelope, looking north



Photograph 26. In the vicinity of the proposed southern substation site, ST survey zone



Photograph 27. Remnant trees beside existing southern turbine access track