Appendix 3 BIODIVERSITY ASSESSMENTS

Appendix 3.1 Biodiversity Assessment Coppabella Hills

EPURON
POWER FOR PORTFOLIOS

Biodiversity Assessment

COPPABELLA HILLS PRECINCT

JULY 2009

nghenvironmental

Document Verification

ngh environmental
planning • assessment • ems • auditing

Job title: Coppabella Wind farm

Document Title	Biodiversity Assessment
File Name	Final_Coppabella_BA.docx

Revision	Date	Prepared by		Checked by		Approved by	
Draft	Dec 08	name	Eleanor Stalenberg	name	Brooke Marshall	name	Nick Graham-Higgs – Director (Certified Environmental Practitioner)
Final	May 09	name	Brooke Marshall, Bianca Heinze, Eleanor Stalenberg	name	Brooke Marshall	name	Steven Sass- Senior Ecologist (Certified Environmental Practitioner)
Final	July 09	name	Brooke Marshall,	name			

1/216 carp street (po box 470) bega nsw 2550 australia t 61 2 6492 8333 f 61 2 6494 7773
web: www.nghenvironmental.com.au email: ngh@nghenvironmental.com.au

206/410 elizabeth st surry hills
nsw 2010 australia
t 61 2 8202 8333 f 61 2 9211 1374

102/63-65 johnston st wagga wagga
nsw 2650 australia
t 61 2 6971 9696 f 61 2 6971 9693

suite 4/4, 234 naturaliste terrace
dunsborough wa 6281 australia
t 61 8 9759 1985 f 61 2 6494 7773

Definition of terms

Site	The area bounded by the property boundaries of involved landowners.
Study area	The subject site and any additional areas which are likely to be affected by the proposal, either directly or indirectly. Extended as far as necessary to take all potential impacts into account.
Subject site	All parts of the site which has potential to carry infrastructure and be directly affected by the proposal. Also referred to as the 'Development Envelope'.
Survey area	Where active and passive fauna or flora surveys were undertaken within the study area.
Development Envelope (DE)	All parts of the site which has potential to carry infrastructure and be directly affected by the proposal. Also referred to as the 'subject site'. Assessment of the development envelope allows fine-scale development planning and site decisions to be informed by the findings of the assessment.
Direct impacts	Impacts that directly affect flora and fauna values. These may include trampling, pollution, vegetation clearing and soil disturbance.
Development footprint	The area that would be directly displaced by proposed infrastructure, including footings, easements and room to manoeuvre machinery.
Blade-strike	Mortality caused by direct collision with turbine blades and by birds being swept down by the wake behind a turbine blade.
Barotrauma	Rapid or excessive air-pressure change near moving turbine blades has been linked to bat fatalities as a result of haemorrhaging of the lungs (pulmonary barotrauma) (Baerwald *et al.* 2008).

Table of Contents

Figures

Tables

1 INTRODUCTION

This Biodiversity Assessment presents the findings of investigations into biodiversity values and likely impacts associated with a proposed wind farm on the 'Coppabella Hills Precinct' site near Yass on the Southern Tablelands, New South Wales. The proposal is one of three geographically separate precincts within the Yass area that together would form the Yass Wind Farm Development (refer to Figure 1-1). This assessment has been undertaken by **ngh**environmental, a specialist study to be included as an attachment to the Environmental Assessment (EA) report prepared on behalf of the proponent Epuron Pty Ltd.

This 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 development and the potential cumulative impacts of the two other wind farm precincts 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 E)
- 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 and bat species at the site (Section 6.3 and Appendix E and F) and
- Provides a series of recommended mitigation measures designed to reduce risks, minimise the impacts and allow for an overall 'maintain or improve' environmental outcome.

The Biodiversity Assessment is intended to meet the assessment requirements under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act), the *Threatened Species Conservation Act 1995* (TSC Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

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

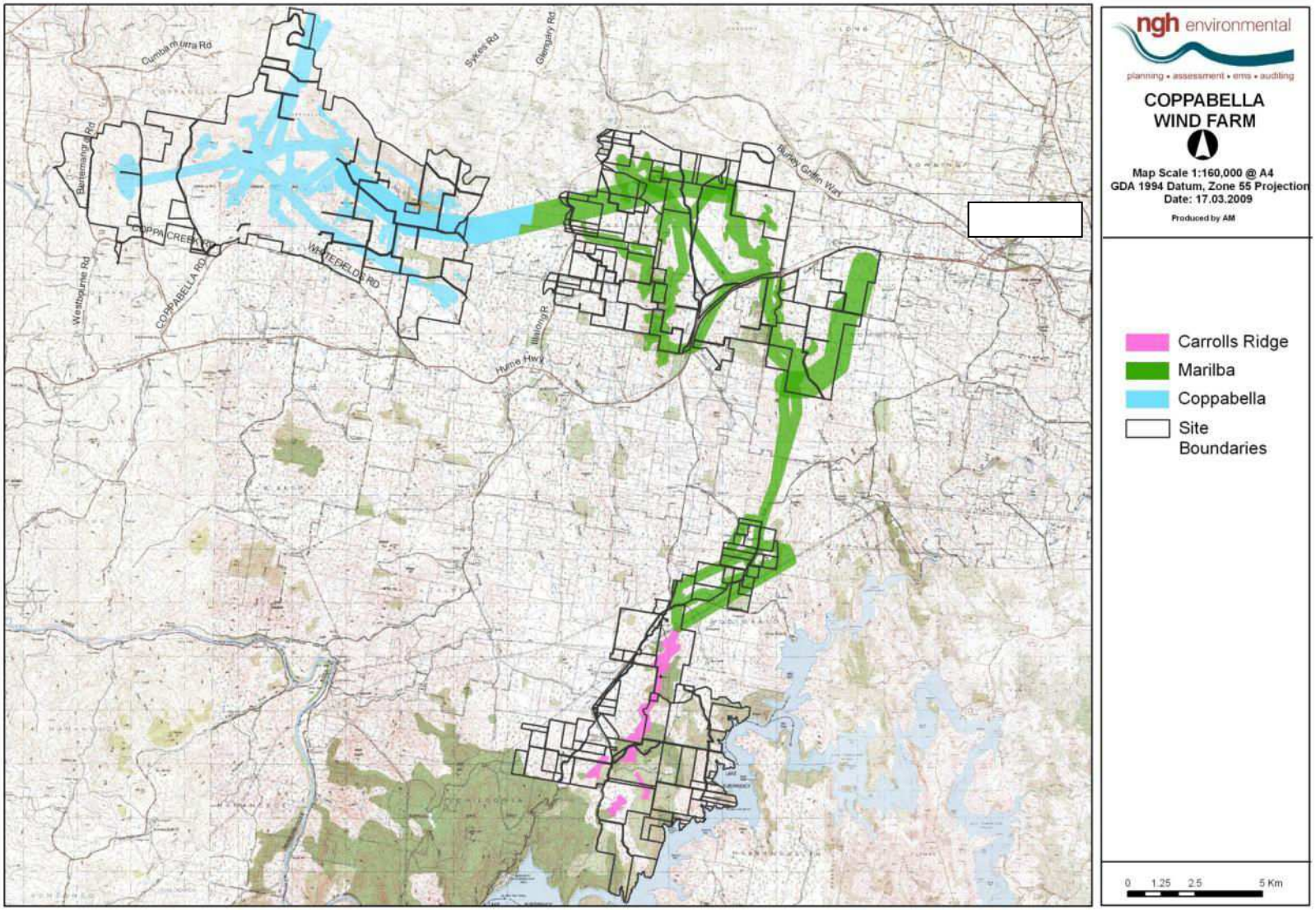


Figure 1-1 Proposed Yass Wind Farm overview map.

Development envelopes of the Coppabella Hills Precinct (top left in blue), Marilba Hills (green) and Carrolls Ridge (pink).

2 ASSESSMENT APPROACH

2.1 AIMS OF THIS DOCUMENT

The preparation of the Biodiversity Assessment involved desktop research, consultations with persons with local and specialist knowledge, fieldwork, data analysis, significance assessment and report compilation. The Biodiversity Assessment covers all of the potential areas of direct and indirect impacts associated with the proposal.

In a step-wise approach, this assessment has sought to:

1. Identify the extent and current condition of biodiversity values with potential to be impacted by the proposal.
2. Evaluate the risks to these values, with recourse to the specifics of this proposal and available literature on the biodiversity impacts of wind farms (risk assessments and threatened species evaluations, Section 5 and 6).
3. Characterise the significance of these risks (using the NSW and Commonwealth Assessments of Significance, Appendix E).
4. Provided a series of measures, including constraints mapping, in order that impacts are avoided or reduced where possible.
5. Apply the 'maintain or improve environmental outcomes' test to the proposal.

2.2 TERMINOLOGY

2.2.1 Subject site and study area

The 'subject site' refers to all areas directly affected by the proposal, and is also referred to as 'development envelope'. 'Direct impacts' are those that directly affect flora and fauna values, and may include trampling, pollution, vegetation clearing and soil disturbance. The term 'study area' includes the subject site and any additional areas which are likely to be affected by the proposal, either directly or indirectly. The study area extends as far as is necessary to take all potential impacts into account. The use of these terms is consistent with the Threatened Species Assessment Guidelines issued by the NSW Department of Environment and Climate Change (DEC 2004).

For referencing purposes in this assessment, each of the eleven discrete turbine clusters has been numbered from west to east. The larger turbine Clusters (3 and 7) have been split into smaller parts (refer to Figure 3-1) to further aid in referencing and discussion.

2.2.2 Development envelope

For a range of practical reasons (discussed further in the Environmental Assessment report for the project), the proposed locations of the wind turbines, transmissions easements and access roads were not able to be precisely defined at the time of the Biodiversity Assessment. The assessment has therefore been broadened to cover all parts of the site which have potential to carry infrastructure,

termed the 'development envelope'. The development envelope approach allows fine-scale development planning and siting decisions to be informed by the findings of this assessment. For example, high biodiversity value areas can be identified and avoided early in the project design process.

The development envelope encompasses ridge and upper slope areas which are nominated for turbine development, transmission access corridors 100 metres wide, proposed road access corridors 50 metres wide and existing road access corridors 20 metres wide. The development envelope for the proposed Coppabella Hills Precinct wind farm is 2829.1 hectares in area, and is shown in Figure 3-1.

Where relevant, the Biodiversity Assessment covers the range of possible impacts within the development envelope, including worst case impact scenarios. This approach is a precautionary response to the uncertainty of wind farm infrastructure positioning and the paucity of scientific research on the impacts of wind farms on biodiversity in Australia.

2.3 DESKTOP RESEARCH AND CONSULTATIONS

Consultation

Information was sourced on threatened species, populations, and communities having potential to be present at the subject site and in the wider study area. Current reference books, research papers, conference papers, wind farm assessments and web tools and publications focusing on relevant species and the study area were sourced. Several experts with local and specialist knowledge have been contacted in relation to threatened flora and fauna in the Yass district specifically for this study, and for earlier surveys within the region (**ngh**environmental 2006). These references are cited in relevant sections of the Biodiversity Assessment. In addition, government representatives and landholders provided relevant local information.

Desktop assessment

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 were used to identify significant environmental features. The Commonwealth Protected Matters search tool using a 50 kilometre buffer was consulted for threatened species, communities and other values listed on the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) that have been recorded or are predicted from the region. The Department of Environment and Climate Chance (DECC) Threatened Species Database was consulted for threatened species, populations or ecological communities listed on the *Threatened Species Conservation Act 1995* (TSC Act) that have been recorded or are predicted to occur from the relevant Catchment Management Authority (CMA) sub-regions: Upper Slopes and Murrumbateman within the Murrumbidgee CMA region. Records of threatened species were obtained from BioNet (which includes collections from the Australian Museum, DECC, NSW State Forests and NSW Fisheries) and the DECC (NPWS) Wildlife Atlas. The full searches are provided in Appendix C.

2.4 FIELD WORK

Site fieldwork for this Biodiversity Assessment was undertaken on 1-3 September, 16-19 September, 8-9 November 2008 and January 19-23 and March 9-10 2009.

A reconnaissance visit was undertaken on 1-3 September 2008 to obtain site information necessary to plan and design the field survey, including broad distribution of vegetation types, key physical features, potential threatened species habitats and access arrangements. The September and November fieldwork sessions 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. The January survey was undertaken specifically to address the potential for high microbat activity onsite[1]. The March survey documented a transmission easement onsite, proposed after the main survey effort.

2.5 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. Dedicated Assessments of 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. Potential impacts to microchiropteran bats were also given specific attention. A series of recommended mitigation measures to avoid and reduce impacts to flora and fauna at the site has been developed, based on identified values and potential impacts. Further, recommendations address the requirement to 'maintain or improve' environmental outcomes as a consequence of the development.

[1] The January microbat survey will be documented as a separate report.

3 THE PROPOSAL

3.1 DESCRIPTION OF THE SITE

The Coppabella Hills Precinct development envelope is located on farmland north the Hume Highway, approximately 35 kilometres west of Yass, New South Wales. The area is characterised by undulating to hilly terrain with broken ridgelines, mostly on volcanic geology.

The site consists of one main north-west to south-east oriented ridgeline and surrounding hills. Areas within the nominated development envelope contain a combination of native and exotic pasture and remnant and regrowth woodland. The ridgelines within the subject site are cleared and have been grazed for many decades and generally carry only scattered remnant trees or small isolated woodland patches.

The site is situated in the upper catchment of Jugiong Creek, which drains to the Murrumbidgee River and the Murray River. There are no major watercourses present at the subject site and there is little remnant tree cover. Several small or intermittent watercourses drain the site northwards to the Jugiong Creek system and south to Lake Burrinjuck.

3.2 PROPOSED WORKS

The Coppabella Hills Precinct would involve the construction, operation and eventual decommissioning of:

- Up to 86 wind turbines, each approximately 5 metres in diameter at the base, with three blades up to 56 metres long mounted on a tubular steel tower 100 metres high. When operational, the minimum height of the turbine blades would be 44 metres above the ground, and the maximum height would be 156 metres.
- Electrical connections between wind turbines using overhead cabling up to 37.5 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 Whitefields Road and Coppabella Road (subject to consultation and engineering assessments), for the construction and maintenance of the wind turbines
- An onsite control room and equipment storage facilities
- A temporary concrete batching plant
- A number of freestanding permanent monitoring masts for wind speed verification and monitoring

The precinct would have a maximum capacity of approximately 3.6 megawatts (likely capacity 2.5MW) and an operational life of up to 30 years. The total area of the development footprint (habitat permanently removed) would be approximately 70 hectares. Turbines may be recommissioned or

decommissioned at the end of 30 years. During decommissioning, all above ground infrastructure would be removed; footings would remain in place.

3.3 GENERAL IMPACT TYPES

Environmental impacts would be associated with construction, operation and decommissioning of the wind turbines and associated infrastructure, as discussed below.

3.3.1 Construction

Construction impacts would occur within a discrete period of between 12-24 months. Direct impacts arising from construction would be temporary. These include vegetation clearing, excavation, and the noise and vibration associated with large machinery. Associated indirect impacts are likely to include erosion, dust, sedimentation and weed ingress. Specific to biodiversity, these impacts equate to removal, modification and fragmentation of habitat.

Vegetation clearing and habitat removal

Turbine footing areas and crane hard stand areas (required adjacent to each turbine), the substation and associated control buildings, access tracks, underground cabling trenches, overhead electricity pole footings, compound areas and stock pile sites would require removal of existing vegetation. The area required to manoeuvre turbine blades into place on top of each tower would require removal of mid and upperstorey vegetation. Similarly, areas beneath electricity easements would require loss or modification of vegetation (i.e. slashing).

Several farm tracks are in place on the property and may be utilised as part of the access requirements. As these are likely to require upgrade, Table 3-1 does not subtract the area of existing tracks. Access roads to the site may also require lopping of removal of upperstorey vegetation in specific areas to allow oversize vehicles to pass.

Excavation

Excavation, including footings, cut and fill batters and the storage and movement of soil, equates to a direct loss of habitat as well as generating potential for indirect impacts including dust, erosion, sedimentation and weed ingress. These indirect impacts can often extend much further, spatially and temporally, than the area of direct excavation.

Increased sedimentation or nutrients that find their way to drainage lines can create ongoing deterioration of water quality and aquatic habitat for many kilometres downstream. Compaction and erosion processes can reduce the ability of soil to support viable vegetation communities and leave them susceptible to weed infestation.

Other construction activities

A concrete batching plant and / or rock-breaking equipment may be established during the construction period to facilitate the construction of turbine footings, hard stand areas and roads. The concrete batching would generate potential for pollution from alkaline wash.

The construction of the substation and gear boxes within the turbines, as well as the use of hydrocarbon fuels carries with it the risk of chemical spills. There is also a risk of soil compaction and fauna collision due to the movement of vehicles across the site.

These activities have the potential to cause direct mortalities as well as remove and modify terrestrial and aquatic habitats. There is potential for indirect impacts including dust, erosion, sedimentation and weed ingress. Spills may affect much larger offsite areas, transported within drainage lines.

Table 3-1 Summary of construction impacts

This table calculates the uppermost areas of direct impact as a percentage of the development envelope (DE). Calculations are based on the indicative infrastructure layout provided by the Proponent.

Coppabella Hills Precinct				
Infrastructure	**Quantity**	**Width (m)**	**Length (m)**	**Area (ha)**
Turbine footing [a]	86.00	25.00	25.00	**5.38**
Crane hardstand [c]	86.00	22.00	40.00	**7.57**
Crane operation area (includes footing and hardstand) [c]	86.00	50.00	50.00	**21.50**
Tracks [a]	1.00	8.00	67063.65	**53.65**
Underground powerlines onsite [c]	1.00	2.00	21905.29	**4.38**
Overhead powerline cabling / easement [b]	1.00	20.00	14517.82	**29.04**
Overhead power pole footings [a]	145.18	1.00	1.00	**0.01**
Substation and control bldg [a]	3.00	2.00	18330.43	**11.00**
Concrete batch plant [c]	1.00	75.00	100.00	**0.75**
Construction compound, staging and storage [c]	1.00	300.00	100.00	**3.00**
Development envelope (DE)				**2829.10**
Percentage of DE permanently removed				**2.48**
Breakdown by impact type:				
a Permanent habitat loss (includes all footings and tracks)				**70.04**
b Habitat modification (transmission easement maintenance)				**29.04**
c Temporary habitat loss (areas that can be rehabilitated post construction)				**24.26**

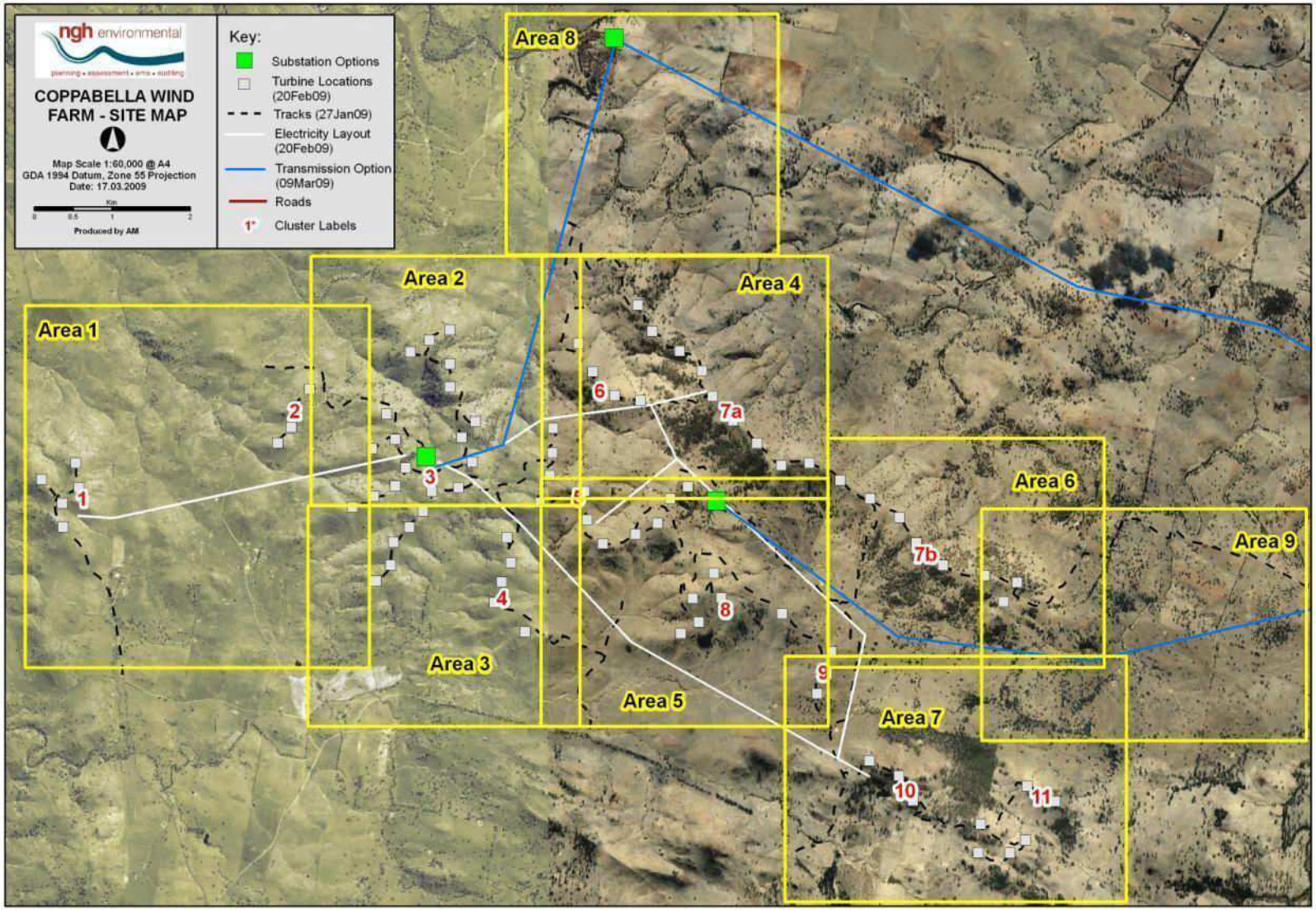


Figure 3-1 Coppabella Hills Precinct development envelope and site boundaries.

The site has been divided into nine map areas and 11 turbines clusters to allow easier discussion.

3.3.2 Operation

Operational impacts on biodiversity values would occur for the duration of the project (considered as 30 years). These may include:

- Habitat avoidance, including alteration of movement or dispersal routes. This may include shadow flicker when the sun is low on the horizon and subaural or low frequency noise effects. This impact is treated as a loss or modification of habitat, for this purpose of this assessment.
- Bird and bat collision with turbine blades
- Barotrauma in bats as a result of atmospheric-pressure drop at turbine blades
- Fauna collision with maintenance vehicles
- Risks of compaction and spills from maintenance vehicles or activities

3.3.3 Decommissioning

Decommissioning impacts are difficult to accurately determine given that construction techniques will progress over the next 30 years. Taking into account these potential technological changes, decommissioning impacts are expected to include the following:

- Vegetation clearing / branch lopping to facilitate the movement of oversize vehicles to the site and to each turbine site. Additional clearing may be required to manoeuvre turbine blades and other infrastructure during disassembly.
- Removal of all above ground infrastructure, requiring limited excavation (concrete slabs and underground cabling would remain in situ)
- Noise and dust would be generated in carrying out the above mentioned activities
- Risks of fauna collision with vehicles
- Risks of compaction and spills from maintenance vehicles or activities

4 REGIONAL CONTEXT

The construction and operation of wind farms have specific characteristics that make it particularly important to examine a broad environmental context when assessing their impact as:

- The turbines can impact migration paths and movement corridors of birds and bats through collision and barotrauma related mortalities, aerial habitat removal and avoidance of habitat
- The transmission easements required to connect the wind farms to the electricity grid can be very long, potentially fragmenting areas of habitat for species of flora and fauna, restricting the movement and dispersal of species
- Upgrades to roads and access trails to facilitate the movement of large machinery onto the locations can disturb road-side vegetation remnants. In modified landscapes, these road side remnants often retain rare species
- The construction of turbines and associated infrastructure may result in key threatening processes such as vegetation clearing, invasion of exotic plants and habitat resource removal. This may result in impacts on local populations of species and communities which may already occur in a cleared and fragmented landscape

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

- **Regional scale:** using data compiled for established regionalisations (South Western Slopes bioregion). Key regional attributes include the abundance, distribution and conservation status of communities and species and the prevalence of threats and disturbance regimes.
- **District scale:** the district scale includes the site, broader study area and the area around for a radius of up to 50 kilometres. Important district-scale factors include foraging and breeding ranges; dispersal patterns and migration routes for fauna; and dispersal and genetic exchange opportunities for flora species.

4.1 REGIONAL SCALE

4.1.1 Regionalisations

Interim Bioregionalisation of Australia (IBRA 5.1)

IBRA bioregions are a landscape-scale approach to land classification using a range of environmental data (Thackway and Cresswell, Environment Australia 2000). There are 17 bioregions across NSW. The study area is located in the South Western Slopes bioregion, close to the South Eastern Highlands Bioregion. Both bioregions capture a wide range of geophysical and biological variation.

Catchment Management Authority (CMA) regions

The study area lies within the Murrumbidgee Catchment, which extends from the Great Dividing Range in the east to the confluence of the Murrumbidgee and Murray Rivers in the west near Balranald. The catchment contains a large variety of landforms and vegetation types, including alpine, montane, tableland and slopes and western plains environments. While many vegetation types in the far eastern parts of the catchment are well represented in conservation reserves, vegetation

elsewhere in the region is poorly conserved (DECC 2008). Box-Gum Woodland and Native Grassland in particular have been extensively cleared and degraded.

CMA sub-regions

CMA sub-regions are based on a simplified overlay of CMA region boundaries with the draft sub-IBRA (V6) boundaries under the IBRA framework (DECC 2008). The study area is located close to the boundary between two sub-regions: Upper Slopes to the west and Murrumbateman to the east. The Upper Slopes sub-region features include Ordovician to Devonian geology, large areas of intrusive granites, steep, hilly and undulating ranges, texture contrast loams and clays grading from red subsoils on upper slopes to yellow subsoils on lower slopes, and shallow stony soils on steep slopes. Vegetation is generally open forests and woodlands (Morgan 2001 in NPWS 2003).

The Murrumbateman sub-region features fine-grained Palaeozoic sedimentary and metasedimentary rocks, with minor areas of coarse acid volcanics, undulating plateaus with rounded hills and peaks, entrenched meandering streams with chain of ponds tributaries. Soils include mottled yellow and brown texture contrast soils with strongly bleached topsoils, dark organic loams and clay loams on valley floors and saline patches. Vegetation is typically Box-Gum Woodland on lower slopes, with Red Stringybark, Bundy and White gum on ridges (Morgan 2001 in NPWS 2003).

Planning Framework for Natural Ecosystems of the ACT and NSW Southern Tablelands

The proposal site also occurs within the South Western Slopes bioregion, 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 Landscape Unit. The Yass Unit is characterised by undulating country largely carrying Box-Gum Woodland. The major land uses are cropping, grazing, rural subdivisions and urban uses, with two major transport links and water-based recreation on Lake Burrinjuck (Fallding 2002). Endemic features include:

- The region's core nesting habitat for Superb Parrot
- The region's only population of Grey-crowned Babbler
- Records of vagrant Major Mitchell's Cockatoos
- Records of Striped Legless Lizard and Pink-tailed Worm-lizard
- The centre of the Yass Daisy distribution
- A minor karst landscape within Hatton's Corner NR.

4.1.2 Flora

A diverse range of vegetation communities occur across the South West Slopes and South Eastern Highlands Bioregions, varying according to topography, soils and micro-climate.

The hill country in the east of the South West Slopes bioregion typically supports Red Stringybark (*Eucalyptus macrorhyncha*) and other species on higher slopes, with White Box (*Eucalyptus albens*), Yellow Box (*Eucalyptus melliodora*) and Blakely's Red Gum (*Eucalyptus blakelyi*) woodland occupying the lower slopes. River Red Gum (*Eucalyptus camaldulensis*) lines the larger central and western streams (NPWS 2003). There are 36 threatened flora species listed in the schedules of the TSC Act in

the bioregion. Of these, 13 are endangered, 22 are listed as vulnerable and one species, *Euphrasia arguta*, is considered extinct in the bioregion (NPWS 2003).

The South-eastern Highlands has a diverse range of vegetation communities, including Yellow Box (*Eucalyptus melliodora*), Red Box (*Eucalyptus polyanthemos*) and Blakely's Red Gum (*Eucalyptus blakelyi*), with areas of white box (*Eucalyptus albens*) occupying 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. There are 88 species listed in the schedules of the TSC Act in the bioregion; 36 are listed as endangered, 50 are listed as vulnerable, and 2 species, *Stemmacantha australis* and *Galium australe*, are considered extinct (NPWS 2003).

In both bioregions, 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 (Fallding 2002), 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. Over 1200 flora species occur in the Southern Tablelands region.

4.1.3 Fauna

Sixty-seven threatened fauna species are found in the South Western Slopes Bioregion; 13 are listed as endangered and 54 are listed as vulnerable (NPWS 2003). Widespread vegetation clearing has caused a decline in woodland-dependent bird, reptile and insect populations.

Eighty-eight threatened fauna species occur in the South Eastern Highlands; 25 are listed as endangered and 63 are listed as vulnerable. Woodland bird species such as the endangered Regent Honeyeater (*Anthochaera phrygia*) have noticeably declined (Australian Terrestrial Biodiversity Assessment 2002 in NPWS 2003) as a result of landscape fragmentation. A decline in groundfeeding insectivores was recently observed in the bioregion (Australian Terrestrial Biodiversity Assessment 2002 in NPWS 2003). Protection and enhancement of woodland fragments is necessary to prevent continued loss of woodland birds. Some bird species such as the Noisy Miner (*Manorina melanocephala*), Australian Magpie (*Gymnorhina tibicen*) and Grey Butcherbird (*Cracticus torquatus*) have substantially increased, consistent with the effects of long term fragmentation (NPWS 2003).

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. Most wetland bird species in the region show signs of long-term decline (Reid *et al.* 2004).

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).

4.1.4 Conservation and environmental management

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 Coppabella Hills Precinct is located in the upper catchment of the Murrumbidgee River. It is estimated that over half of the catchment has been cleared of native vegetation. Some of the areas where native vegetation remains are in severely degraded condition (MCMA 2005).

4.2 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 were examined. The assessment was limited by air photograph quality and existing road access, 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 across a radius of 50 kilometres. Key conservation values include:

- The district forms part of the core breeding area for the threatened Superb Parrot
- The district forms part of the core foraging area for the threatened Eastern Bent-wing Bat and a known maternity cave
- The district is the centre of distribution for the threatened Yass Daisy
- The district contains remnant Box-Gum Woodland (a threatened ecological community)
- A number of conservation reserves are present in the district

4.2.1 District habitat features

Watercourses and wetlands

Two permanent creeks are located to the north of the subject site; Illalong Creek and Jugiong Creek. Each has sections carrying substantial tree cover. The subject site itself contains lower order drainage lines, with little natural vegetation cover.

Jugiong Creek is a tributary of the Murrumbidgee River which runs west-east and is impounded by Lake Burrinjuck around 29 kilometres south-east of the site. The Murrumbidgee River corridor and Lake Burrinjuck are likely to provide locally important habitat for waterbirds, with connectivity to the Murrumbidgee system and more significant wetlands below the dam. The north-west and south –east

oriented ridgelines and valleys provide intermittent connectivity between the subject site and Lake Burrinjuck.

Farmland surrounding the subject site is dotted with small farm dams, which provide ephemeral habitat for mobile waterbirds, but possibly at the expense of river flows and river-dependent species (Reid *et al.* 2005).

Grassland, woodland and forest remnants

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. Woodland remnants contain depauperate or exotic understorey, with many affected by sheep camps. There are some highly restricted and fragmented examples of woodland understorey without tree cover in paddocks and saddles within the study area. There are also fragmented patches of remnant and regrowth woodland with tree cover and relatively intact understorey.

Small Box-Gum Woodland remnants are scattered throughout the Yass district, particularly along roadsides (including Black Range and Illlalong Roads), 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 box-gum woodland. Paddock tree density varies throughout the district and is generally low in the vicinity of the study area. 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 and declining woodland bird species. Threatened and regionally significant plant species are also known to occur in woodland remnants in the district.

Remnant forest in the district is commonly associated with steep slopes and ridges. In view of the general loss of native vegetation in the district, all structurally and floristically intact forest remnants can be considered to have regional conservation value. The closest large area of intact forest is Burrinjuck Nature Reserve, Burrinjuck Waters State Park and adjoining private land[2], which carry tableland dry sclerophyll and montane wet sclerophyll forest types.

4.2.2 Conservation reserves in the district

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.

[2] Some of this private land includes the Carrolls Ridge Precinct, included within the proposed Yass Wind Farm, see Figure 1-1.

Burrinjuck Nature Reserve and Burrinjuck Waters State Park

Burrinjuck Nature Reserve occupies 5,250 hectares and is located approximately 20 kilometres south-west of the study area. The reserve is contiguous with Burrinjuck Waters State Park, on the shores of Lake Burrinjuck, which has a strong recreational management and water catchment 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 (3.9 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 45 kilometres east of the study area. The reserve occupies 1,470 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 45 kilometres south of the study area. Significant fauna recorded in the reserve includes the Eastern Bent-wing Bat, Regent Honeyeater, Gang-gang Cockatoo and White-throated Needle-tail.

Black Andrew Nature Reserve

This is a 1,559 hectare reserve located south of Burrinjuck, around 30 kilometres south 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 hectare 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.

4.2.3 Corridors

Much of the sub-catchment has been cleared of woodland vegetation. Remaining remnants of substantial size (greater than 100-200 ha) are moderately rare in the landscape and linkages between these are limited to intermittent road-side and riparian corridors and smaller 'stepping-stone' woodland patches. Larger patches of remnant vegetation tend to occur on the steep slopes, with flats and ridges cleared for more intensive land use. The largest continuous area of forest and woodland vegetation within the district occurs to the south around Burrinjuck and Black Andrew Nature Reserve and within Bungongo, Wee Jasper, Red Hill and Bondo State Forests (Figure 4-1 Coppabella Hills Precinct district context. The location of Eastern Bentwing-bat maternity cave at Wee Jasper is also shown as this is a target species for the impact assessment.

).

Large water bodies in the district include Lake Burrinjuck, Lake Bethungra and Lake George (semi-permanent). The Murrumbidgee river system connects district wetland habitats including the Yass River and Lake Burrinjuck to wetlands on the slopes and inland of the Great Dividing Range. Nomadic and migratory water birds are likely to pass over the site when moving between large wetland systems.

4.3 NATIONAL AND STATE THREATENED SPECIES AND COMMUNITIES

4.3.1 Threatened Species Conservation Act 1995

The DECC Threatened Species web-based search tool was used to identify threatened species, populations and communities listed under the NSW *Threatened Species Conservation Act 1995* which are known or predicted to occur within the Upper Slopes and Murrumbateman sub-regions of the Murrumbidgee CMA region. The likelihood of the presence of these species, populations and communities at the subject site is evaluated in Appendix D and summarised in Sections 5 and 6.

4.3.2 Environment Protection and Biodiversity Conservation Act 1999

The EPBC Matters of National Environmental Significance reporting tool (ERT) was used to identify significant species, populations and communities listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, within a 50 kilometre radius of the development envelope (Appendix C). The likelihood of the presence of these species, populations and communities at the subject site is evaluated in Appendix D and summarised in Sections 5 and 6.

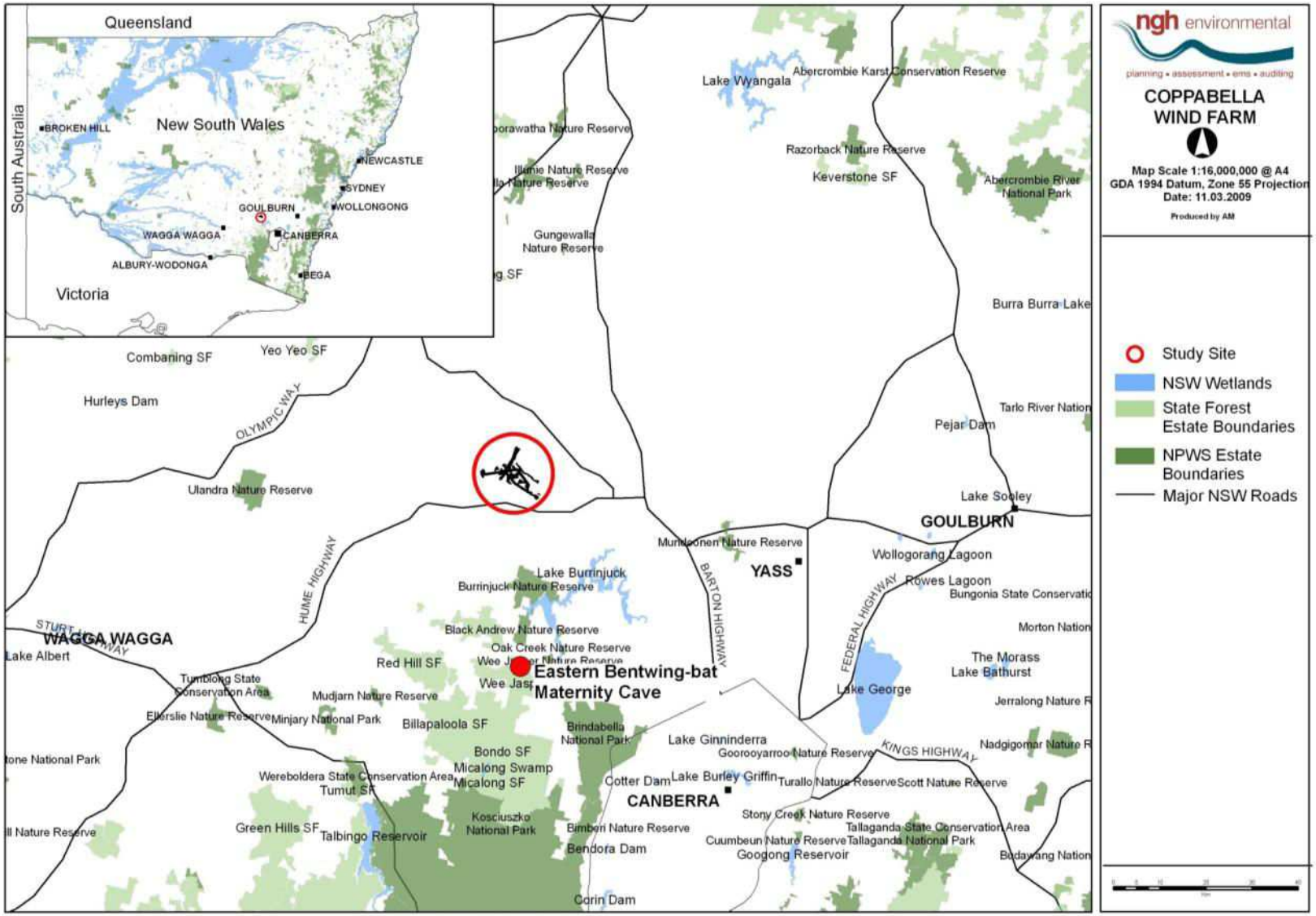


Figure 4-1 Coppabella Hills Precinct district context. The location of Eastern Bentwing-bat maternity cave at Wee Jasper is also shown as this is a target species for the impact assessment.

5 FLORA AND ECOLOGICAL COMMUNITIES

5.1 METHODS

5.1.1 Preliminary assessments

The 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 surveys and records contained in national and state databases were consulted to identify known and potential values. Predictive vegetation mapping (Fallding 2002, Thomas *et al.* 2000) was used to assess the potential for the occurrence of threatened species and communities at the site. Key web-based databases included the Commonwealth Protected Matters search tool using a 50 kilometre buffer, Bionet and the DECC Wildlife Atlas.

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.

A preliminary scoping visit was undertaken on 1-3 September 2008 to obtain site information necessary to plan and design the field survey, including broad distribution of vegetation types, key physical features, potential threatened species habitats and access arrangements.

Vegetation typing, mapping and nomenclature

The identification of specific vegetation types is based on the classification developed for the Southern Region Comprehensive Regional Assessment by Thomas *et al.* (2000), updated by Gellie (2005). 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 GPS unit (Garmin 76), and are based on the GDA 94 datum. The study area is covered by the Binalong and Bookham 1:25,000 topographic map sheets.

5.1.2 Field survey and mapping

Survey effort

The development envelope including representative sections of the grid connection transmission routes were surveyed for flora values on 16-22 September 2008. Additional surveys in areas identified as having potential threatened species habitat were carried out in a follow-up visit, 8 November 2008.

A further survey was undertaken on 10-11 March 2009 to investigate a new transmission easement option, linking the Coppabella Hills and Marilba Hills Precincts substations[3]. This survey focussed on vegetation types and condition.

A total of 70 person hours was spent on the vegetation survey (not including scoping visit). The survey methods and outputs are intended to meet the requirements of the Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities Working Draft (DEC 2004).

The survey area targeted all areas within the 'development envelope' that would potentially be directly or indirectly affected by the proposal. In addition, existing roads and tracks at the site which may be used during construction was examined for significant or sensitive vegetation features. Nearby areas of natural vegetation were also inspected for potential use as offset[4] areas.

Stratification

Following a preliminary scoping visit to the subject site and using aerial photographs, the survey area was stratified based on preliminary vegetation typing, landform and vegetation condition.

5.1.3 Survey methods

A three-tiered approach incorporating plot-based quadrats, traverse (random meanders) and general spot inspection methods was used to ensure that vegetation could be characterised in detail, while providing the areal coverage required for a project of this scale. Points at the centre of the survey sites have been mapped on Figure 5-1[5].

Quadrats

In each vegetation type, a 0.04ha standard quadrat (generally 20 metres x 20 metres) was used to survey vegetation structure and floristics, and site physical values. Examples of representative quadrat data are presented in Appendix A.

Random meanders

Formal random meanders (after Cropper 1993) within relatively homogeneous vegetation of up to 30 minutes duration and covering up to 1 hectare were undertaken at a number of sites in each vegetation type, recording floristics, with structural and physical data. This method complements the quadrat data by improving comprehensiveness in terms of species and variation within types, and improves opportunities for detecting significant or sparsely distributed plant species.

[3] Only the portion of this transmission easement within the Coppabella Hills Precinct site boundary is discussed in this report. The remainder is dealt with in the Marilba Hills Precinct Biodiversity Assessment.

[4] Under the Native Vegetation Act clearing of remnant vegetation or protected regrowth can only be approved when the clearing will improve or maintain environmental outcomes. An 'Offset Plan' can be developed to ensure this outcome is achieved, for example, by managing identified areas for conservation outcomes in perpetuity.

[5] Flora and fauna survey effort are included on the same map set. Separate map sets have been produced for flora results, fauna results and biodiversity constraints.

Spot inspections

In addition to the traverse and plot-based survey sites the majority of the subject site was inspected on foot or by vehicle during the September survey to confirm vegetation types, map the distribution of Endangered Ecological Communities (EECs) and search for threatened species. EECs and areas of natural vegetation in better condition were given particular attention. 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 to Appendix D). A return visit on 8 November targeted areas with greatest potential to support threatened species which may not have been detectable during the September survey such as flowering orchids. Representative areas of heavily disturbed habitats or areas carrying mainly exotic species, such as improved pasture and cropped paddocks, were surveyed to record species composition. Because of their low conservation significance, not all of these highly modified areas were inspected in detail.

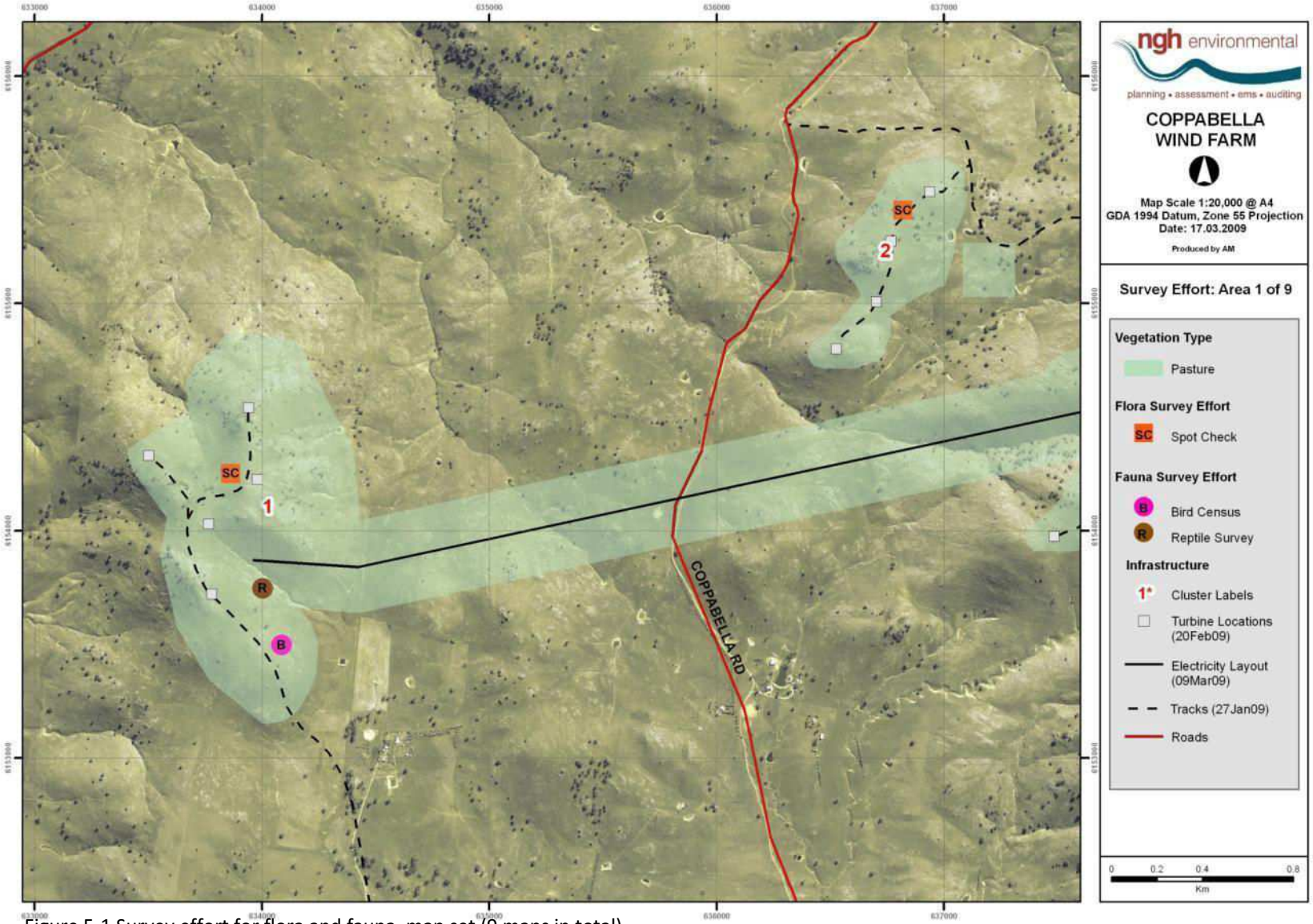
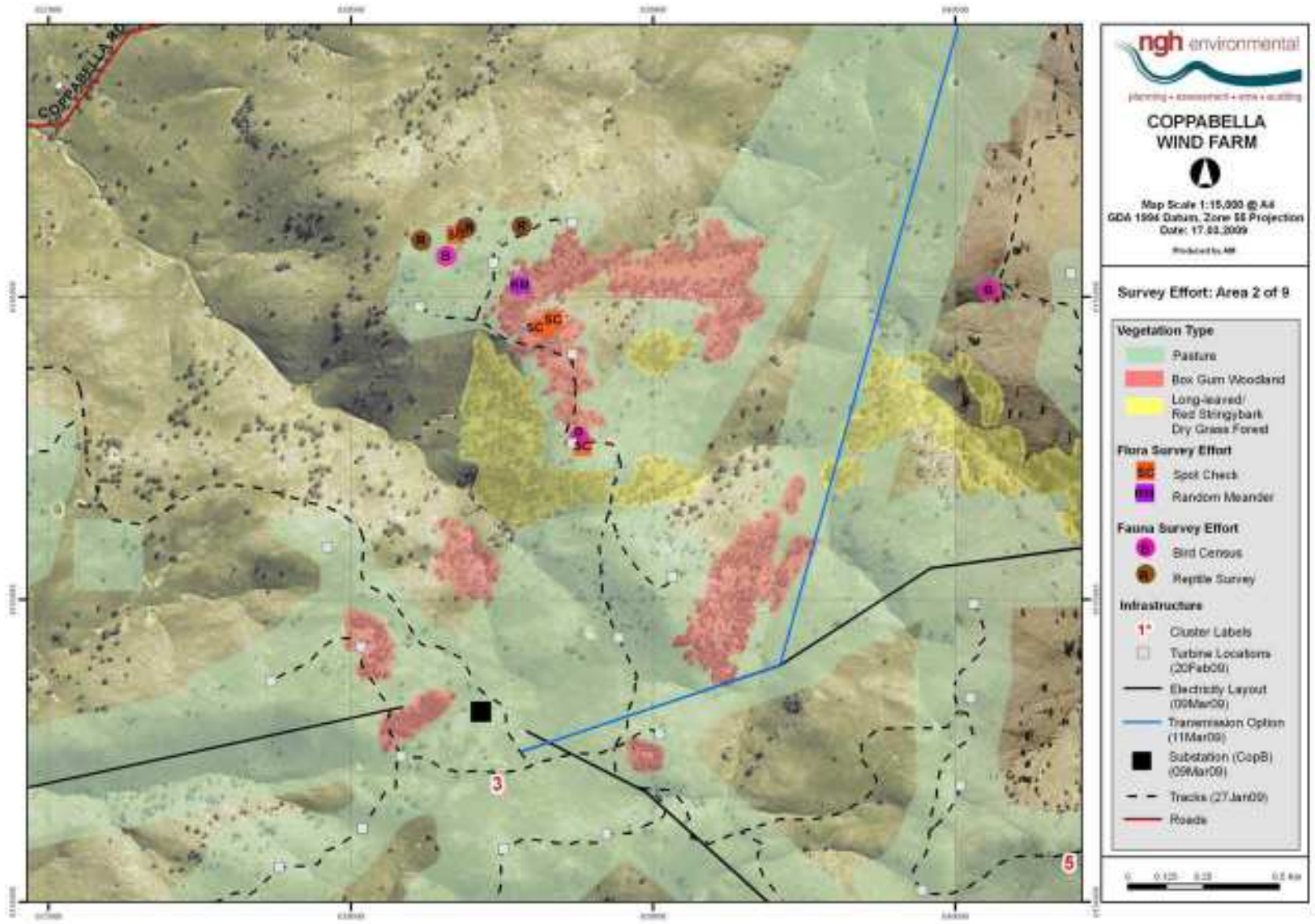
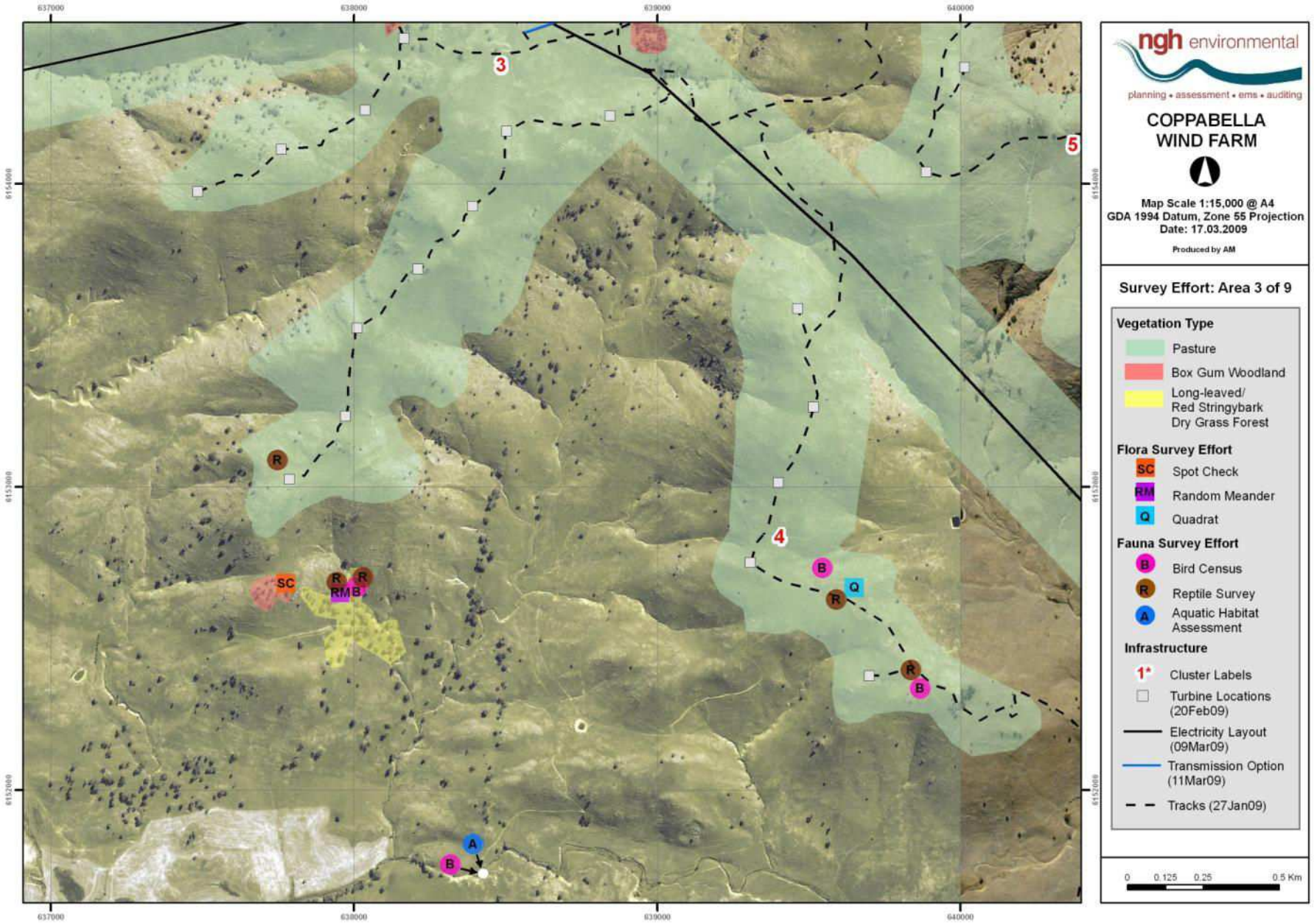
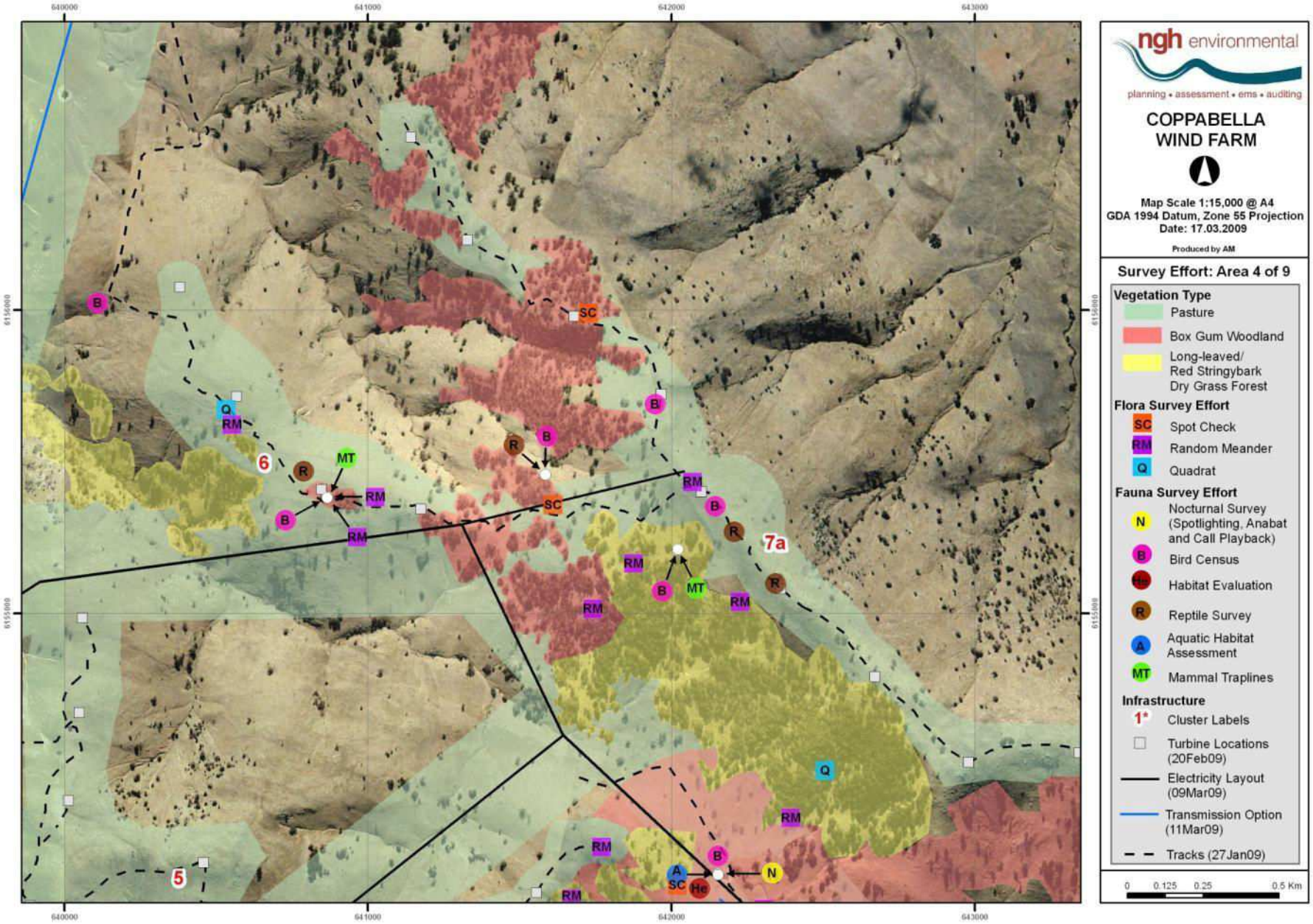


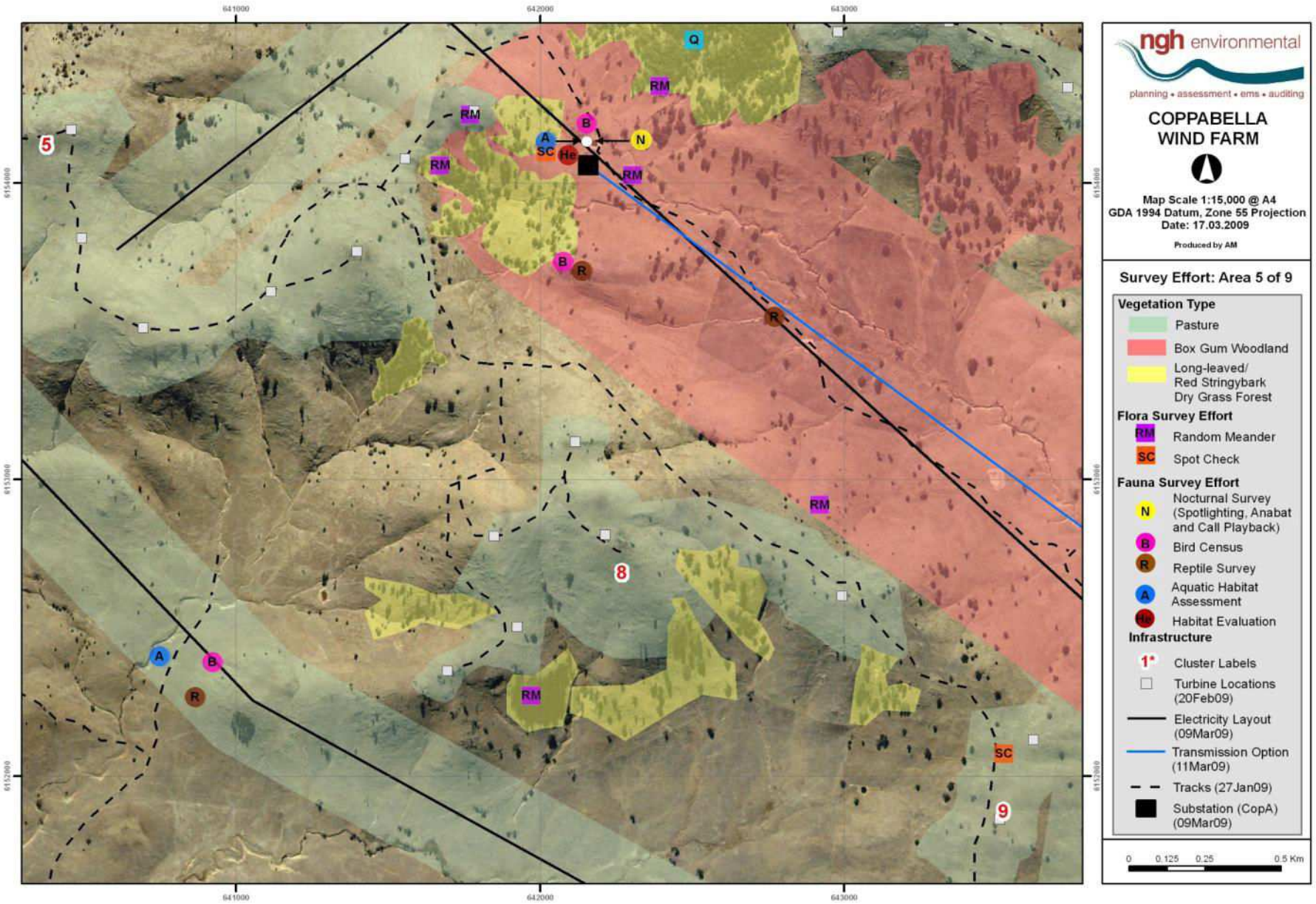
Figure 5-1 Survey effort for flora and fauna, map set (9 maps in total)

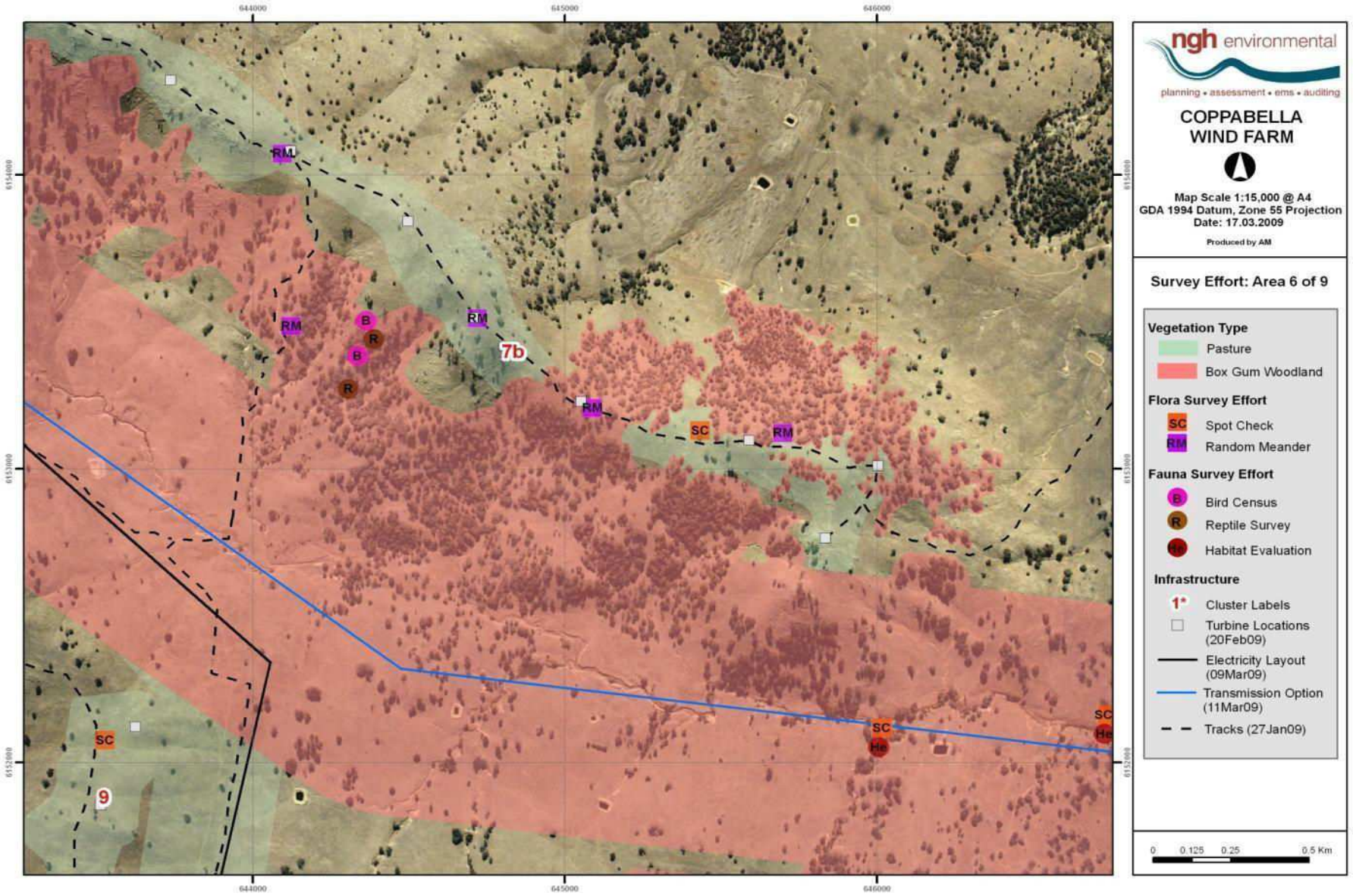
The overview map is presented in Figure 3-1

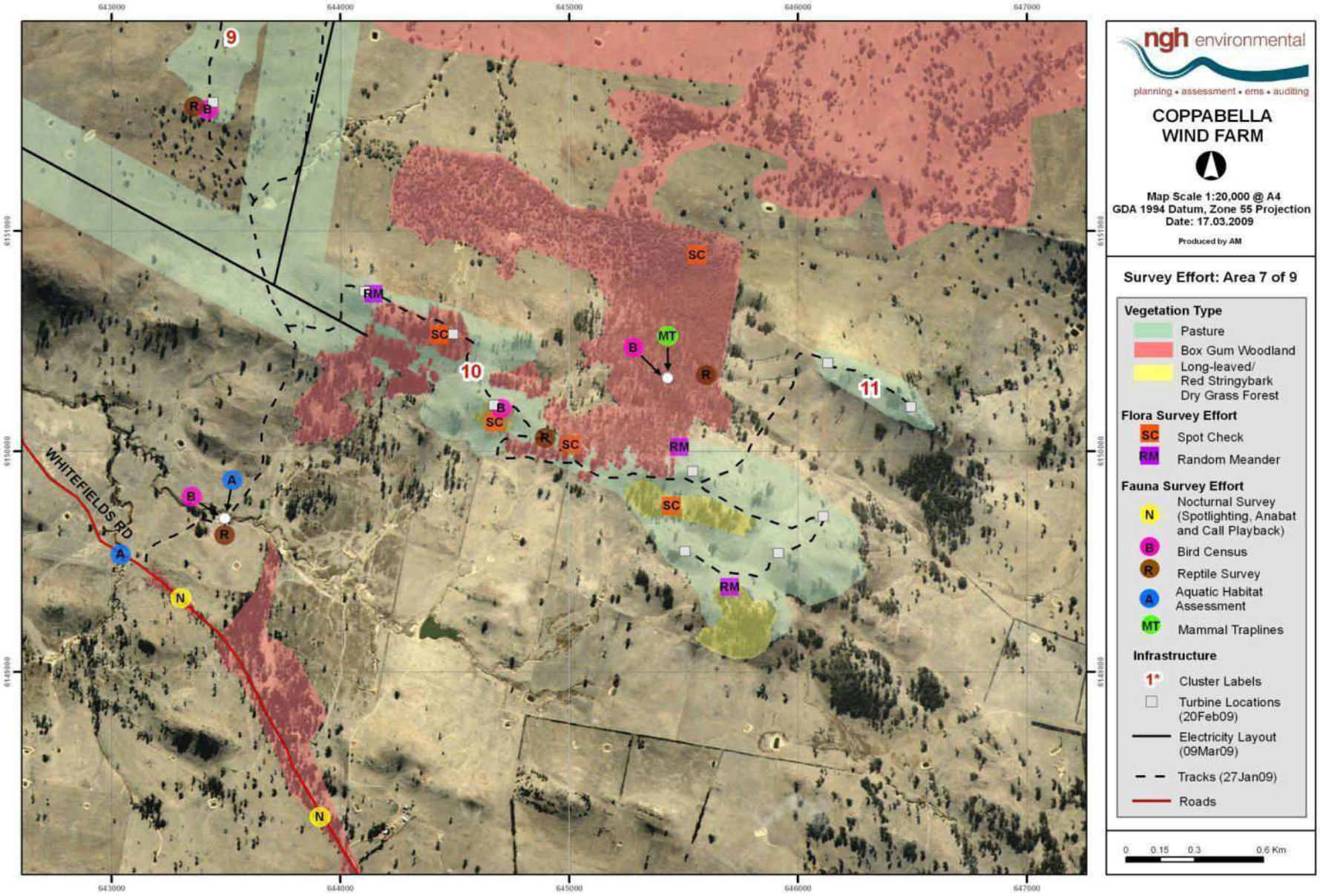

COPPABELLA RD
ngh environmental
COPPABELLA WIND FARM
Map Scale 1:15,000 @ A4
GDA 1996 Datum, Zone 55 Projection
Date: 17.03.2009
Survey Effort: Area 2 of 9
Vegetation Type
Pasture
Box Gum Woodland
Long-leaved/ Red Stringybark Dry Grass Forest
Flora Survey Effort
SC Spot Check
RM Random Meander
Fauna Survey Effort
B Bird Census
R Reptile Survey
Infrastructure
1* Cluster Labels
Turbine Locations (20Feb09)
Electricity Layout (09Mar09)
Transmission Option (11Mar09)
Substation (CopB) (09Mar09)
Tracks (27Jan09)
Roads
3
5

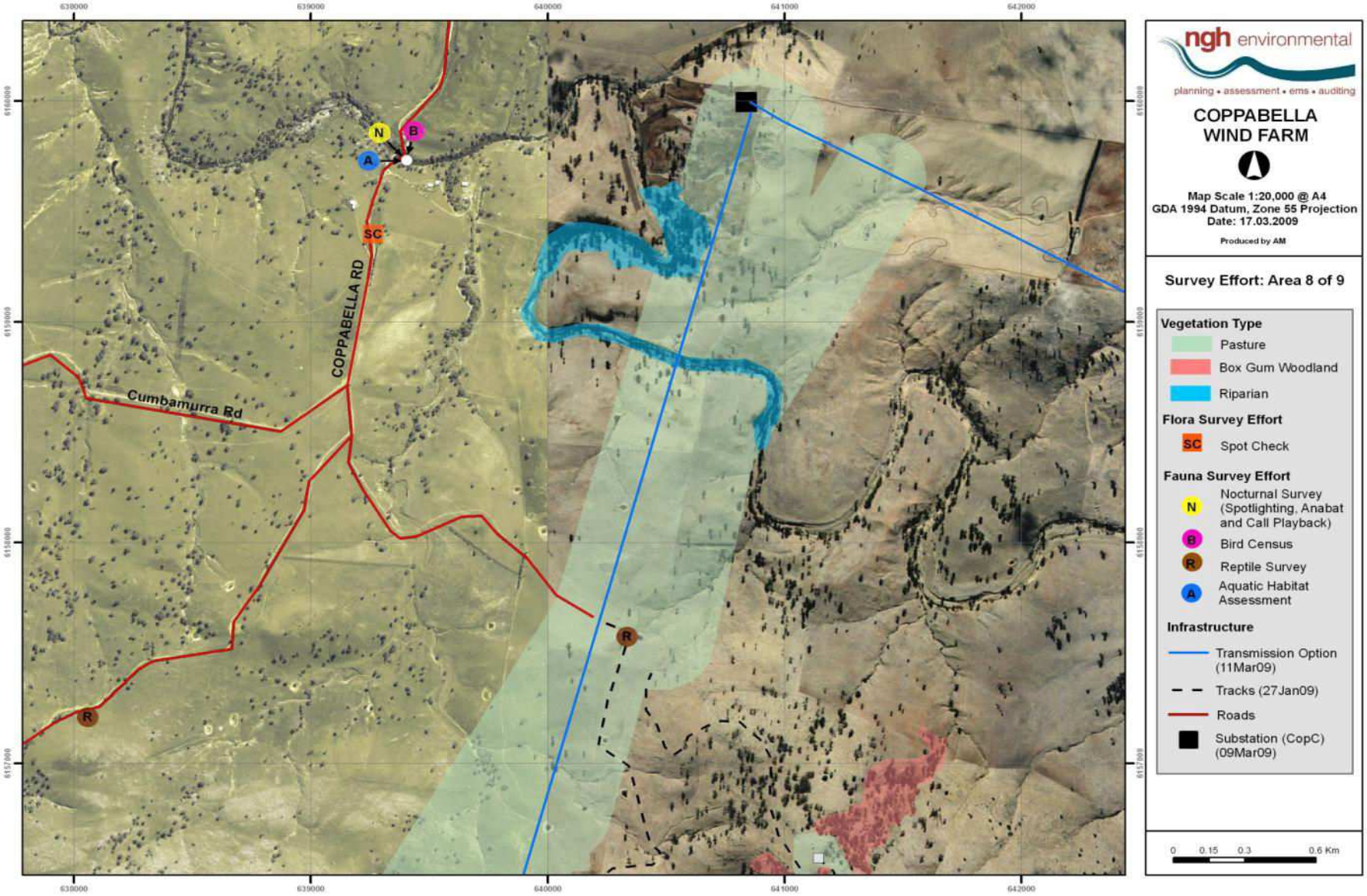

637000
638000
639000
640000
6154000
6153000
6152000
3
4
5
R
SC
RM
B
Q
A
ngh environmental
planning • assessment • ems • auditing
COPPABELLA
WIND FARM
Map Scale 1:15,000 @ A4
GDA 1994 Datum, Zone 55 Projection
Date: 17.03.2009
Produced by AM
Survey Effort: Area 3 of 9
Vegetation Type
Pasture
Box Gum Woodland
Long-leaved/
Red Stringybark
Dry Grass Forest
Flora Survey Effort
SC Spot Check
RM Random Meander
Q Quadrat
Fauna Survey Effort
B Bird Census
R Reptile Survey
A Aquatic Habitat
Assessment
Infrastructure
1* Cluster Labels
Turbine Locations
(20Feb09)
Electricity Layout
(09Mar09)
Transmission Option
(11Mar09)
Tracks (27Jan09)
0 0.125 0.25 0.5 Km

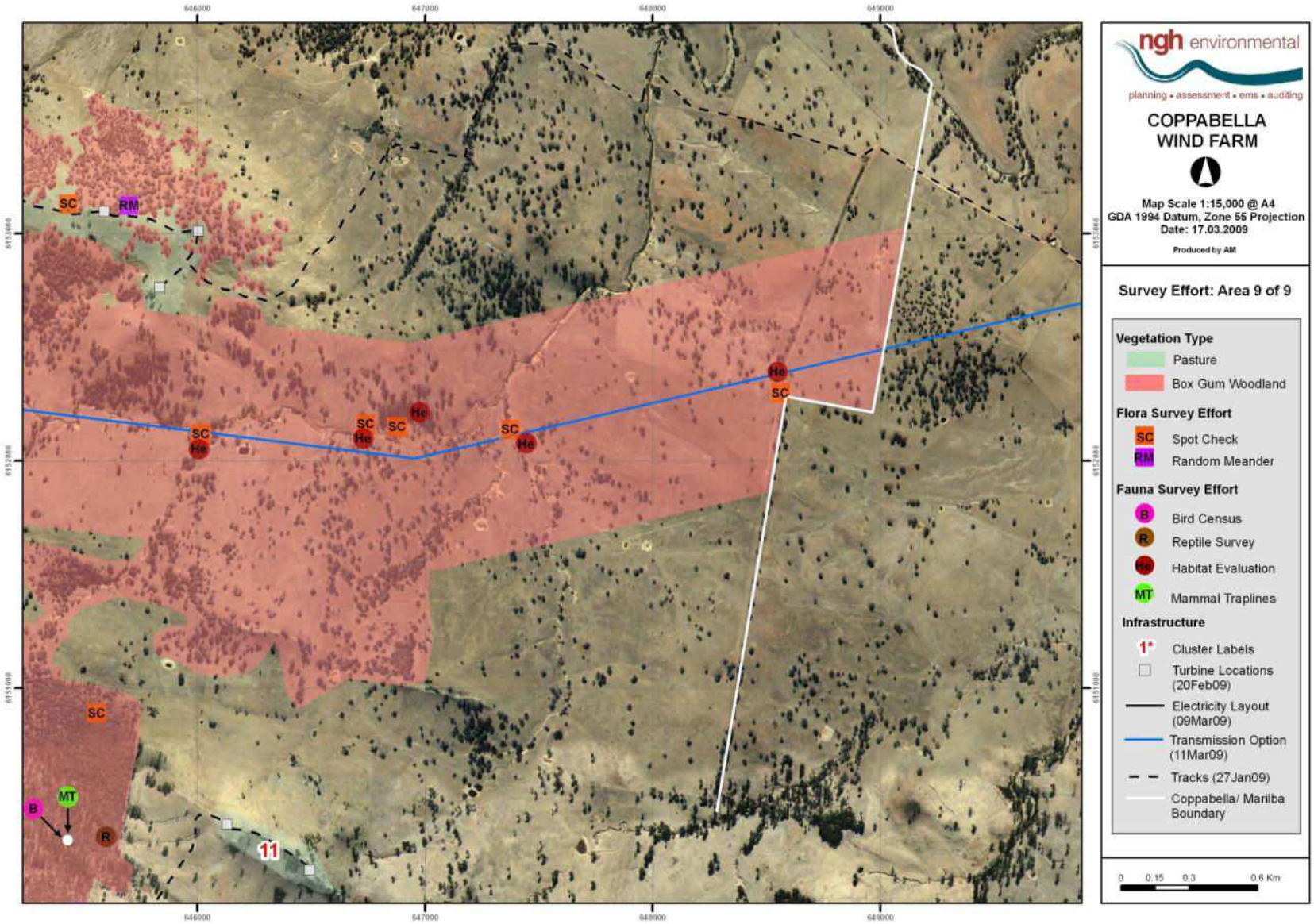

640000
641000
642000
643000
6156000
6155000
ngh environmental
planning • assessment • ems • auditing
COPPABELLA
WIND FARM
Map Scale 1:15,000 @ A4
GDA 1994 Datum, Zone 55 Projection
Date: 17.03.2009
Produced by AM
Survey Effort: Area 4 of 9
Vegetation Type
Pasture
Box Gum Woodland
Long-leaved/
Red Stringybark
Dry Grass Forest
Flora Survey Effort
SC Spot Check
RM Random Meander
Q Quadrat
Fauna Survey Effort
N Nocturnal Survey
(Spotlighting, Anabat
and Call Playback)
B Bird Census
He Habitat Evaluation
R Reptile Survey
A Aquatic Habitat
Assessment
MT Mammal Traplines
Infrastructure
1* Cluster Labels
Turbine Locations
(20Feb09)
Electricity Layout
(09Mar09)
Transmission Option
(11Mar09)
Tracks (27Jan09)
0 0.125 0.25 0.5 Km
5
6
7a


641000
642000
643000
6154000
6153000
6152000
Q
RM
B
A
SC
He
N
R
5
8
9
ngh environmental
planning • assessment • ems • auditing
COPPABELLA
WIND FARM
Map Scale 1:15,000 @ A4
GDA 1994 Datum, Zone 55 Projection
Date: 17.03.2009
Produced by AM
Survey Effort: Area 5 of 9
Vegetation Type
Pasture
Box Gum Woodland
Long-leaved/ Red Stringybark Dry Grass Forest
Flora Survey Effort
Random Meander
Spot Check
Fauna Survey Effort
Nocturnal Survey (Spotlighting, Anabat and Call Playback)
Bird Census
Reptile Survey
Aquatic Habitat Assessment
Habitat Evaluation
Infrastructure
Cluster Labels
Turbine Locations (20Feb09)
Electricity Layout (09Mar09)
Transmission Option (11Mar09)
Tracks (27Jan09)
Substation (CopA) (09Mar09)
0 0.125 0.25 0.5 Km


644000
645000
646000
6154000
6153000
6152000
RM
B
R
7b
SC
He
9
ngh environmental
planning • assessment • ems • auditing
COPPABELLA
WIND FARM
Map Scale 1:15,000 @ A4
GDA 1994 Datum, Zone 55 Projection
Date: 17.03.2009
Produced by AM
Survey Effort: Area 6 of 9
Vegetation Type
Pasture
Box Gum Woodland
Flora Survey Effort
Spot Check
Random Meander
Fauna Survey Effort
Bird Census
Reptile Survey
Habitat Evaluation
Infrastructure
Cluster Labels
Turbine Locations (20Feb09)
Electricity Layout (09Mar09)
Transmission Option (11Mar09)
Tracks (27Jan09)
0
0.125
0.25
0.5 Km


643000
644000
645000
646000
647000
6151000
6150000
6149000
9
10
11
WHITEFIELDS RD
SC
RM
MT
B
R
A
N
ngh environmental
planning • assessment • ems • auditing
COPPABELLA
WIND FARM
Map Scale 1:20,000 @ A4
GDA 1994 Datum, Zone 55 Projection
Date: 17.03.2009
Produced by AM
Survey Effort: Area 7 of 9
Vegetation Type
Pasture
Box Gum Woodland
Long-leaved/
Red Stringybark
Dry Grass Forest
Flora Survey Effort
SC Spot Check
RM Random Meander
Fauna Survey Effort
N Nocturnal Survey
(Spotlighting, Anabat
and Call Playback)
B Bird Census
R Reptile Survey
A Aquatic Habitat
Assessment
MT Mammal Traplines
Infrastructure
1* Cluster Labels
Turbine Locations
(20Feb09)
Electricity Layout
(09Mar09)
Tracks (27Jan09)
Roads
0 0.15 0.3 0.6 Km


638000
639000
640000
641000
642000
6160000
6159000
6158000
6157000
N
B
A
SC
COPPABELLA RD
Cumbamurra Rd
R
R
ngh environmental
planning • assessment • ems • auditing
COPPABELLA
WIND FARM
Map Scale 1:20,000 @ A4
GDA 1994 Datum, Zone 55 Projection
Date: 17.03.2009
Produced by AM
Survey Effort: Area 8 of 9
Vegetation Type
Pasture
Box Gum Woodland
Riparian
Flora Survey Effort
SC Spot Check
Fauna Survey Effort
N Nocturnal Survey (Spotlighting, Anabat and Call Playback)
B Bird Census
R Reptile Survey
A Aquatic Habitat Assessment
Infrastructure
Transmission Option (11Mar09)
Tracks (27Jan09)
Roads
Substation (CopC) (09Mar09)
0 0.15 0.3 0.6 Km


646000
647000
648000
649000
6153000
6152000
6151000
SC
RM
He
B
R
MT
11
ngh environmental
planning • assessment • ems • auditing
COPPABELLA
WIND FARM
Map Scale 1:15,000 @ A4
GDA 1994 Datum, Zone 55 Projection
Date: 17.03.2009
Produced by AM
Survey Effort: Area 9 of 9
Vegetation Type
Pasture
Box Gum Woodland
Flora Survey Effort
Spot Check
Random Meander
Fauna Survey Effort
Bird Census
Reptile Survey
Habitat Evaluation
Mammal Traplines
Infrastructure
Cluster Labels
Turbine Locations (20Feb09)
Electricity Layout (09Mar09)
Transmission Option (11Mar09)
Tracks (27Jan09)
Coppabella/ Marilba Boundary
0 0.15 0.3 0.6 Km

Condition assessment

Condition was rated according to a five-point condition class scale, focusing on floristic integrity in the understorey:

Poor	Groundcover dominated by exotic species
Poor-moderate	Groundcover dominated by one or two native grass species, very few native forbs
Moderate	Groundcover dominated by several native grasses, native forbs present but low diversity
Moderate-good	Groundcover dominated by several native grasses with a range of native forbs
Good	High groundcover diversity, including significant forb species.

5.1.4 Threatened species and communities

Threatened species and communities listed under the TSC Act or the EPBC Act were specifically targeted in the assessment. Threatened species or communities recorded from the region, or with potential to occur there, were identified using previous survey records and a DECC threatened species search based on the relevant Catchment Management Authority (CMA) sub-regions. 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') listing under the TSC Act draws on the definition provided in the DECC online profile (DECC 2008b), the DECC final determination (NSW Scientific Committee 2002), the NPWS fact sheet and the identification guidelines for the EEC (NPWS undated-a; b). Verbal advice was sought from DECC staff (A. Treweek, R. Rehwinkel, pers.com) where matters of EEC definition were problematic. The identification of the Critically Endangered community White Box - Yellow Box - Blakely's Red Gum Grassy Woodlands and Derived Native Grasslands listed under the Commonwealth EPBC Act relies on the Commonwealth listing and conservation advice provided on the Australian Government Department of the Environment, Water, Heritage and the Arts (DEWHA) website (Threatened Species Scientific Committee 2006a; b). A precautionary approach has been adopted where distribution and habitat information is incomplete or uncertain.

5.1.5 Survey limitations

Survey extent

The development envelope survey area covers approximately 2,829.1 hectares, which includes substantial buffer areas to allow for the fine-scale planning and siting of elements of the proposed development. Given the large area, not all of the site could be inspected in detail.

Closer attention was paid to areas supporting predominantly native Box-Gum Woodland understorey and remnant forest. Representative areas of pasture dominated by exotics were surveyed to record general species composition. Where potential habitat was present, targeted searches for threatened species were undertaken in representative areas, particularly in Box-Gum Woodland remnants.

Specific areas that would be affected by road construction, realignment, widening or other improvement works were not defined at the time of survey and therefore, could not be surveyed in detail. However observations of EEC presence along access track or road verges were noted.

Survey timing

The main survey effort was undertaken in early spring, following good rainfall approximately a month earlier. This is likely to have introduced a bias toward fast-growing annual and perennial species, particularly exotic weed and pasture species and may have masked the 'normal' representation of native perennial grasses and forbs at the site. Most grasses were not identifiable with certainty at the time of the September survey, other than by dried remains of the previous season's fruiting stems, so the proportion of the cover provided by the various grass species could not be estimated accurately. A return visit to the site in November 2008 increased the certainty of grass identification and proportional cover of native grasses.

Some geophytic species (such as terrestrial orchids and lilies) which flower outside the survey period will not have been recorded, and some species could be identified only to genus, due to lack of fertile material. Conversely, some species which are only apparent at this time (e.g. *Wurmbea* spp) were abundant during the survey period but would not have been detected by a later survey. Ephemeral species which flower in response to irregular disturbance events such as fire will also have gone unrecorded.

A further survey was undertaken on 10-11 March 2009 to investigate a new transmission easement option, between the Coppabella Hills and Marilba Hills Precincts. Conditions in March were very dry, but grass seed heads were still reasonably abundant in most areas, so it was possible to determine the nature of the understorey (whether predominantly native or exotic). However, some species are certain to have been overlooked, so the assessment of vegetation condition class could be out by one class. That is, areas assessed as poor-moderate condition could have been moderate in some areas, but insufficient native species were detectable to be able to make this distinction.

Disturbance

Most of the subject site was grazed by sheep at the time of survey and this will have affected the recording of some taller or grazing-sensitive species, particularly grasses. However, the most heavily grazed areas were clearly largely composed of exotic plant species (either all exotic, or exotic forbs among native grasses). Conversely the impact of current grazing on the steeper side slopes where the bulk of the native vegetation occurs appeared low at the time of the survey. Grazing impacts are therefore not likely to have greatly impacted species detection.

Mapping

The vegetation communities present on the site intergrade and overlap, making vegetation mapping problematic. The spatial extent of the different vegetation communities in the region and their condition are related to cover and diversity of native groundcover species. Groundcover composition and condition may be highly variable over a small area, and will often change over time depending on

season, water availability and grazing pressure. These factors, combined with the high level of disturbance to the understorey from grazing makes definition and mapping of vegetation types and their condition in the field or using aerial photographs problematic.

Vegetation mapping focused only on the treed areas on the site and involved extrapolation of field data through aerial photographic interpretation. The overlap of vegetation types, the poor condition of many patches, and the error associated with aerial photography interpretation means that the vegetation mapping can only be considered to be a general representation of the vegetation composition on the site. A precautionary approach has been used where classification of vegetation types is uncertain.

Threatened species and communities

In view of the degree of habitat degradation from grazing over most of the site, it is considered unlikely that any threatened species which have been recorded in the region have been overlooked. However, in view of the limitations discussed above, a precautionary approach has been applied to ensure that the potential for impacts on threatened flora is assessed appropriately. The possibility of unrecorded threatened species occurring on the site has been assessed in the threatened species evaluation and the impact assessment in Section 5.3 and 5.4 of this report.

5.2 ASSESSMENT AND SURVEY RESULTS

5.2.1 Species recorded at the subject site

A total of 165 vascular plant species were recorded during the flora survey, including 51 exotic species. A full list of species recorded in the eleven survey zones (Clusters 1-10 and the potential offset area), and their typical cover/abundance, is provided in Appendix A. One threatened species: Yass Daisy (*Ammobium craspedioides*) was identified at the subject site (Section 5.4).

5.2.2 Vegetation communities

The majority of the study area is farmland that has been cleared and carries a high abundance of exotic forbs and pasture grasses. All parts have been impacted by ongoing sheep or cattle grazing, presumably over many decades. These disturbances made it difficult to enable confident attribution to particular vegetation types. Three broad groupings of Box-Gum Woodland and derived native pasture Southern Region vegetation types defined by Thomas, Gellie and Harrison (2000) and Gellie (2005) most closely correspond to the remnant vegetation present in the study area. These include: Box Gum Woodland, Long-leaved Box-Red Stringybark Dry Shrub/Grass Forest and Riparian River Red Gum Forest and are discussed below.

Full diagnostic species lists and habitat information for the Southern Region CRA vegetation types mentioned are contained in Thomas *et al.* (2000) and Gellie (2005). Box-Gum Woodland is listed as an Endangered Ecological Community under the TSC Act, and a Critically Endangered Ecological Community under the EPBC Act (Section 5.3.1). All three communities present intergrade and overlap, and this combined with the high level of disturbance to the understorey from grazing makes definition and mapping of vegetation types problematic. A full species list for the subject site can be found in

Appendix A. This species list has not been divided by vegetation type, since most species are common to most vegetation types, with only the proportions differing from type to type.

The extent, location, condition class and conservation significance of vegetation within the development envelope is presented in Figure 5-6, Table 5-1 and Table 5-2. Treeless native and exotic pasture habitats dominate the development envelope. The location, condition and conservation significance of these habitats is also discussed below

Woodland communities

Box-Gum Woodland and derived native pasture

Vegetation was conservatively assigned to Box-Gum Woodland if Yellow Box (*Eucalyptus melliodora*), White Box (*E. albens*) or Blakely's Red Gum (*E. blakelyi*) was present, even as a minority component. Box-Gum Woodland with additional tree species Red Box (*E. polyanthemos* ssp *polyanthemos*), Red Stringybark (*E. macrorhyncha*) or Long-leaved Box (*E. goniocalyx*) is present in many parts of the Coppabella Hills Precinct, in varying condition. Unlike many tableland areas where this community is restricted to lower slopes and valley floors and is replaced by a different assemblage (usually including *E. dives* and *E. mannifera*) on more exposed ridge tops, this Box-Gum Woodland community also occurs on ridge tops in parts of the site. This is possibly as a result of the volcanic geology of the area, which has given rise to relatively deep and fertile soils on the ridge tops.

The Box-Gum Woodland community on the site is located on fertile soils, and therefore coincides with prime farmland. It has been heavily impacted by clearing, grazing, cultivation and the introduction of weed and pasture species. Parts of the subject site have lost nearly all evidence of the natural woodland, including most of the ridge crests and much of the intervening valley floors. Relatively intact Box-Gum Woodland remnants are present in a few small areas in saddles on Cluster 10, and in a large remnant on flats north of Cluster 10 (outside the impact zone). Ridgetop woodland remnants generally consist of regrowth eucalypts of Yellow Box, White Box or Blakely's Red Gum with low species diversity groundcover.

Occasional smaller trees, Kurrajong (*Brachychiton populneus*) or Hickory Wattle (*Acacia implexa*), are also a feature of this community. On some cleared ridges only Kurrajongs remain, while Hickory Wattle is most often present as dead trees.

Scattered trees in pasture are frequently in poor condition, with dieback-affected crowns. Shrubs are extremely rare and occur only around Cluster 10 and on the slopes of Cluster 7. Shrubs are generally restricted to only two species: *Hibbertia obtusifolia* and *Melichrus urceolatus*, although a greater diversity of shrubs was found in the woodland flat north of Cluster 10.

The condition of the groundcover of Box-Gum Woodland remnants on the site is extremely variable across the site and appears to coincide with the intensity of grazing. The condition ranges from good in areas with little or no grazing pressure and a range of native forb and grass species present in the understorey (as in parts of Cluster 10); to poor on crests where exotic species are dominant (parts of Clusters 2 and 3). Poor quality Box-Gum Woodland remnants may or may not include a tree stratum and are most often located at the highest points of the landscape where sheep camp. Many poor quality areas carry thistles (**Onopordum acanthium*, **Carthamus lanatus*), Paterson's Curse (**Echium plantagineum*) and European nettle (**Urtica urens*) as the dominant species. In some areas exotic pasture species such as Barley Grass (**Hordeum leporinum*) and Perennial Rye Grass (**Lolium perenne*)

and legumes (*_Trifolium_* spp) may also be abundant, but more often it is exotic forbs which form the bulk of the cover.

Many Box-Gum Woodland remnants along the ridges, saddles and upper slopes on the site are in poor-moderate to moderate condition. These areas generally have few overstorey trees although carry a higher proportion of native grass and forb species, such as grasses *Austrodanthonia* spp., *Austrostipa scabra* ssp *falcata*, *Aristida ramosa*, *Bothriochloa macra*, and *Microlaena stipoides*, with forbs *Rumex brownii, Solenogyne dominii*, *Hypoxis vaginatus, Drosera peltata* and *Wurmbea* spp. In and near some remnant woodland patches forbs such as *Dichondra repens, Hydrocotyle laxiflora* and *Oxalis perennans* persist in small numbers, but often only beneath logs and rock outcrops where grazing pressure is slightly reduced.

Parts of the site with a predominately native understorey have recovery potential if grazing pressure were reduced. Some areas, generally in saddles where native groundcover species tend to dominate, may be capable of producing some tree regeneration and improved native groundcover diversity. Other areas, mostly those on the highest points where turbines would be located, appear to be most heavily impacted by sheep and are unlikely to be capable of recovery as the remaining trees are too stressed to produce seed, and if grazing pressure were reduced exotic groundcovers would simply become more dominant.

There are several closely related Box-Gum Woodland vegetation types described by Thomas *et al.* (2000) and Gellie (2005) which include all or two of White Box, Yellow Box and Blakely's Red Gum. Relevant communities are Forest Ecosystem 116 (*E. macrorhyncha-E. blakelyi*, with occasional *E. melliodora* or *E. goniocalyx*), FE117 (*E. albens-E. blakelyi*), FE120 (*E. macrorhyncha-E. albens* with occasional *E. blakelyi* and *E. polyanthemos*), FE160 (*E. blakelyi-E. melliodora*), FE161 (*E. melliodora*) and FE163 (*E. blakelyi-E. polyanthemos*). All these communities are said to have few or no shrubs and a grassy understorey of very similar species composition, and most of the indicator species mentioned by Gellie (2005) for any of these communities occur on or near the Coppabella Hills Precinct. The SCRA classification is likely to be based on samples from highly disturbed remnants, and any variation in species composition may reflect past management rather than any inherent community differences. Given these identification difficulties, and since all the types have similar EEC conservation status, they have not been distinguished in this assessment.

Lowland woodland and exotic pasture

The original vegetation occupying the lowlands surrounding the clusters, and over much of the proposed transmission routes, is likely to have been Box-Gum Woodland dominated by Yellow Box and Blakely's Red Gum. Modified Box-Gum Woodland remnants are present alongside Whitefields and Illalong Roads. The road verge clusters have a depauperate groundcover, but frequently include large mature trees. In many arable lowland paddocks, soils have been cultivated and fertilised and the understorey has been replaced with exotic pasture, fodder and weed species. Mixed pasture is also present in valley floors in mosaic with less modified native pasture.

Long-leaved Box – Red Stringybark dry grass forest

Long-leaved Box (*E. goniocalyx*) tends to dominate patches of remnant forest or woodland on relatively steep slopes often on sheltered aspects, at Clusters 7, 6 and small parts on Clusters 10, 8, and 5. Apart from a small patch on the eastern end of Cluster 10, all examples of this community are outside the development envelope. Long-leaved Box also occurs with Red Stringybark (*E.*

macrorhyncha) on upper slopes and occasionally ridges as small copses or scattered trees over native pasture (Cluster 8 and 5). The largest area of this community is on the south-west facing slopes of Cluster 7, although this area does include scattered Yellow Box trees, causing it to have been classified as Box Gum woodland, despite the predominance of Long-leaved Box.

Occasional small trees in this community include Kurrajong, and much less commonly Hickory Wattle, Native Cherry (*Exocarpos cupressiformis*) and Drooping Sheoak (*Allocasuarina verticillata*). In all stands understorey vegetation has been modified, with the general elimination of the shrub stratum, except for a very occasional plant of *Hibbertia obtusifolia, Dodonaea viscosa* or *Melichrus urceolatus*. The groundcover varies from largely native on steep midslopes as at Cluster 7 to mostly exotic in small remnants on more heavily grazed ridgetop sites as at site 10 (**Lolium perenne, *Hordeum leporinum, *Urtica urens, *Erodium* spp and thistle spp). Native understorey species at less disturbed sites include grasses *Microlaena stipoides, Elymus scaber, Austrodanthonia* spp., and numerous native forbs including *Geranium solanderi, Poranthera microphylla, Cymbonotus* sp*., Hydrocotyle laxiflora, Wahlenbergia stricta* and many other species, along with annual weeds **Briza maxima* and **Stellaria media*.

This community corresponds most closely to Forest Ecosystem 118: Western Slopes Dry Grass Forest in the Southern Region CRA classification, though a number of very similar communities are described (FE119, Western Tablelands Dry Shrub/Grass Forest, FE121, Northern Tablelands and Slopes Dry Shrub/Grass Forest and FE122, Northern Tablelands and Slopes Dry Shrub/Grass Forest, all of which include several indicator species found on Coppabella Hills Precinct). Key diagnostic species for FE118 present at Coppabella include the trees *Eucalyptus goniocalyx, E. macrorhyncha* and occasionally *E. blakelyi* or *Allocasuarina verticillata*, the shrub *Hibbertia obtusifolia,* the forbs *Gonocarpus tetragynus, Wurmbea dioica, Senecio tenuiflorus* and *Hydrocotyle laxiflora* and the grasses *Microlaena stipoides, Elymus scaber* and *Austrodanthonia* spp.

The difference between Long-leaved Box woodland and Box-Gum Woodland is not well defined in the field, since many stands are of mixed tree species composition. Long-leaved Box Woodland intergrades, and shares many understorey and canopy species, with a number of Box-Gum Woodland vegetation types. Examples of FE188 which have a grassy understorey and a representation of *E. melliodora, E. blakelyi* or *E. albens* may be included in the Box-Gum Woodland EEC/CEEC listed under the TSC Act and the EPBC Act.

The understorey composition can be very similar between the two communities, particularly for stands with similar levels of grazing intensity. Management may have caused initially different understoreys to converge over time due to the elimination of shrubs and more palatable native grasses and forbs. It is not clearly apparent on this site that Long-leaved Box Woodland is a different community from Box-Gum Woodland, although its prominence on sheltered slopes suggests that the two communities may have formerly partitioned the landscape between them based on aspect. Clearing and grazing has since blurred the distinction between them.

Modified riparian habitats: Western Slopes Riparian Moist Sedge Forest/Woodland

A riparian community dominated by River Red Gum (*E. camaldulensis*) with occasional Apple Box (*E. bridgesiana*) is present along Jugiong Creek. Because of its inherent fertility, and due to impacts arising from clearing, grazing, erosion, sedimentation, and disruption to flow regimes, the riparian habitat has been extensively colonised by exotic pasture grasses and weeds. This community falls within a single SCRA Forest Ecosystem: FE43 Western Slopes Riparian Moist Sedge Forest/Woodland. The single

sample of this community seen at Jugiong Creek consisted of very sparse mature River Red Gums, a scatter of young saplings in the creek bed as a result of recent fencing of the riparian zone, a few browsed specimens of bottlebrush *Callistemon sieberi* and an entirely exotic groundcover. Similar vegetation was seen in a less disturbed situation in Travelling Stock Reserve No. 38 on Illalong Road south of the Coppabella Hills Precinct and detected at various points along Illalong Road where the creek closely approaches the road.

Pasture habitats

Native pasture

Treeless pasture dominated by native grasses occurs on upper side slopes and in saddles in mosaic with more highly modified areas dominated by weeds (Figure 5-2 and Figure 5-3). The dominant native grass species in pasture areas were *Austrodanthonia* spp, *Aristida ramosa, Bothriochloa macra, Microlaena stipoides, Austrostipa scabra* ssp *falcata,* and occasional *Panicum effusum* at the time of the survey. The diversity and abundance of native grass and forb species is highly variable between sites and within small areas, and is likely to change over time depending on season, water availability and grazing pressure. To account for this spatial and temporal variability, native pasture areas and exotic pasture areas have been mapped as a single vegetation type.

On most surveyed pasture areas, exotic grasses and forbs were found to dominate native groundcover species. Native pasture tends to occur predominately within saddles and more sheltered areas although potentially occurs in small areas on all clusters and along access roads. It was identified at surveys on Clusters: 6 (partial), 8 (ridge), 9 (ridge), the saddle between 6 and 7, 7b (ridge), 10 (saddle) and 3 (partial, south).

The most commonly encountered native forbs are *Wurmbea dioica, W. latifolia, Hypoxis vaginata, Oxalis perennans, Cymbonotus* sp., *Crassula sieberiana, Solenogyne dominii* and *Drosera peltata*, with occasional *Geranium solanderi, Acaena echinata, Dichondra repens* and *Einadia nutans*. Among sheltered crevices created by rocks are ferns are *Cheilanthes* spp, and very rarely, *Asplenium flabellifolium* or *Pleurosorus rutifolius*. Such native pasture is likely to be derived from Box-Gum Woodland, which is the most widespread community in the area. The composition of native pasture sites reflect a long grazing history and is usually low in native species diversity so that although the bulk of the vegetative cover may be composed of native grasses, the majority of the species present are exotic.

Exotic pasture

The most modified parts of the study area generally occur on the highest points (ridge crests and peaks), where sheep camps are generally located. These carry pasture dominated by exotic grasses (**Lolium perenne, *Hordeum leporinum*), legumes (**Trifolium* spp) and weeds (thistles, **Erodium* spp, **Arctotheca calendula, *Echium plantagineum*), with very little representation of native species (*Rumex brownii, Oxalis perennans* and occasional *Cheilanthes* spp, *Dichondra repens* or *Hydrocotyle laxiflora* where logs or rocks provide a little protection from grazing pressure). Forbs are generally dominated by exotic weed and pasture species.

Figure 5-2 Mixed exotic and native pasture on Cluster 7b (looking west)

Figure 5-3 Mixed exotic and native pasture on Cluster 10 (looking east)

Occasional trees (eucalypts or Kurrajong) occur within this vegetation type, often in poor health. Very rocky areas, such as Cluster 1, also tend to be dominated by exotics, mostly thistles (**Onopordum acanthium* or **Carthamus lanatus*) and European Nettle (**Urtica urens*). No rock outcrops of sufficient size or ruggedness to prevent access by sheep, and hence degradation and weed invasion, were seen on all parts of the site.

Surveyed areas that were dominated by exotics include: Clusters 1 (Figure 5-4), 2 (Figure 5-5) and 4, parts of 5 and 6 (upper slope), parts of 7a and 7b (ridge and upper slope); 3a (upper slope); and parts of 10.

Figure 5-4 Exotic pasture on Cluster 1 (looking east)

Figure 5-5 Exotic pasture on Cluster 2 (looking east)

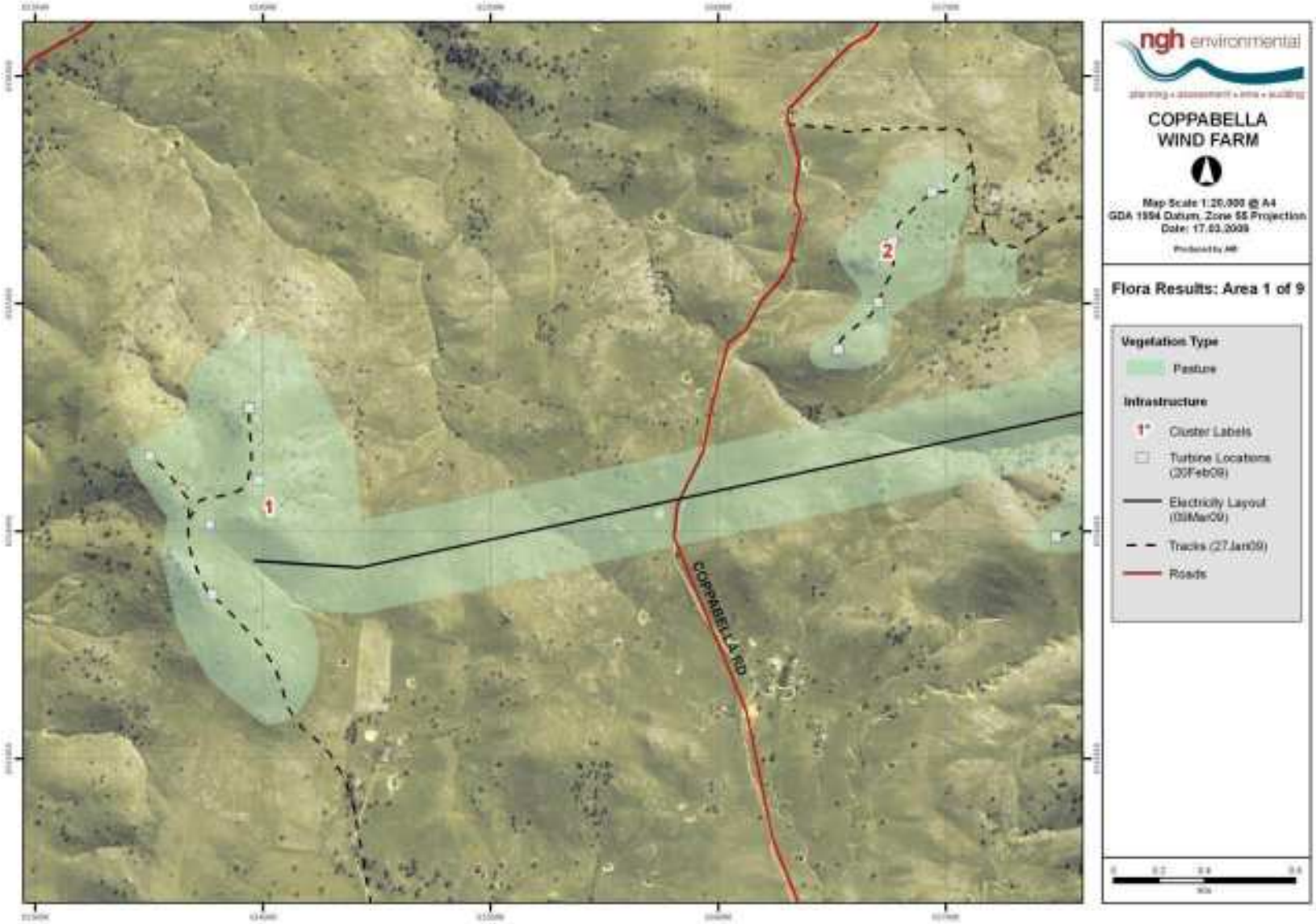
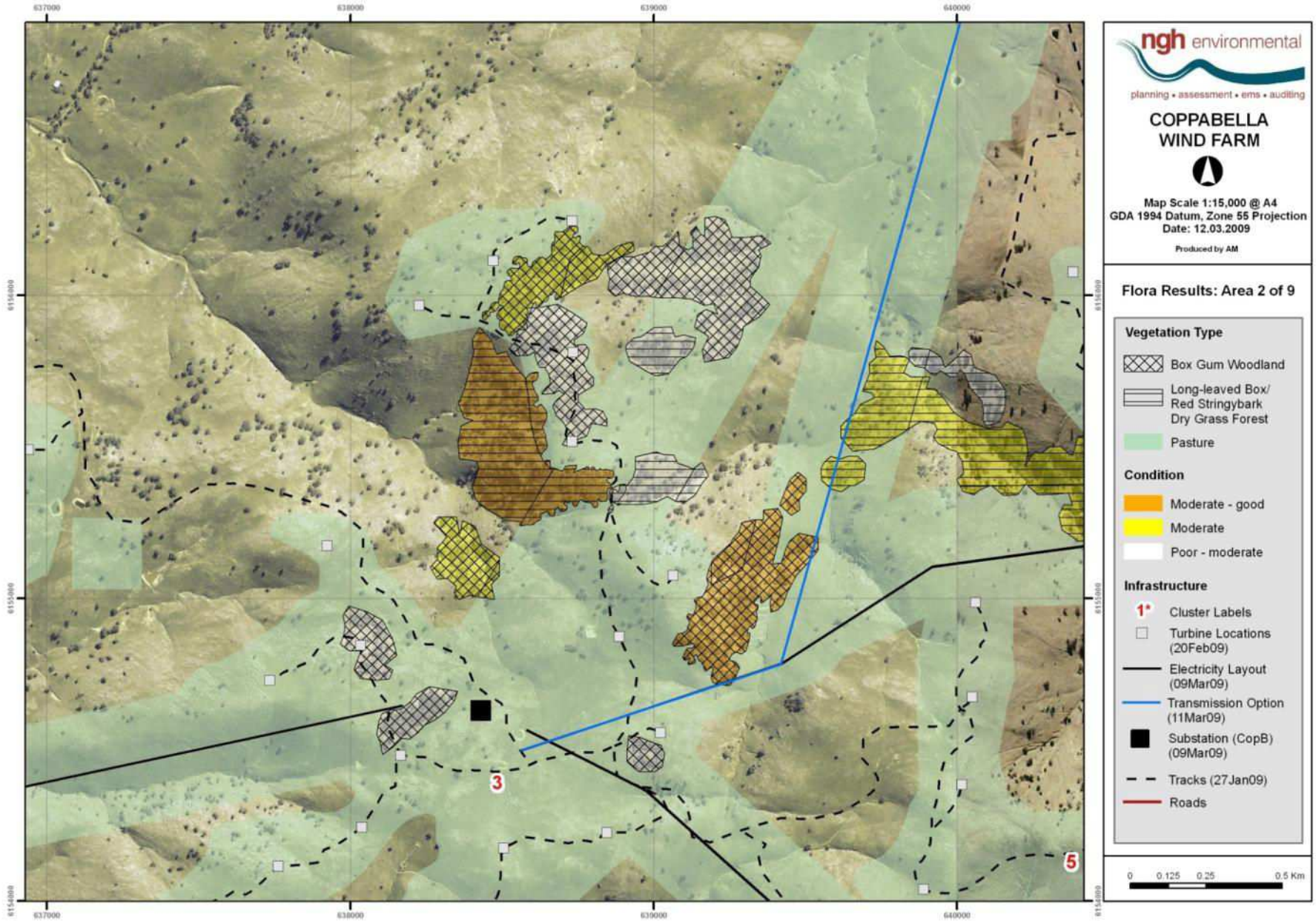
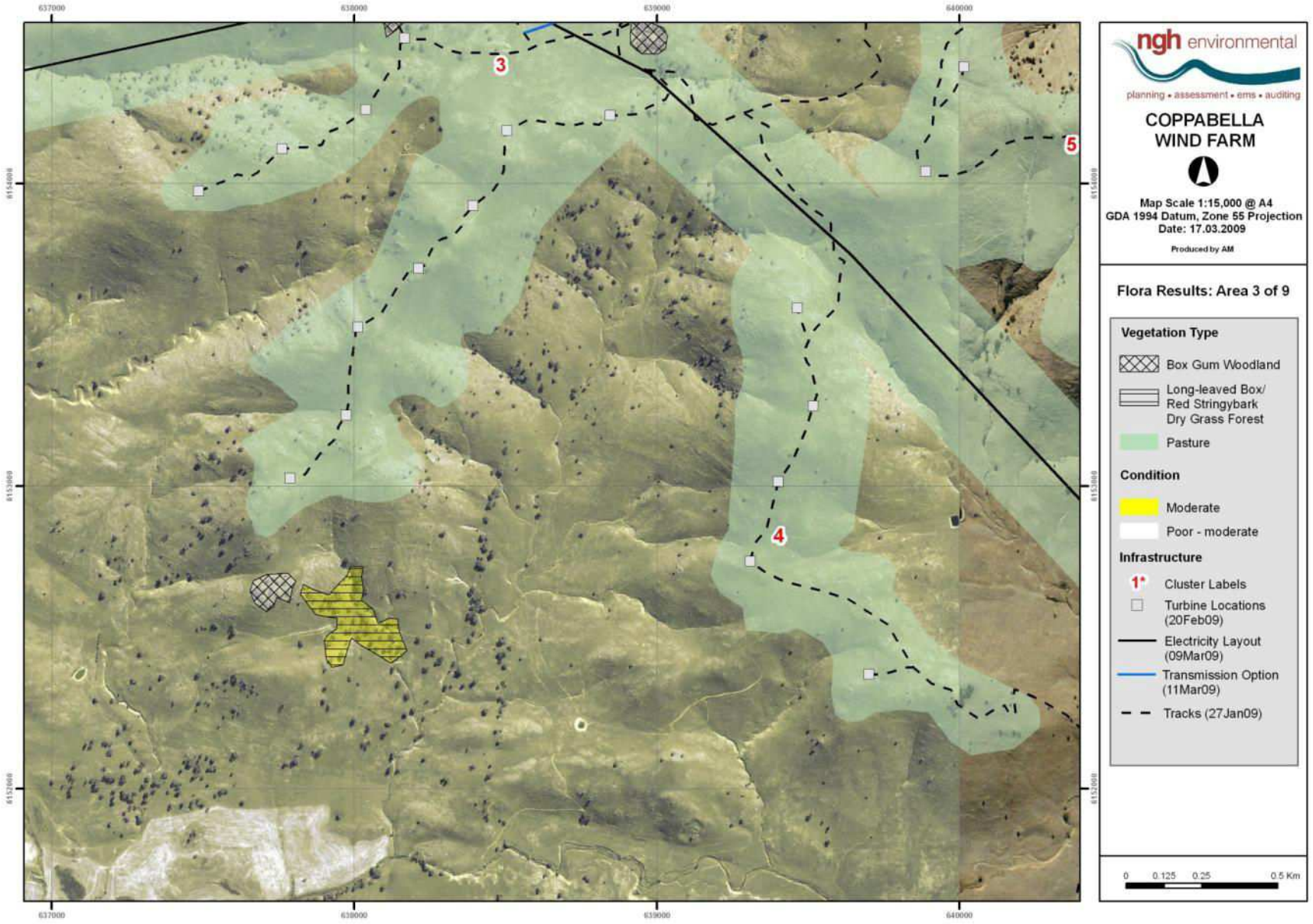
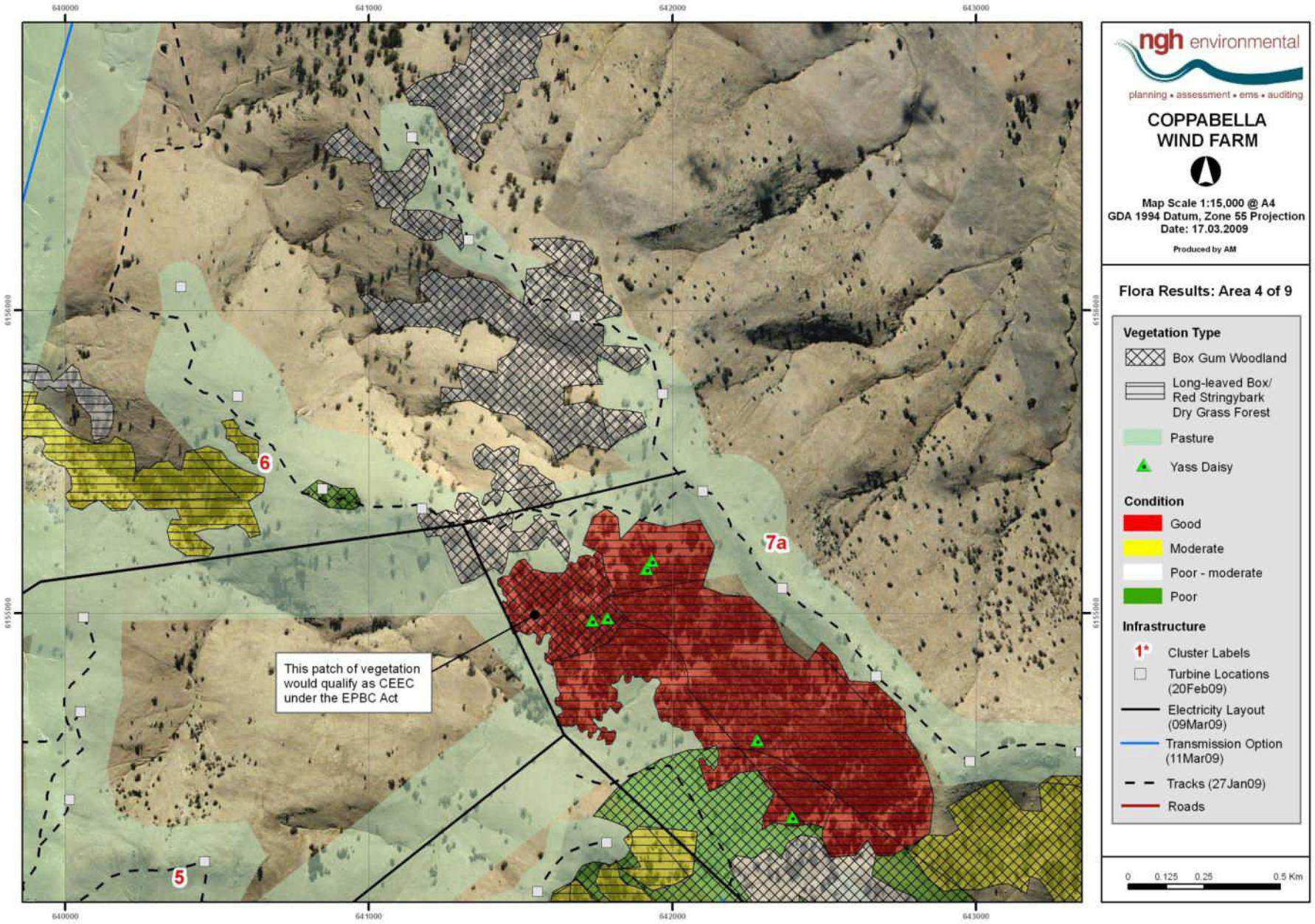
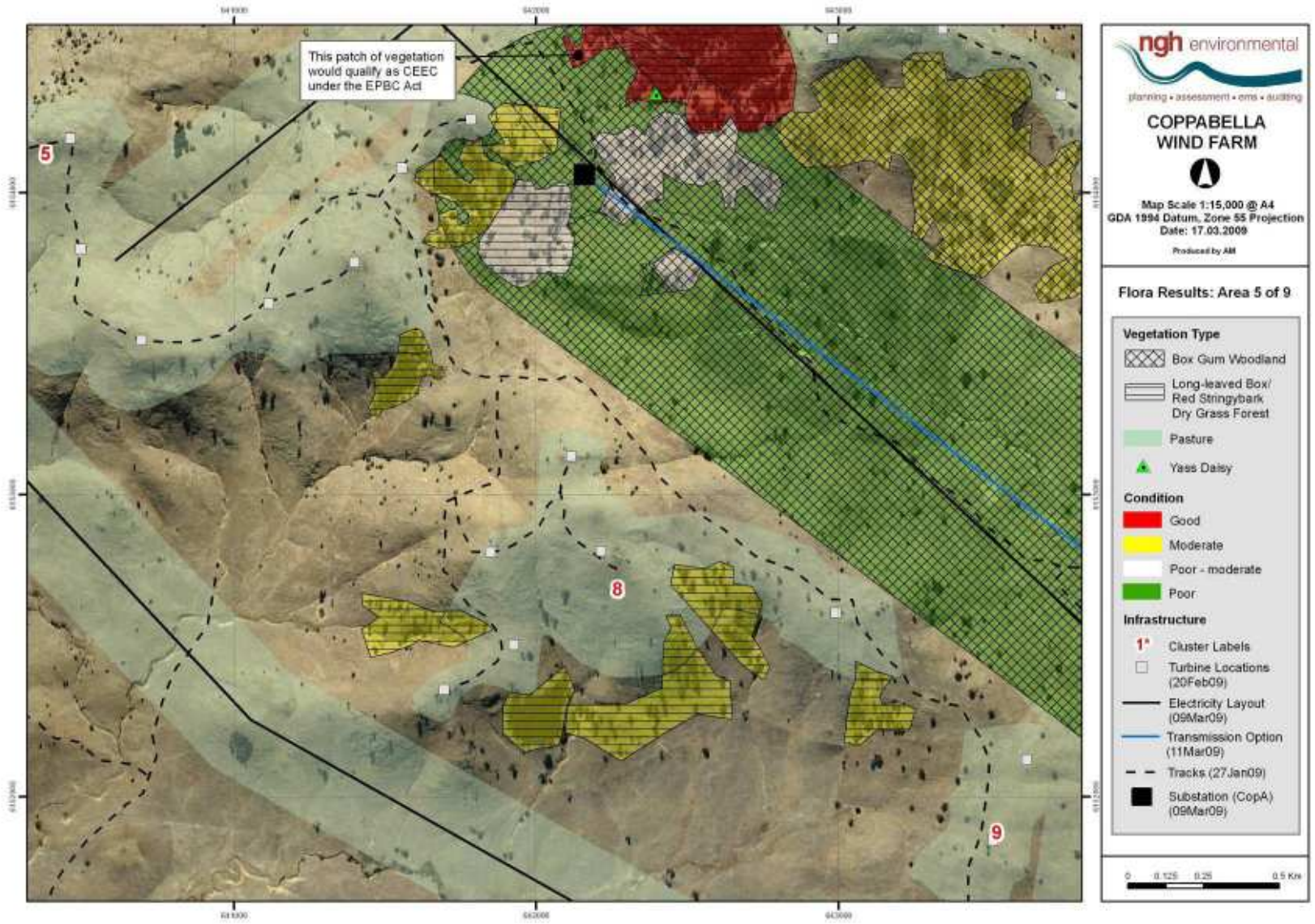


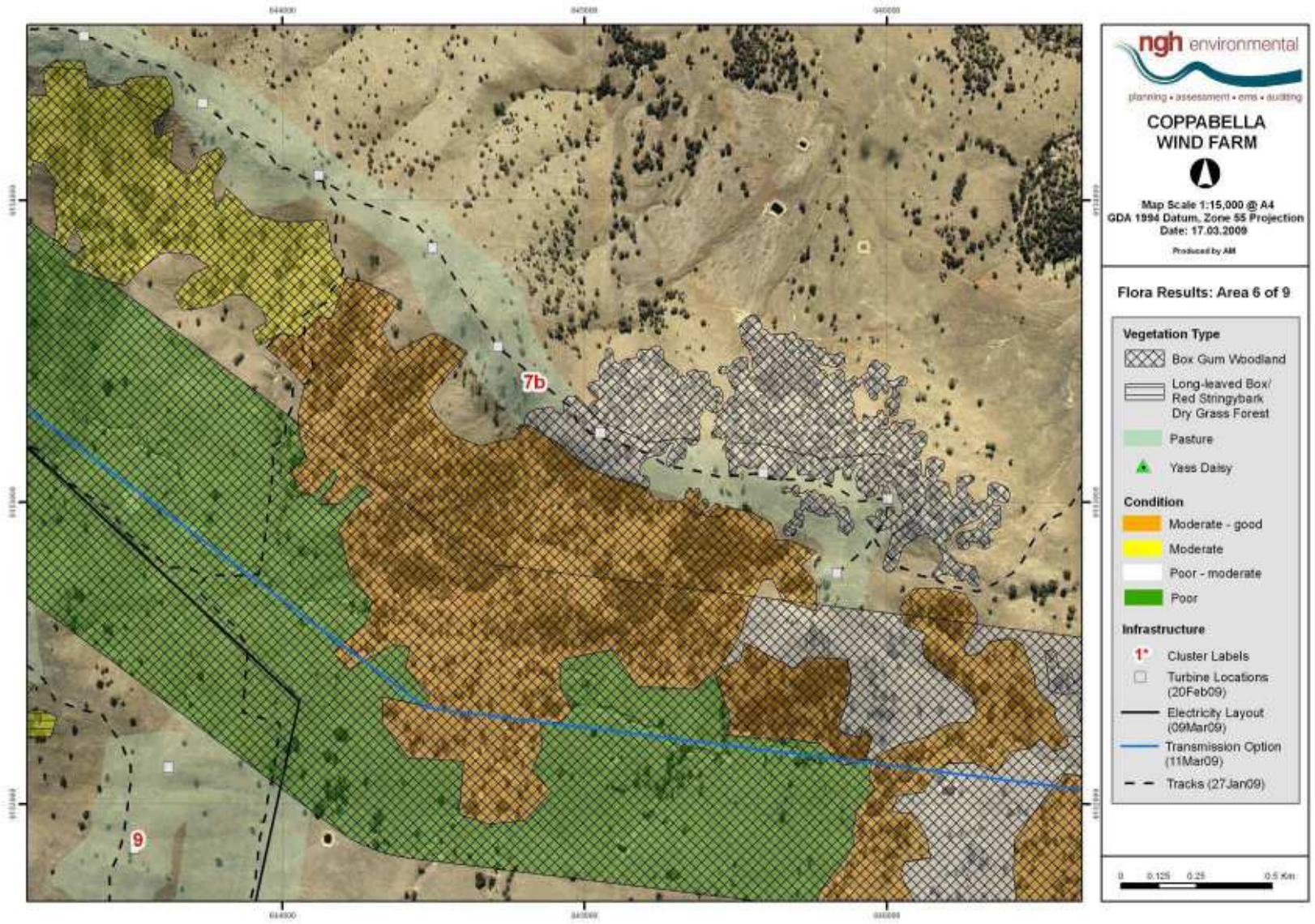
Figure 5-6 Flora results, map set (9 maps in total)

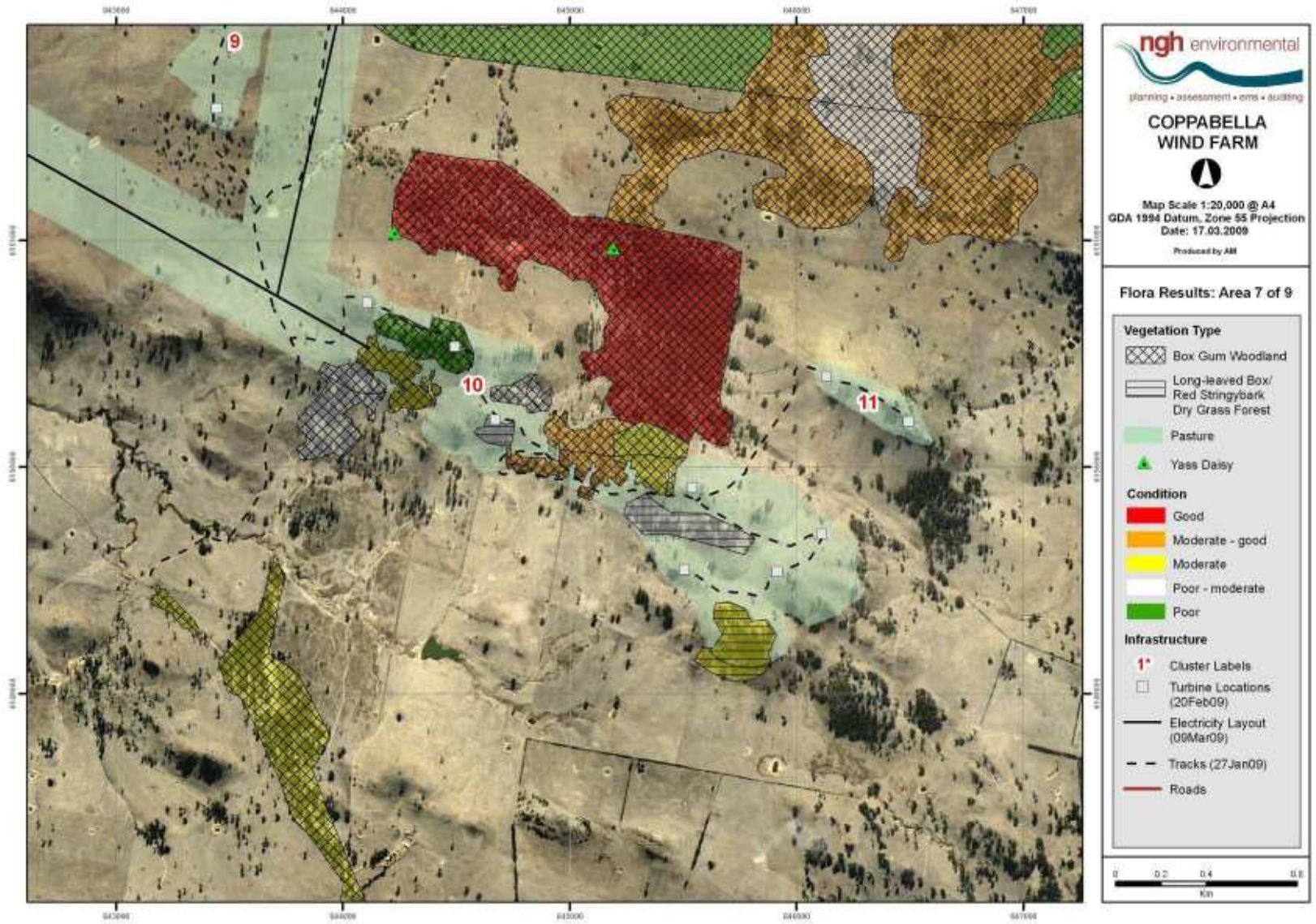

637000
638000
639000
640000
6156000
6155000
6154000
3
5
ngh environmental
planning • assessment • ems • auditing
COPPABELLA
WIND FARM
Map Scale 1:15,000 @ A4
GDA 1994 Datum, Zone 55 Projection
Date: 12.03.2009
Produced by AM
Flora Results: Area 2 of 9
Vegetation Type
Box Gum Woodland
Long-leaved Box/
Red Stringybark
Dry Grass Forest
Pasture
Condition
Moderate - good
Moderate
Poor - moderate
Infrastructure
1*
Cluster Labels
Turbine Locations
(20Feb09)
Electricity Layout
(09Mar09)
Transmission Option
(11Mar09)
Substation (CopB)
(09Mar09)
Tracks (27Jan09)
Roads
0
0.125
0.25
0.5 Km

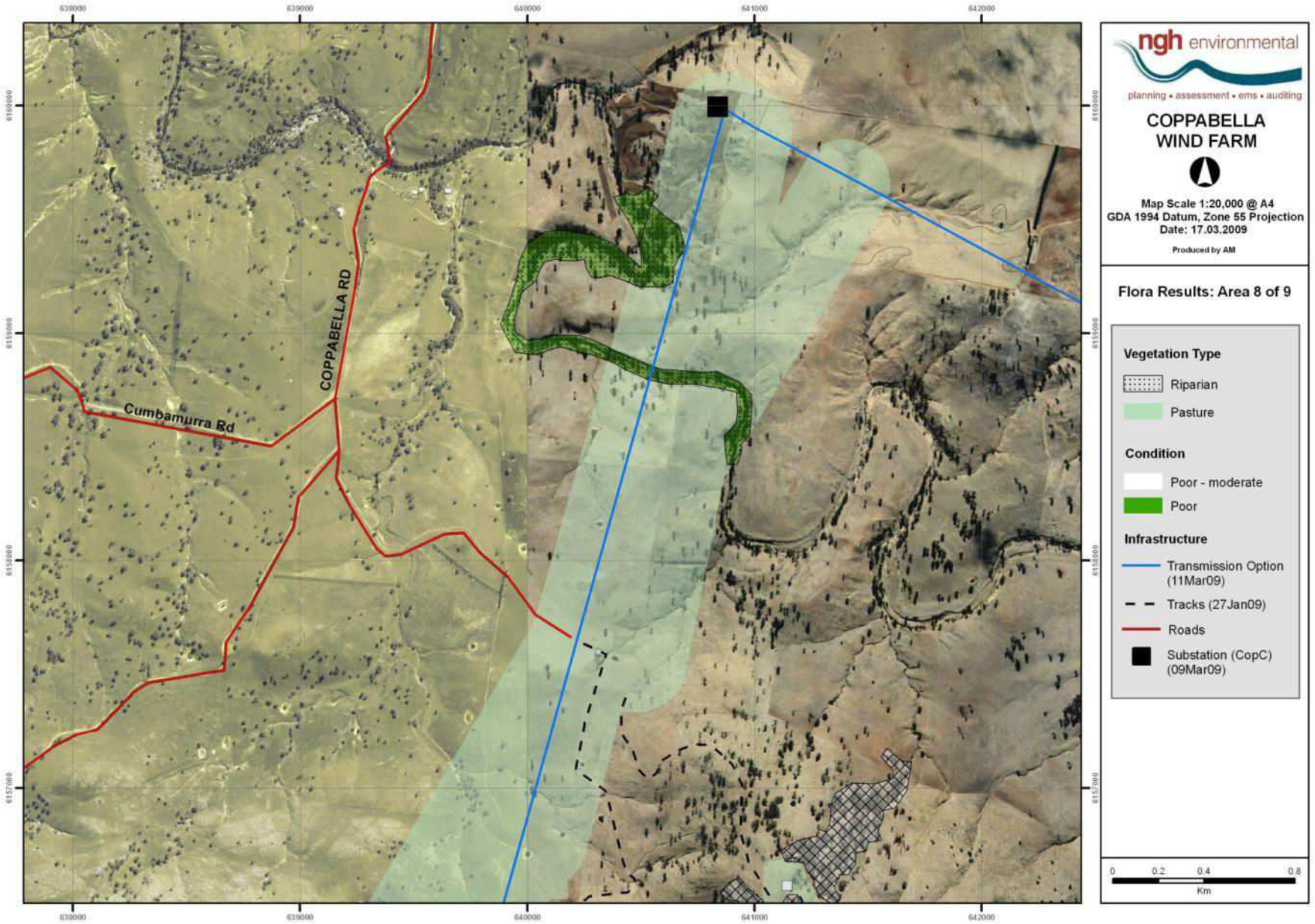

637000
638000
639000
640000
6154000
6153000
6152000
3
4
5
ngh environmental
planning • assessment • ems • auditing
COPPABELLA
WIND FARM
Map Scale 1:15,000 @ A4
GDA 1994 Datum, Zone 55 Projection
Date: 17.03.2009
Produced by AM
Flora Results: Area 3 of 9
Vegetation Type
Box Gum Woodland
Long-leaved Box/
Red Stringybark
Dry Grass Forest
Pasture
Condition
Moderate
Poor - moderate
Infrastructure
1* Cluster Labels
Turbine Locations
(20Feb09)
Electricity Layout
(09Mar09)
Transmission Option
(11Mar09)
Tracks (27Jan09)
0 0.125 0.25 0.5 Km


640000
641000
642000
643000
6156000
6155000
6
7a
5
This patch of vegetation would qualify as CEEC under the EPBC Act
ngh environmental
planning • assessment • ems • auditing
COPPABELLA WIND FARM
Map Scale 1:15,000 @ A4
GDA 1994 Datum, Zone 55 Projection
Date: 17.03.2009
Produced by AM
Flora Results: Area 4 of 9
Vegetation Type
Box Gum Woodland
Long-leaved Box/ Red Stringybark Dry Grass Forest
Pasture
Yass Daisy
Condition
Good
Moderate
Poor - moderate
Poor
Infrastructure
Cluster Labels
Turbine Locations (20Feb09)
Electricity Layout (09Mar09)
Transmission Option (11Mar09)
Tracks (27Jan09)
Roads
0 0.125 0.25 0.5 Km


This patch of vegetation would qualify as CEEC under the EPBC Act
5
8
9
ngh environmental
planning • assessment • ems • auditing
COPPABELLA WIND FARM
Map Scale 1:15,000 @ A4
GDA 1994 Datum, Zone 55 Projection
Date: 17.03.2009
Produced by AM
Flora Results: Area 5 of 9
Vegetation Type
Box Gum Woodland
Long-leaved Box/ Red Stringybark Dry Grass Forest
Pasture
Yass Daisy
Condition
Good
Moderate
Poor - moderate
Poor
Infrastructure
1* Cluster Labels
Turbine Locations (20Feb09)
Electricity Layout (09Mar09)
Transmission Option (11Mar09)
Tracks (27Jan09)
Substation (CopA) (09Mar09)
0 0.125 0.25 0.5 Km


7b
9
ngh environmental
planning • assessment • ems • auditing
COPPABELLA
WIND FARM
Map Scale 1:15,000 @ A4
GDA 1994 Datum, Zone 55 Projection
Date: 17.03.2009
Produced by AM
Flora Results: Area 6 of 9
Vegetation Type
Box Gum Woodland
Long-leaved Box/ Red Stringybark Dry Grass Forest
Pasture
Yass Daisy
Condition
Moderate - good
Moderate
Poor - moderate
Poor
Infrastructure
1* Cluster Labels
Turbine Locations (20Feb09)
Electricity Layout (09Mar09)
Transmission Option (11Mar09)
Tracks (27Jan09)
0 0.125 0.25 0.5 Km


9
10
11
ngh environmental
planning • assessment • ems • auditing
COPPABELLA
WIND FARM
Map Scale 1:20,000 @ A4
GDA 1994 Datum, Zone 55 Projection
Date: 17.03.2009
Produced by AM
Flora Results: Area 7 of 9
Vegetation Type
Box Gum Woodland
Long-leaved Box/
Red Stringybark
Dry Grass Forest
Pasture
Yass Daisy
Condition
Good
Moderate - good
Moderate
Poor - moderate
Poor
Infrastructure
1* Cluster Labels
Turbine Locations
(20Feb09)
Electricity Layout
(09Mar09)
Tracks (27Jan09)
Roads
0 0.2 0.4 0.8
Km


638000
639000
640000
641000
642000
6160000
6159000
6158000
6157000
COPPABELLA RD
Cumbamurra Rd
ngh environmental
planning • assessment • ems • auditing
COPPABELLA
WIND FARM
Map Scale 1:20,000 @ A4
GDA 1994 Datum, Zone 55 Projection
Date: 17.03.2009
Produced by AM
Flora Results: Area 8 of 9
Vegetation Type
Riparian
Pasture
Condition
Poor - moderate
Poor
Infrastructure
Transmission Option (11Mar09)
Tracks (27Jan09)
Roads
Substation (CopC) (09Mar09)
0
0.2
0.4
0.8
Km

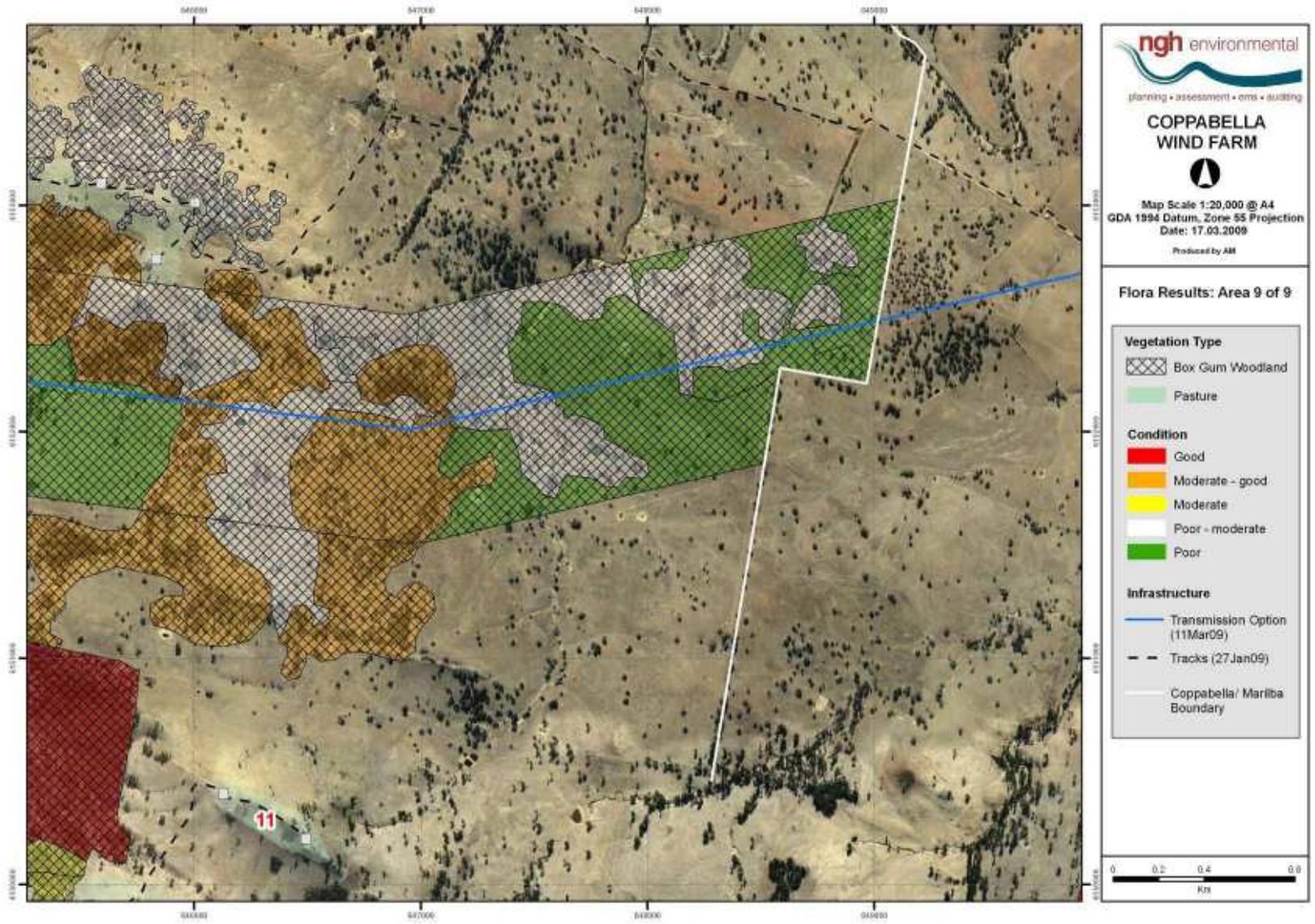

ngh environmental
planning • assessment • ems • auditing
COPPABELLA
WIND FARM
Map Scale 1:20,000 @ A4
GDA 1994 Datum, Zone 55 Projection
Date: 17.03.2009
Produced by AM
Flora Results: Area 9 of 9
Vegetation Type
Box Gum Woodland
Pasture
Condition
Good
Moderate - good
Moderate
Poor - moderate
Poor
Infrastructure
Transmission Option (11Mar09)
Tracks (27Jan09)
Coppabella/ Marilba Boundary
0 0.2 0.4 0.8
Km
11

Table 5-1 Summary of vegetation types

VEGETATION GROUP (VG) (GELLIE 2005)	OVERSTOREY DOMINANTS	LOCATION	LANDFORMS	SURVEY EFFORT	SIGNIFICANCE[6]
Box-Gum Woodland					
May be derived from one or more of: VG 116 (*E. macrorhyncha-E. blakelyi*), VG117 (E. *albens-E. blakelyi*), VG120 (*E. macrorhyncha-E. albens*), VG160 (*E. blakelyi-E. melliodora*), VG161 (*E. melliodora*) and VG163 (*E. blakelyi-E. polyanthemos*).	Variably *Eucalyptus melliodora, E. albens, E. blakelyi, E. goniocalyx,* small areas with *E. polyanthemos* or *E. macrorhyncha*	All clusters, though in most cases highly modified. Also dominant in adjacent lowland areas, generally in a more highly modified condition	Ridge crests, saddles, gentler slopes and valleys, on volcanics, all elevations	Quadrats: 1 Random meanders: 22 Inspections: 9	EEC as listed on the TSC Act, 3 examples of CEEC listed on the EPBC Act (north of Cluster 10, and below 7a) Threatened species Yass Daisy was sighted within a transmission envelope between Clusters 7a and 6, below Cluster 7a and within the woodland north of Cluster 10 (refer to Figure 5-6).
Dry grass forest					
May be derived from one or more of: VG 118 (*E. sideroxylon-E. macrorhyncha-E. goniocalyx-E. blakelyi*), VG 119 (*E. macrorhyncha-E. polyanthemos*), VG 121 (*E. macrorhyncha-E. goniocalyx-E. rossii*), VG 122 (*E macrorhyncha - E. goniocalyx*)	*E. goniocalyx*	• South-west facing slope below Cluster 7 • Eastern part of Cluster 10 • Below Cluster 6 • South east facing slope on Cluster 5 • South facing slope on Clusters 8 and 3	Steeper sideslopes, particularly sheltered aspects Rocky knolls only in eastern half of site 10.	Quadrats: 1 Random meanders: 5	Comes under the TSC Act definition of EEC, and one small area of CEEC (lower slopes on 7a). Yass Daisy below Cluster 7a within a transmission envelope between Clusters 7a and 6
Riparian forest					
VG43 (*E. camaldulensis-E.*	*E. camaldulensis*	Present at Jugiong Creek transmission crossing and	Creek banks and flats	Quadrats: 0	A depleted and degraded community but not listed as

[6] EEC – Endangered Ecological Community listed under the NSW TSC Act; CEEC – Critically Endangered Ecological Community listed under the Commonwealth EPBC Act

VEGETATION GROUP (VG) (GELLIE 2005)	OVERSTOREY DOMINANTS	LOCATION	LANDFORMS	SURVEY EFFORT	SIGNIFICANCE[6]
bridgesiana)		patchily along Illalong Road		Random meanders: 1 Inspections: 0	an EEC
Largely Treeless Pasture					
Mostly derived from Box-Gum Woodland types (refer above), some limited areas from dry grass forest types (refer below)	*Austrodanthonia* spp, *Microlaena stipoides, Austrostipa scabra* ssp *falcata, Aristida ramosa* Exotic component variable – dominant in sheep camp areas on ridge crests.	Dominant vegetation type at all clusters	The dominant vegetation type on cleared ridges, saddles and slopes. Also dominant in intervening valley areas.	Quadrats: 2 Random meanders: 3 Inspections: 4	Areas with predominately native pasture come under the TSC Act definition of EEC (derived from Box-Gum Woodland) Does not come under the EPBC Act definition of CEEC

Table 5-2 Extent and location of vegetation type condition classes within the development envelope (DE)

CONDITION CLASS	APPROXIMATE EXTENT WITHIN DE (HA)	LOCATION WITHIN DE
Box-Gum Woodland		
Poor	421.38	**Clusters:** 10 north west, 6 ridge
Poor-moderate	274.59	**Clusters:** 10 central west, 7b far south east,7a far north west, 3 north and central **Transmission envelopes**: between 6 and 7a, below 10, north of 3
Moderate	14.09	**Clusters:** southern edge of Cluster 7, 3 north, 10 north west and 10 central **Transmission:** near 3
Moderate-good	16.15	**Clusters:** 10 central, 7b **Transmission:** east of 3
Good	165.90	**Transmission:** between 6 and 7
Total	**892.11**	
Dry Grass Forest		
Poor	0	No locations
Poor-moderate	21.91	**Clusters:** 10 central east **Transmission:** east of 3
Moderate	35.48	**Clusters:** 10 far east, 8, 6 slope and small areas on 5 **Transmission**: gully between 6 and 3, and between 5 and 7a
Moderate-good	4.03	**Clusters**: 3 central north
Good	29.59	**Transmission:** Western-facing slope of 7a
Total	**91.01**	
Riparian forest		
Poor	11.27	Where the proposed transmission envelope crosses Jugiong Creek to the north of the development envelope
Total	**11.27**	
Largely Treeless Pasture		
Native and mixed pasture	Not mapped	Survey points on Clusters: parts of 6, 8 ridge, 9 ridge, parts of 7a and 7b ridge and parts of 3 south
Exotic pasture	Not mapped	Survey points on Clusters: 1, 2, 4, 5; parts of 6, parts of 7a, 7b and 8 ridge and upper slope; 3a upper slope; parts of 10
Total	**1834.72**	
Totals	**2829.11**	

5.2.3 Disturbance and weeds

Forests and woodlands in the study area have been progressively ring-barked and felled over the past two centuries 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, erosion of soils, particularly wind erosion from exposed ridge tops, 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, areas subjected to pasture improvement and cultivation and areas selectively targeted by sheep for grazing and camping (the latter usually on ridges and peaks). In many areas, grazing is likely to have reduced or eliminated selectively grazed or grazing sensitive species, such as Kangaroo Grass (*Themeda australis*), terrestrial orchids, native legumes, wattles and other shrubs.

The subject site carries a high proportion of exotic weed and pasture species, ranging from less than one quarter of total herbaceous cover on less disturbed steep side slopes to total displacement of native species on many of the most exposed treeless ridges. The major exotic species are grasses (**Lolium perenne, *Hordeum leporinum*), clovers (**Trifolium* spp), asteraceous weeds (Capeweed, **Arctotheca calendula* and thistles, **Onopordum, *Carthamus* and **Cirsium* spp), Storksbill (**Erodium* spp) and Paterson's Curse (**Echium plantagineum*).

In less disturbed areas with a tree canopy the most common exotic species at the time of the survey were annuals, Chickweed (**Stellaria media*) and Quaking Grass (**Briza maxima*). These areas would probably appear less weedy later in the season, when these species have seeded and disappeared.

Six weeds listed as noxious in the Southern Slopes County Council area [7] control area under the *Noxious Weeds Act 1993* were recorded at the subject site. Locations where these weeds were recorded are provided in Table 5-3 below.

The six 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. They are required to be controlled in accordance with a local management plan published by the local control area authority.

[7] Includes the Councils of Boorowa, Harden, Yass Valley and Young

Table 5-3 Locations of main occurrences of declared noxious weeds

NOXIOUS WEED SPECIES	CLASS	LOCATION
Devil's Claw **Ibicella lutea*	4	Single detached dried fruit in Cluster 1 (near GDA 634006 6153408).
Paterson's Curse **Echium plantagineum*	4	Very common throughout the site, in the more heavily grazed ridge top areas.
Scotch Thistle **Onopordum acanthium*	4	Common in heavily grazed ridge top areas, particularly Clusters 1 and 2.
Sweet Briar **Rosa rubiginosa*	4	Very occasional plants on ridge tops, locations not recorded.
Blackberry **Rubus fruticosus* sp. agg.	4	Sparsely scattered in vicinity of remnant woodland on sheltered slopes, e.g. Cluster 3 southern end (near GDA 637956 6152651), Cluster 9 southern end (near GDA 643336 6152317).
Serrated Tussock **Nassella trichotoma*	4	A single plant tentatively identified on ridge in north-eastern area of Cluster 5 (GDA 641583 6154036).

5.3 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 5-4, based on data presented in Gellie (2005).

Table 5-4 shows the high level of depletion and poor conservation status of the Box-Gum Woodland vegetation types which would have originally occupied much of the study area. The impact of this depletion is compounded by the severe fragmentation and continuing degradation of remaining stands. 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).

Table 5-4 Conservation status of natural vegetation types in the study area

VEGETATION TYPE	PRE-1750 EXTENT (HA)	EXTANT AREA (HA)	RESERVED IN CRA SOUTHERN REGION (HA)
Box-Gum Woodland types			
Vegetation Group 116: Western Slopes Herb/Grass Woodland	83,000	6,500 (8% of 1750 extent)	nil
Vegetation Group 117: Western Slopes White Box Dry Grass Woodland	107,200	8,400 (8% of 1750 extent)	nil
Vegetation Group 120: Western Slopes Shrub/Herb/Grass Dry Forest	131,300	20,200 (16% of 1750 extent)	2,500 (2% of 1750 extent)
Vegetation Group 159: Northern Slopes Dry Grass Woodland	17,700	1,900 (11% of 1750 extent)	nil
Vegetation Group 160: Western Slopes Dry Grass Woodland	247,500	7,000 (3% of 1750 extent)	nil
Vegetation Group 161: Tablelands and Slopes Dry Herb/Grass Woodland	87,100	3,800 (4% of 1750 extent)	nil
Vegetation Group 163: Central North Slopes Dry Grass Woodland	7,400	260 (22% of 1750 extent)	nil
Long-leaved Box-Red Stringybark types:			
Vegetation Group 118: Western Slopes Dry Grass Forest	6,900	3,100 (45% of 1750 extent)	500 (7% of 1750 extent)
Vegetation Group 119: Western Tablelands Dry Shrub/Grass Forest	121,800	23,000 (19% of 1750 extent)	1,300 (1% of 1750 extent)
Vegetation Group 121: Western Slopes Grass/Herb Dry Forest	90,800	56,400 (62% of 1750 extent)	16,900 (19% of 1750 extent)
Vegetation Group 122: Northern Tablelands and Slopes Dry Shrub/Grass Dry Forest	48,600	11,800 (24% of 1750 extent)	nil
Riparian Forest:			
Vegetation Group 43: Western Slopes Riparian Moist Sedge Forest/ Woodland	29,600	1,300 (4% of 1750 extent)	nil

5.3.1 Box-Gum Woodland Endangered Ecological Community

Box-Gum Woodland is listed as threatened under both the NSW *Threatened Species Conservation Act* (as the White Box Yellow Box Blakely's Red Gum Woodland Endangered Ecological Community and the Commonwealth *Environment Protection and Biodiversity Conservation Act* (as Yellow Box – White Box-Blakely's Red Gum Grassy Woodland and Derived Native Grasslands, a Critically Endangered Ecological Community). The Commonwealth-listed community represents a higher quality subset of the NSW-listed community.

The condition classes indicate relative patch conservation value. All areas of moderate, moderate to good and good condition woodland patches are considered to be of high conservation significance. Areas of poor, poor to moderate, and treeless examples are considered to be of moderate conservation significance.

NSW TSC Act

Woodland examples

The Box-Gum Woodland EEC 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). Recent verbal advice from DECC staff (A. Treweek, R. Rehwinkel, pers. comm. 2008) on interpretation of this EEC is that these three species need not be the dominant trees, but may be a small proportion of the total tree cover, and the EEC would still be regarded as being present.

Under the EEC Final Determination, disturbed remnants form part of the EEC. Some remnants survive partly or wholly cleared of trees, or with the tree layer intact but with the understorey degraded or lost through grazing or pasture modification. The EEC definition includes

> '*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*',

but does not specifically exclude stands with no natural understorey or assisted natural regeneration potential or soil seed bank. It includes degraded remnants which have few, if any native species in the understorey (NPWS undated). So long as one or more of the diagnostic tree species are present in woodland formation, remnants form part of the EEC irrespective of the condition of the groundcover stratum (DECC 2008b).

Hence, all parts of the study area carrying Yellow Box, Blakely's Red Gum or White Box in a woodland formation would be considered part of the EEC, regardless of understorey condition. Box-Gum Woodland with these species as dominants, or as minority species in association with *E. goniocalyx,* is the most common vegetation type in the study area, with remnant or regrowth woodland stands present in varying condition at most of the sites. The conservation value of degraded stands is influenced by stand condition, the presence of significant species, local levels of depletion, fauna habitat values, recovery potential and connectivity with other areas of natural vegetation. Condition in the study area is generally poor and poor to moderate such as on parts of Cluster 6 with sparse dieback-affected White Box over a heavily grazed exotic understorey; although higher condition remnants are also present such as on parts of Cluster 10 which features Blakely's Red Gum-White Box regrowth over a diverse native grassy understorey.

The 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). These species were not recorded in grazed parts of the subject site.

Woodland dominated by Long-leaved Box is still relatively common on the site. This vegetation type tends to occur on steep sideslopes beyond the impact zone (such as below Cluster 7a) but is occasionally present within the impact zone, as on the knoll at the south-eastern end and those either side of the central saddle on Cluster 10. The groundcover in the latter areas is highly disturbed, and it is impossible to tell whether this type of woodland is floristically distinct from typical Box-Gum Woodland dominated by White Box, Yellow Box or Blakely's Red Gum. The relatively intact stand assessed on the steep slopes below Cluster 7a appears quite similar in understorey composition to the most intact Box-Gum Woodland remnant surveyed on the flat north of Cluster 10.

Woodland dominated by Long-leaved Box has been assigned to a different vegetation type (FE118) under the SCRA classification, but the similarity of the groundcover in the two least disturbed areas surveyed at Coppabella suggests that despite the dominance of Long-leaved Box below Cluster 7a and its almost complete absence from the flat north of Cluster 10, the vegetation in both areas is essentially a grassy woodland with a similar understorey. Remnants with even a single tree of White Box, Yellow Box or Blakely's Red Gum present are regarded as belonging to the EEC under NSW legislation (A. Treweek, R. Rehwinkel, pers. comm.). Whether remnants lacking any of those species are regarded as belonging to the EEC depends on the landscape scale at which the site is viewed, since one of these species is likely to be present within cleared pasture nearby, if not actually present within the woodland remnant. It is therefore considered that the Long-leaved Box remnants are also part of the Box-Gum Woodland EEC, listed under the TSC Act.

Woodland vegetation at the subject site has moderate-high conservation significance, particularly in view of the general depletion of grassy woodland vegetation in the region. However, the conservation value of remnants on the site is reduced by the loss of floristic and structural integrity and dominance of the groundcover by weeds in many instances.

Treeless examples – native pasture, with or without sparse trees

The EEC determination also includes treeless areas with an 'intact understorey'. The key in the NPWS identification guidelines for the community includes treeless areas which would once have carried one of the Box-Gum tree species and which are now 'predominantly grassy'. Subsequent DECC advice has also confirmed that secondary grassland derived from the past clearing of Box-Gum Woodland forms part of the EEC (DECC 2008b, A. Treweek and R. Rehwinkel, pers. comm. 2008).

An area of pasture that is dominated by native grasses therefore has the potential to form part of the EEC. The vast majority of native pasture in the study area shows very low levels of native forb diversity (typically 1-4 species) and high levels of exotic forb cover (pasture and weed species). Locations where exotic forbs form a greater proportion of total vegetation cover than native grasses are not uncommon and would not be regarded as belonging to the EEC.

Dominant pasture species typically change from *Themeda triandra* and *Poa* spp. to *Austrostipa falcata, Austrodanthonia* spp. and *Bothriochloa macra* as grazing intensity increases (Moore 1953a in NSW SC 2002). The native pasture in the study area is dominated by *Austrodanthonia* spp and *Austrostipa scabra* ssp *falcata* (syn. *A. falcata*), with occasional *Bothriochloa macra* and *Aristida ramosa,* on ridges, saddles and slopes, and with *Microlaena stipoides* in sheltered sites, indicating a long history of grazing. While derived from Box-Gum Woodland and technically part of the EEC, these pastures are considered to be of relatively low conservation significance due to the highly degraded nature of the groundcover and very limited recovery potential.

Commonwealth EPBC Act

The identification criteria for the Box-Gum Woodland Critically Endangered Ecological Community (CEEC) are considerably more stringent under Commonwealth legislation, than the criteria for the Box-Gum Woodland EEC under the NSW legislation. Vegetation forms part of the CEEC if:

- One of the most common overstorey species is, or was,
    - Yellow Box,

  - Blakely's Red Gum, or
  - White Box.
- The understorey is predominantly native
- The patch is greater than 0.1ha
- And either:
  - there are 12 or more non-grass species in the understorey including at least one important species (based on a list issued by the Environment Department), or
  - if native species diversity is lower than this, then the patch is greater than 2ha with an average of 20 or more mature trees per hectare, or with natural regeneration of the dominant overstorey eucalypts.

Under these criteria, the woodland remnant on the flat north of Cluster 10, small patches on the lower slopes of Cluster 7a and in the valley between Clusters 5 and 7a would be included in the listed community. Although much of the area around Clusters 5 and 7a is dominated by Long-leaved Box, with little or no Yellow Box, it is considered to qualify as the CEEC as it has a predominantly native understorey with more than 12 non-grass species, of which several are 'important' species including the threatened Yass Daisy. Some small patches with better quality groundcover around the saddle at the middle of Cluster 10 also qualify as CEEC, where White Box and Blakely's Red Gum regrowth are present above a groundcover with a number of grassy woodland indicator species including *Hibbertia obtusifolia, Melichrus urceolatus, Bulbine bulbosa, Oxalis perennans, Wahlenbergia stricta, Hydrocotyle laxiflora, Geranium solanderi, Wurmbea* spp, *Diuris chryseopsis, Cymbopogon refractus, Themeda australis, Austrostipa* spp and *Elymus scaber*.

The indicative distribution of the Commonwealth listed CEEC in the study area is illustrated on Figure 5-6. Examples of the community are shown in Photographs 7 and 8 in Appendix H.

Additional assessment of the transmission easement connecting to Marilba Hills Precinct substation

All of the vegetation within the proposed route would come under the TSC Act definition of box-gum woodland EEC, since at least scattered eucalypts are present throughout the route, with trees denser in some areas. The groundcover is predominantly native for most of the proposed route, with the exception of scattered small weedy patches dominated by exotic forbs such as thistles or exotic grass such as phalaris. Dominant groundcover species are the grasses *Austrodanthonia* sp. and *Bothriochloa macra*. Near the 'Whitefields'/'Mylora' boundary there are some small patches of kangaroo grass (*Themeda australis*) on both properties, suggesting a less heavy grazing history. However, no native forbs were seen in these patches, so condition is no better than moderate. Generally groundcover condition is poor-moderate, with two native grass species dominant and few or no native forbs.

In areas of higher tree density, vegetation appears to fit the definition of the Critically Endangered box-gum woodland ecological community listed under the EPBC Act. Although it does not have the higher groundcover species diversity required by the EPBC Act definition, it satisfies the other criteria (patch size is >2 hectares, tree density appears to be >20 trees per hectare and/or tree regeneration is present).

No areas on the Whitefields section of the route appear to fit the CEEC definition. Areas on the 'Mylora' property which do so are located along Bushrangers Creek and its tributary gully where the

proposed route follows the creek at the eastern end of the ridge on which turbine Cluster 7b is located, and a patch of woodland running south from the creek between two gully crossings immediately south of this section of the creek. Even if there are patches within these areas which have fewer than 20 trees per hectare, the presence of tree regeneration would place these areas within the CEEC definition.

The proposed route close to Bushrangers Creek within the 'Mylora' property should be avoided. The combination of proximity to a steep hillslope, presence of an eroded creek channel, relatively dense trees with some of them hollow-bearing and presence of tree regeneration and even an occasional shrub or small tree in the understorey (*Callistemon sieberi*, Acacia *dealbata, A. implexa*) means this area has construction difficulties as well as biodiversity issues, in comparison with a route located further south. Moving the route to the south by 100-200 metres through this property would avoid the higher conservation value area along the creek, but it would not be possible to find an entirely tree-free route. Since the groundcover is of low native species diversity even in areas which fit the CEEC definition, the main issue of concern is tree removal, particularly of large old trees with hollows, or of an age to begin forming hollows soon. Trees in better health would also be of greater conservation significance than trees severely affected by dieback, and Yellow Box or Blakely's Red Gum trees of greater significance than Long-leaved Box or Red Stringybark trees. Some CEEC will probably have to be traversed even if the creek-side route is avoided, and the route of least tree density should be chosen.

On Whitefields, although none of the vegetation fits the CEEC definition, there are a number of large old hollow-bearing Yellow Box and Blakely's Red Gum, particularly in the western half of the route. Putting the route on the northern side of the creek up to a point about 3-400m short of the 'Mylora' boundary, then changing direction and crossing the boundary about 200m south of the proposed crossing point would avoid a lot of trees. There is scope to reroute this transmission line to avoid high constraint areas.

Assessment of significance

Although not a legal requirement of a Part 3a development, an Assessment of Significance (seven-part test) provides a transparent and systematic characterisation for TSC Act listed EEC, to determine the potential for significant impacts on this community arising as a result of the proposed development. The seven-part test is included in Appendix E.

An Assessment of Significance of potential impacts on Box-Gum Woodland CEEC has been undertaken in Appendix E pursuant to the EPBC Act.

5.4 SPECIES OF CONSERVATION SIGNIFICANCE

5.4.1 Threatened and nationally significant species

A number of threatened flora species have potential distribution ranges which include the Coppabella Hills Precinct. 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 D. Based on this analysis, two threatened species are considered to have the potential to be impacted by

the proposed development. One species: Yass Daisy was recorded at the subject site. The second species: Burrinjuck Spider Orchid (*Caladenia* sp *Burrinjuck*) has been recorded close to the site in habitat similar to that on parts of the site and therefore has a low to moderate potential of being present in the study area. Another two species: Hoary Sunray (*Leucochrysum albicans* ssp *albicans* var *tricolor*) and Small Scurf-pea (*Cullen parvum*) have been considered on the basis of either being found close to the site, or being known to tolerate disturbed habitats. Other grassy woodland species (*Thesium australe, Swainsona sericea, Diuris tricolor, Prasophyllum petilum*) or rocky outcrop species (*Senecio garlandii*) which occur in the region are very unlikely to tolerate the level of disturbance present within those parts of the impact zones of the subject site which were inspected.

Yass Daisy (*Ammobium craspedioides)*: Vulnerable TSC Act, Vulnerable EPBC Act

This species was found in two broad locations, neither of them within the proposed turbine cluster development envelope. One is the slope south-west of Cluster 7a and below the saddle which joins Clusters 6 and 7a, in Long-leaved Box forest. The other area is the large woodland remnant on flats north of Cluster 10. In both these areas the plant appears widespread and the population size is likely to number in the hundreds, if not thousands.

nghenvironmental recommend that all proposed infrastructure be microsited away from areas where Yass Daisy occur to avoid significant impacts on this species.[8]

Records have been submitted to the Wildlife Atlas database. The location of records is shown in Figure 5-6 and Appendix A.6.

Burrinjuck Spider Orchid (*Caladenia* sp *Burrinjuck):* covered by the listing of *Caladenia concolor* as endangered under both the TSC Act and the EPBC Act until such time as it is described as a separate species:

This species has potential habitat in forest dominated by *E. goniocalyx* or *E. macrorhyncha* in Clusters 3, 7 and 10. This community is broadly analogous to known habitats in Burrinjuck Nature Reserve to the south (NPWS 2003), though the site is possibly grassier as it is located on relatively fertile soils. The species flowers from late August to October, which coinicides with the September survey, although it may not flower until October, in which case the survey timing (Sept 16-21) would have been too early in September and too late in November. The heavy grazing history over most of the site and the highly restricted distribution of the species reduces the likelihood of its presence at the site.

Hoary Sunray (Leucochrysum albicans ssp albicans var tricolor): Endangered EPBC Act

Hoary Sunray is listed as nationally Endangered under the EPBC Act. It is widespread though uncommon in the Southern Tablelands region and is not listed as threatened in NSW. The species may be sensitive to grazing but can be locally common on road verges in some areas. It is a large conspicuous daisy and the survey coincided with its flowering period. It was not recorded during the survey, though not all suitable habitats were searched. The long grazing history of most of the subject site makes it unlikely that this species would occur there.

[8] See Section 9 for details on how the proposed layout has been modified to address this recommendation.

Small Scurf-pea (*Cullen parvum*): Endangered TSC Act

This small legume has been recorded in Box-Gum Woodland at Galong, only 20km north of the site (Friends of Grasslands, 2006). However, the level of grazing pressure over most of the site makes it very unlikely that this species would occur there. Native legumes were extremely uncommon on the site, with only two occurrences each recorded of *Glycine clandestina* and *Desmodium varians* (on the slope below Cluster 7a and north of Cluster 10). The long grazing history is the probable cause of this loss of native legumes, which are usually quite common in lightly grazed remnants of grassy woodland types.

The Yass Daisy and Burrinjuck Spider Orchid have been included in the Assessment of Significances pursuant to the TSC Act and the EPBC Act presented in Appendix D. Although not a legal requirement of a Part 3A development, a seven-part test provides a transparent and systematic characterisation for TSC Act listed species, to determine the potential for significant impacts on this community. The Hoary Sunray and Small Scurf-pea and other grassy woodland species have not been included because they were not detected at the subject site during the survey and have a very low likelihood of being present at the site.

5.4.2 Regionally significant species

There are a number 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 (*Leptorhynchos 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 may occur on less disturbed remnants in the Yass area, however none were recorded within the subject site. Single plants of Yam Daisy and Blue Devil (*Eryngium rostratum*) and large numbers of the orchid *Diuris chryseopsis* were detected in the large remnant north of Cluster 10 (off-site).

6 FAUNA

6.1 APPROACH AND METHODOLOGY

6.1.1 Field survey

Survey timing

Following an initial reconnaissance survey on 1-3 September 2008, survey work was carried out for diurnal and nocturnal vertebrates and their habitats on 16-19 September 2008. The survey team consisted of two Biodiversity Project Officers (responsible for fauna survey) and one technical assistant (responsible for habitat assessment). Follow-up visits were conducted between 6-7 November 2008 and 9-11 March 2009 (habitat assessment).

Survey methodologies and effort

The location of the wind turbines and associated electricity and road infrastructure was not able to be precisely defined at the time of the assessments. This assessment was therefore broadened to the 'development envelope' which includes all parts which have potential to carry this infrastructure.

Survey effort within the development envelope was stratified by habitat and vegetation type (Box-Gum Woodland, Long-leaved Box woodland, pasture, and wetlands) and landscape position (ridges, slopes, flats, gullies) to ensure that the assessment covered the diversity of habitats that would be directly or indirectly impacted by the proposal. Additional areas adjacent to the development envelope with higher quality habitat resources or unique habitat types were surveyed in order to maximise the diversity of species and habitat types recorded from the locality. Additional areas surveyed included the woodland remnant on the flat north of Cluster 10, Jugiong Creek (approximately 200m north of the site) and road side vegetation along Coppabella Road and Whitefields Road.

All vertebrate groups and their habitats were surveyed, however areas considered most likely to provide habitat for threatened fauna were focused on. Comprehensive surveying techniques were employed including trapping, nocturnal survey, bird, reptile and frog survey, Anabat recording and habitat assessment.

Trapping

Trapping targeted small and medium-sized mammals, including the threatened Squirrel Glider and the Spotted-tailed Quoll. Trapping surveys aim to provide information on the diversity of small mammals on the site to indicate overall habitat quality of the area and also demonstrate the availability of prey for larger species such as forest owls and raptors. Trapping was undertaken at the north-western end of Cluster 7 and on the flat north of Clusters 10 and 11, where the more extensive areas of vegetation are located. The trapping survey effort was biased toward larger, more intact and less disturbed woodland remnants as it was inferred that these areas would be more likely to support threatened species and also carry a higher species abundance and diversity than the other more disturbed parts of the site. Habitat evaluation was considered sufficient to rule out the potential for threatened small ground mammals to be present at other parts of the subject site.

Bird census, reptile survey, frog censuses and habitat assessment

Bird censuses and general habitat assessments were undertaken within most clusters and along proposed transmission line routes in representative areas of vegetation, habitat and landform types. Bird censuses took into account the flying height of each bird observed.

Reptile searches (rock rolling) were undertaken in suitable habitat (rocky outcrops) on the ridges of most clusters and on different aspects of ridges. Reptile surveys targeted ridges and upper slopes within the nominated development envelope, although were also conducted opportunistically on lower slopes and valleys where ever suitable habitat was present. The abundance of black ants (an indicator for the threatened *Aprasia parapulchella)* was recorded. Reptile searches on ridges and steep slopes were limited by access. Clusters 5, 8 and 11 were not accessible at the time of surveying and habitat assessments of these areas were undertaken from adjacent hill tops and slopes and in adjacent habitat of higher quality.

Habitat assessments considered vegetation composition and structure, disturbances and provision of habitat for threatened species. Reptile habitat assessments were conducted on rocky outcrops to assess their potential to support threatened reptile species. Frog censuses and aquatic habitat assessments were undertaken in representative examples of riparian corridors, drainage lines and farm dams to identify the diversity of frog species present and the condition and quality of these habitats.

Nocturnal surveys

Nocturnal surveys commenced with call playback of the threatened Powerful Owl, Masked Owl, Barking Owl and Squirrel Glider and were followed by foot-based or vehicle-based spotlighting survey. These surveys targeted nocturnal bird and mammal species. Microbat echolocation recording was conducted overnight in three locations during the September survey (along Whitefields road in remnant woodland, at the base of Cluster 7a/5 and at Jugiong Creek). Further microbat survey was undertaken in January 2009.[9]

Opportunistic records

Searches for scats and for signs of animals' presence were conducted opportunistically whilst conducting other surveys. All opportunistic records of fauna were recorded throughout the survey period.

The survey effort is summarised in Table 6-1 and illustrated in Figure 5-1. Refer to Appendix B for further details, including grid references of all survey sites.

[9] The January microbat survey will be documented as a separate report.

Table 6-1 Summary of fauna survey effort

SURVEY TYPE	DESIGN	LOCATION	TOTAL SURVEY EFFORT	TARGET SPECIES
Ground Elliot trap (A)	50 Elliot traps set in 5 transects over 3 nights.	• Site 7a on the western facing slope in woodland • Site 6 on ridge in remnant copse of Long-leaved Box • North of Cluster 10 in intact woodland patch	150 trap nights	Small mammals (antechinus species and rodents) Target threatened species: diversity and abundance of prey for carnivorous species including Large forest owls, Spotted-tail Quoll and raptors (such as the Square-tailed Kite)
Tree Elliot traps (B)	1 transect of 10 traps over 3 nights. Traps were placed 2-3m above the ground on trunks of mature trees. Baited with a mixture of peanut butter, rolled oats, cat food and honey. Honey dissolved in water was sprayed 1m above and below the trap to attract fauna.	• Site 7a on the western facing slope in woodland. Traps were placed on mature hollow-bearing trees around the northern edge of the woodland	30 trap nights	Small and medium sized arboreal mammals (Squirrel Glider, Common Brushtail Possum, Sugar Glider) Target threatened species: Squirrel Glider, Brush-tailed Phascogale, also diversity and abundance for carnivorous species including forest owls and raptors
Cage trap transects	2 transects consisting of five traps each. Cage traps were placed in between ground Elliot traps along two transects. Cage traps were baited with a mixture of peanut butter, rolled oats, cat food and honey.	• Site 7a on the western facing slope in woodland • North of Cluster 10 in intact woodland patch	30 trap nights	Medium sized animals (quolls, bandicoots and potoroos, reptiles) Target threatened species: Spot-tailed Quoll

SURVEY TYPE	DESIGN	LOCATION	TOTAL SURVEY EFFORT	TARGET SPECIES
Bird censuses	Species seen and heard were recorded. Surveys involved spot surveys and transects through representative habitats. The height of individuals was recorded when observed flying above 30m from the ground. If species were observed to be flocking, the number of individuals in each flock was recorded. Birds were identified by sight and by call. The reference CD collection 'A Field Guide to Australian Birds' published by the Bird Observers Clubs of Australian (Plowright 2002) was consulted to assist with call identification.	Surveys were undertaken in representative areas of all vegetation, habitat and landform types.	25 surveys of 20-90 person minutes duration: 17.5 person hours	All avifauna. Surveys focussed particularly on threatened and migratory birds, raptors, flocking species and wetland birds
Reptile searches	Rocks were rolled and the raked with a hand rake. Number of rocks rolled and percentage of rocks with black ants were recorded. A variety of slope aspects and disturbance regimes were surveyed.	Representative herpetofauna habitat was surveyed. Searches focused on ridge and slopes with extensive rock outcropping, however woodland, leaf litter, hollow logs, tussocks, and sheets of metal were also searched.	25 surveys of 20-90 person minutes: 11.5 person hours.	All reptile species. Particular focus was given to potential habitat for threatened reptiles *(Delma impar, Aprasia parapulchella*)
Frog censuses	7 surveys of 30-90 person minutes. Riparian sites (creek lines and drainage lines) and dams were visited and frog species were identified by call. The reference CD 'Australian Frog Calls – Subtropical East' of the Nature Sounds series by David Stuart was consulted to assist with call identification (Stuart 1998).	Representative riparian corridors, drainage lines and dams	7 frog censuses at aquatic habitats, 6 person hours	All frog species

SURVEY TYPE	DESIGN	LOCATION	TOTAL SURVEY EFFORT	TARGET SPECIES
Call playback	3 surveys of 65 minutes Vocalisations of the threatened Powerful Owl, Masked Owl, Barking Owl and Squirrel Glider were each carried out after a 5 minute acclimation period. Calls for each species were played for 2.5 - 5 minutes. Listening for responses was carried out for an additional ten minutes. Spotlighting followed call play-back sessions.	Call playback was undertaken at spotlighting locations which included woodland on the lower slopes of Cluster 7a, in remnant roadside vegetation along Whitefields Road and at Jugiong Creek.	3.25 person hours	Threatened nocturnal bird and arboreal mammal species (Powerful Owl, Masked Owl, Barking Owl and Squirrel Glider)
Spotlighting	2 vehicle-based transects and 1 foot-based transect, each conducted by 3 surveyors. Spotlighting was conducted using hand-held 12v 50w spotlights. Foot-based transects were a minimum of two persons for 15 minutes in duration. The length of vehicle-based transects was determined by length of track suitable for spotlighting.	Spotlighting surveys were biased towards areas with mature and hollow-bearing trees to target hollow-dwelling fauna. Spotlighting transects included woodland on the lower slopes of Cluster 7a, in remnant roadside vegetation along Whitefields Road and at Jugiong Creek.	5 person hours	Nocturnal mammals (predominately arboreal although also terrestrial), birds and bats
Microbat echolocation call recording with Anabat	Initial echolocation surveys were undertaken during the September survey using Anabat.	Anabat surveys were undertaken at Jugiong Creek, along Whitefields Road and at a dam in the valley between sites 5 and 7a, west end 7a and middle of 10.	5 overnight surveys (3 in September, 2 in January)	Microchiropteran bats, particularly the threatened Eastern Bent-wing Bat
Habitat assessment	A standard form was used to record habitat and vegetation type; habitat structure, condition and disturbance; important habitat features and resources; and quality of habitat for threatened fauna species. The habitat assessment form trageted the ecological requirements of threatened species.	Habitat assessments were undertaken in representative areas of all vegetation, habitat and landform types.	32 habitat assessments	All fauna species and their habitats
Aquatic habitat assessment	Riparian and wetland (farm dam) habitat was assessed for their potential to provide habitat and resources for fauna in the locality. Specific factors include condition and disturbance; depth, size and shape; and the presence and type of aquatic, fringing and surrounding vegetation.	Representative riparian corridors, drainage lines and dams	11 aquatic habitat assessments	All fauna species, although particularly birds and bats as they may readily move between water sources across the landscape.

SURVEY TYPE	DESIGN	LOCATION	TOTAL SURVEY EFFORT	TARGET SPECIES
Reptile habitat assessment	Rocky areas were assessed for their potential to provide habitat for reptile species. The assessment targeted the known ecological requirements of threatened reptile species. Factors considered included spatial extent; aspect and landscape position; disturbance; groundcover composition and refuge; and number of rocks with ants (relevant to *Aprasia parapulchella*).	Rocky outcrops and ridges and slopes (within and adjacent to the development envelope)	15 targeted fauna habitat surveys in rock outcrops, 27 vegetation and habitat surveys completed in rocky habitats	All reptile species, focussing on threatened species *(Delma impar, Aprasia parapulchella*)
Searches for scats, scratch marks and other signs of fauna presence	Searches for signs of fauna presence and use of the habitat were carried out opportunistically whilst conducting other surveys.	Opportunistically	-	All fauna species
Opportunistic records	All opportunistic records of fauna were recorded. Observations included species type, location of sighting, and the height (above or below 40m) and number of individuals in a flock it the observation was a bird.	Opportunistically	66 observations	All fauna species, with particular focus on birds (also recording their foraging height).

6.1.2 Mapping

Different fauna habitat types were identified from habitat assessments and vegetation surveys conducted on site. The spatial extent of these habitats was mapped using point data collected using hand-held GPS devices (GDA 1994) which were projected onto aerial photographs of the site using ArcGIS. Habitat areas within and adjacent to the development envelope were then extrapolated using the aerial photographs and were based primarily on tree cover and location of rocky outcrops.

6.1.3 Threatened and significant species

The basis of the field survey program and this biodiversity assessment was to evaluate the risk to threatened species, species at particular risk from construction and operational impacts of wind farms, regionally significant species and more generally, the risk to the integrity of the ecology of the area as a result of the proposed activity.

Threatened and migratory fauna declared under the TSC Act and the EPBC Act recorded or predicted to occur from the region were identified using previous survey records and online database search tools. Following the field surveys, risk assessments were compiled to compare the potential risk to threatened and migratory fauna and to fauna specifically at risk from impacts of wind farms. These risk assessments were used to inform the constraints and the threatened fauna evaluation to determine which species had moderate or high potential to be impacted by the proposed activity (for which a seven-part test was prepared), and to develop species-specific mitigation measures to reduce the potential biodiversity impacts of the proposal.

6.1.4 Survey timing

The early spring timing tended to cool conditions in the evenings (see Table 6-2). This was not optimal for recording reptiles and microchiropteran bats which are generally less active in the cooler months. To address this limitation, additional surveys were undertaken (November 2008 and January 2009).

Three nights were spent spotlighting for nocturnal fauna. The first two nights (17 and 18 September 2008) were cool (overnight minimums -1 and 0.5°C), although fine with light winds from the south-west. The third night was warmer (overnight minimum of 6.3°C), conditions were calm and fine. On all survey nights the moon was bright (full moon on 15 September 2008). Daytime conditions were generally fine, warm and sunny (maximum ~24°C on 19 and 20 September), with moderate to fresh easterly winds developing on 19 and 20 September. Recent rains resulted in good conditions for wetland birds.

Table 6-2 Weather conditions during September surveys

Summarised information from the Yass (Linton Hostel) Bureau of Meteorology weather station

				9am			3pm		
Date	Min temp. (°C)	Max temp. (°C)	Rainfall (mm)	Cloud (oktas)	Wind direction	Wind speed (km/h)	Cloud (oktas)	Wind direction	Wind speed (km/h)
16/09/2008	4.8	11.1	2.2	6	W	33	6	WSW	37
17/09/2008	-1	15.8	0	2	SW	4	3	SW	4
18/09/2008	0.5	19.5	0	6	SW	4			
19/09/2008	6.3	24.5	0	0		Calm	1	NW	22
20/09/2008	8.5	24	0	3	E	22	0	E	37
21/09/2008	4.5	20	0	1	NW	20	1	W	26

6.1.5 Survey limitations

Survey extent

The surveys targeted areas within the proposed development envelope, which included the proposed turbine envelope, access tracks, transmission easements and electricity substations (refer to Figure 5-1). The large size of the development envelope within it (2,829 hectares), together with access difficulties in particular lack of safe tracks, restricted complete survey coverage of some clusters including the central Clusters 5, 8 and 3 and the eastern portion of Cluster 11. Where access to ridgelines was limited, observations were made from the lower slopes and valleys and from adjacent slopes to ensure a habitat assessment could be made. A follow-up visit in November targeted areas that were not exhaustively covered in the September visit to ensure adequate data was collected across the entire site.

Nocturnal survey (spotlighting and call playback) was particularly restricted by access across the site. Foot-based spotlighting was completed in one woodland location: on the lower slopes of 7a, where the gradients, tracks and creek crossing were considered to be negotiable in the dark. Vehicle-based spotlighting was completed in two locations in areas of remnant paddock trees and mature woodland.

Mapping

Fauna habitat mapping was conducted by field data extrapolation using aerial photographs. The error associated with this technique means that the habitat mapping should be considered only a general representation of the vegetation composition on the site. A precautionary approach has been used where classification of habitat types is uncertain.

Threatened species

The survey effort is considered by the authors of this report to have been appropriate for the identification of biodiversity constraints. However, this report acknowledges that the field surveys

were limited in spatial and temporal extent and therefore this assessment requires a precautionary approach, as even extensive surveying at optimal periods can fail to detect species. Threatened species were assessed for their potential to occur based on the habitat available, known ecological characteristics of species and known records. Where assumed to occur, areas of potential habitat were identified as constraints to be avoided (for example, woodland).

6.2 ASSESSMENT AND SURVEY RESULTS

6.2.1 Fauna habitats in the study area

The study area provides a variety of habitat resources to fauna. The type and quality of these resources present in any one location is related to variable factors such as the disturbance history (grazing, clearing and weed invasion), vegetation composition and structure and seasonal and climatic variables. Static variables are also important for defining the habitat resources available to fauna and include topographical characteristics of the land such as slope, aspect, topography and geomorphology.

Six fauna habitat types were identified across the study area. These include four vegetation-based habitat types and one landform-based habitat type. These were defined as follows:

Vegetation-based

1. Woodland
2. Disturbed woodland
3. Pasture
4. Wetland and riparian habitats: creeks, dams and drainage lines

Landform-based

5. Rocky outcrops and ridges

The spatial extent of these habitat types within and adjacent to the development envelope is shown on

Figure 6-1. The location, description and extent of these habitats are discussed below and summarised in Table 6-4.

Vegetation-based habitat types

1. Woodland

Description and location

- Woodland habitat on the site includes remnant and regrowth Box-Gum Woodland and Dry Grass Forest patches with a relatively continuous overstorey cover (20-30%), occasional shrubs and a predominately native groundcover, although some patches carrying mixed native and exotic grasses and forbs.
- Much of the area is likely to have once been woodland, although has since been cleared and disturbed for grazing and cropping.

- Woodland patches are in areas that have had less grazing pressure than other areas on the site. Woodland habitat occurs on steep, sheltered side slopes (where stock have difficulty to access), and in the south-eastern corner of the site around Cluster 10, where grazing appears to be kept at a minimum.
- The quality of a woodland fauna habitat patch varies according to its degree of connectivity to other patches, the size of the patch and the degree of grazing and weed invasion. High quality woodland patches mostly occur outside the development envelope on the south-facing slopes of 7a and 7b and on the flat north of Cluster 10, which extends on to the saddle of 10, and along the gully in the western portion of the transmission line from substation A ('COP (A) Substation'). Smaller, more isolated patches of woodland occur on the northern end of Cluster 3 (approximately 46 hectares though fragmented); and small patches of dense regrowth woodland occur on south-facing lower slopes on Clusters 5 and 8.
- Clusters 3 and 10, and small areas on 7, have woodland that occurs within the turbine development envelope. The saddle and valley between 5, 6 and 7a, and on the eastern slope of 3 carry woodland habitat that occurs within the proposed transmission envelope. The access track leading up to 7b and the inter-turbine track on 3 pass along-side areas of woodland.

Habitat provision/species observed

- The highest fauna species richness was observed in this habitat type: 45 species, 20 of these occurred only in woodland and no other habitat types. A total 28 fauna species were observed in the high-quality woodland patch north of Cluster 10; many of which were not recorded elsewhere on the site (including Red-capped Robin, Varied Sitella (declining woodland birds), Spotted Pardalote, Leaden Flycatcher, and White-throated Gerygone). Other species observed in woodland habitat include the threatened Superb Parrot, Red-capped Robin, Jacky Winter (a declining woodland bird), Weebill, Boobook Owl, Copper-tailed Skink, Swamp Wallaby and Red-necked Wallaby. Survey results are discussed further below.
- Woodland habitat on the site is generally dominated by regrowth trees and carries only scattered mature hollow-bearing trees, with higher numbers located around the edges of patches. The paucity of hollows in the woodland patches suggests that less-mobile hollow-dependent species such as the threatened Squirrel Glider and Brush-tailed Phascogale are unlikely to occur.
- The habitat features a moderate structural diversity and provides extensive ground habitat and refuge including native grasses and other feed resources, fallen woody debris and litter, and scattered rocky outcrops (as on Cluster 7). These resources are likely to be important for supporting ground-dwelling mammals, reptiles and ground-foraging birds.

2. Disturbed woodland (<50% native groundcover, often on ridges, isolated small stands of trees, also on road sides). Some habitat for mobile species and edge species.

Description and location

- This habitat type is intermediate between woodland habitat and pasture with scattered trees. It includes cleared and fragmented woodland areas that are disturbed by grazing and often weed invasion. Most areas of disturbed woodland have a canopy percentage cover of less than 20% and have a predominately exotic groundcover.
- This habitat type is widespread throughout the study area and occurs on various landform types, including on side slopes, gullies, flats, and occasional ridges. Large areas of the proposed COP (A) Substation transmission line fall into this habitat type also.
- Turbine Clusters 7a and 7b, 3, 6, 8 and 10 feature small areas of this habitat type that occur within the nominated turbine development envelope. It also occurs within the proposed electricity easement envelope in a few locations (in the saddle between 6 and 7a and north of Cluster 3)

Fauna habitat provision/observed fauna

- In general, this habitat type carries more mature trees, and therefore higher numbers of hollow-bearing trees than more continuous woodland remnants. Multiple hollows were observed on the northern end of Cluster 10 and 6, on the edges of woodland habitat on site 7a and b, as well as in road side remnants along Whitefields Road and along the proposed COP (A) Substation transmission line route. Mature trees in this habitat type also provide native floral, sap and nectar feed resources. Ringtail Possum, Brushtail Possum, Superb Parrot, Red-rumped Parrot, Rainbow Lorikeet, Eastern Rosella, Barn Owl, Boobook Owl, Laughing Kookaburra, Sulphur-crested Cockatoo and Galah are among the many fauna species observed on the site that are known to utilise hollows
- Some refuge habitat such as fallen debris and scattered rocky outcrops is available for use by ground-dwelling fauna in this habitat type. However ground habitat resources are generally not as extensive and diverse as those available in woodland habitats. Native groundcover and understorey feed resources have been suppressed by grazing and weed invasion in most examples of this habitat type.
- Thirty nine species of fauna were observed within this habitat type. Species included Brushtail Possum, Ringtail Possum, Striated Pardalote, Red Fox, Brown Thornbill, Yellow Thornbill, Crimson Rosella, Euro and Eastern Grey Kangaroo

3. Pasture with scattered trees

Description/location

- This habitat type is the dominant habitat type within the development envelope. It encompasses all non-treed areas and areas with only scattered paddock trees (Long-leaved Box, Red Stringybark, White Box and Yellow Box) and Kurrajong, often in poor health. Planted shelterbelts (non-indigenous native and introduced species) are present along some fence lines.
- Most pasture areas surveyed were heavily impacted by grazing.
- The proportion of native to exotic groundcover species is highly variable in treeless pasture areas on the site and appears to be negatively correlated to the intensity of grazing pressure. Individual sites that were surveyed were also highly variable over a small

area and this is likely to vary dependent on the time of year, grazing pressure and water availability. As a result of the uncertainty associated with mapping groundcover, no distinction has been made between areas of exotic and native groundcover in the habitat and vegetation mapping.

- As a general rule, native pasture tends to be located in gullies and plains and more sheltered aspects (as in the gully between 6 and 7a, on the northern end of Cluster 3 and large parts of proposed COP (A) Substation transmission line route).
- Although groundcover composition was variable, all survey points on cleared ridges featured an exotic forb component and many were dominated by exotic grasses and forbs (Clusters 1, 2, 4, 5, 6, 7a, and parts of Cluster 10).

Fauna habitat provision/observed fauna

- Fauna habitat provision in pasture areas includes native and exotic grass, rocky outcrops on ridges and side slopes (discussed below) and forb groundcover feed resources, some ground refuge opportunities and scattered mature paddock trees.
- Areas with native groundcover vegetation are likely to provide higher quality foraging resources for native fauna than areas dominated by exotic pasture grasses or exotic forbs. Native grass species provide food and habitat resources to native fauna, including the threatened Diamond Firetail. Exotic species (particularly pasture grasses and weeds such as thistles) tend to dominate native grasses and forbs and reduce the diversity of feed resources available to native fauna species.
- Some ground refuge features are available in this habitat type. Features such as fallen logs, stumps and rock outcrops provide shelter opportunities for fauna (particularly reptiles), as well as perch-and-pounce opportunities for birds such as the threatened Hooded Robin.
- Anthropogenic constructions and materials (farm sheds, refuse and building materials such as tin, tyres and corrugated iron) are also present within this habitat type providing unique habitat opportunities for fauna, particularly reptiles. Reptiles in particular utilise resources such as fence posts and sheets of corrugated iron for refuge. Eastern Bearded Dragon and *Delma inornata* were found around anthropogenic habitat on pasture flats within the study area. Welcome Swallows were observed nesting on the rafters of multiple sheds.
- Hollows are present in some of the scattered eucalypts that occur within examples of this habitat type. Large hollows were observed in many mature trees along Whitefields Road, in the gully south of valley below Cluster 7a along proposed transmission and transmission routes and also along Whitefields Road and Coppabella Road.
- Nineteen fauna species were observed in pasture habitat. Species were of a typical open country assemblage including Galah, Sulphur-crested Cockatoo, Welcome Swallow, Common Starling, Dusky Woodswallow, and Richard's Pipit. Smaller, insectivorous and nectivorous birds were observed within the windbreak vegetation and in the canopies of mature trees including Superb-blue Fairy Wren and Silvereye.

4. Modified wetland areas, dams and watercourses

Location and description

- Small dams and watercourses are present on the site. These areas are generally cleared of tree cover and heavily degraded by weeds, streambed erosion and sedimentation. Many watercourses featured exotic Willow along the banks or within the channel.
- Dam levels were moderately high, and small watercourses were running during survey following recent rains. Some dams were fringed with long grass and sedges, offering refuge for a range of species including frogs, snakes and skinks.
- Higher quality creeks and watercourses are those with clear, running water; fringing grass and sedges; aquatic vegetation; and small, slower running pools. Some areas along Bushrangers Creek, along the proposed COP (A) Substation transmission line route fit this description.

Habitat provision and species observed

- Waterbodies and watercourses at the subject site are small, degraded and mostly ephemeral, and are not likely to provide a sustained habitat for large numbers of waterbirds.
- Forty fauna species were observed in wetland habitats.
- Species observed along watercourses included Clamorous Reed Warbler, Rainbow Bee-eater, Willy Wagtail, *Common Starling, rosellas and parrots, Galah and four frog species (*Crinia signifera, Crinia parinsignifera, Limnodynastes dumerilii, Limnodynastes tasmaniensis*).
- Species observed in dams within the study area include frogs, Eastern Long-necked Turtle, Eurasian Coot, Hardhead, Grey Teal, Australian Wood-duck, Hoary-headed Grebe, Willy Wagtail, White-fronted Chat and Masked Lapwing.
- The September microbat surveys targeted wetland areas (dam and Jugiong Creek). Four species of microbat were identified, although no threatened species.

Jugiong Creek

- Jugiong Creek was surveyed at the Coppabella Road crossing point. This creek has substantial water flow, and features abundant aquatic vegetation, rocky bank, and mature trees. Groundcover is limited to exotic pasture grasses and weeds. Barn Owl, Silvereye, White-plumed Honeyeater and Red-bellied Black Snake were observed at Jugiong Creek.

Landform-based habitat types

1. Ridges and rocky outcrops

- Turbine Clusters are located on a north-west to south-east oriented ridgeline and surrounding hills. The ridge lines are predominantly pasture, with only scattered remnant trees or highly disturbed woodland. Most sites are heavily grazed.

Rocky outcrops

Description/location.

- Rocky outcrops are present within all nominated turbine envelopes. They predominately occur within cleared pasture habitats; although are also present below Cluster 7a and 7b, on 3 and within the development envelope on Cluster 10 in steep woodland and disturbed woodland habitat types (refer to
- Table 6-3 and
- Figure 6-1).
- With the exception of Cluster 10, all ridge-top rocky outcrops surveyed were heavily degraded by grazing and clearing resulting in overall loss of vegetative cover and suppression of native groundcover species. All survey points had an exotic forb component (such as nettle and thistle), and many were dominated by exotic grasses and forbs (Clusters 1, 2, 4, 5, 6, 7a, and parts of Cluster 10). Rocky outcrops among native pasture also occur on the site, for example on the saddle on Cluster 10; and on parts of Clusters 8 and 3. As with the pasture habitat type discussed above, no distinction has been made between areas of exotic and native groundcover in the fauna habitat mapping as the composition is highly spatially and temporally variable.

Table 6-3 Location, extent, vegetation type and condition of rock outcrops at survey locations on the site

HABITAT	SURVEY POINTS ON TURBINE CLUSTERS	UNDERSTOREY	CONDITION	VEGETATION TYPE	EXTENT OF ROCKY OUTCROPPING
Woodland	Cluster 3 saddle, 6 north end on south facing slope, Cluster 7 on west-facing slope and a patch on Cluster 8	Predominately native grasses and mixed forbs	Moderate-good	Dry grass forest and box-gum woodland	Patchy
Disturbed woodland	Cluster 3 south, Cluster 7 on edges of woodland, parts of Cluster 10 (within development envelope)	Mixed grass and forbs	Poor-moderate	Dry grass forest and box-gum woodland	Abundant to patchy
Native and mixed pasture	Cluster 6 slope, Cluster 8 ridge, Cluster 9 ridge, parts of Cluster 7a and 7b ridge and upper slope, parts of Cluster 3 south	Predominately native grasses and mixed forbs/mixed grasses and forbs	Poor and poor-moderate	Derived box-gum woodland and pasture	Abundant
Exotic pasture	Cluster 1, 2, 4, 5, 6, parts of Cluster 7a and 7b ridge and upper slope; Cluster 3a upper slope; parts of Cluster 10	Exotic	Poor	Pasture	Abundant

Habitat provision and survey results

- Abundant volcanic rock outcrops with crevices, smaller loose or partially embedded rocks and scattered fallen logs and stags are present on all ridge tops within the development envelope and these provide potential shelter and basking habitat required by reptiles. The quality of these habitats for reptile use is greatly impacted by intensive grazing, clearing and the predominance of exotic groundcover species (Dorrough and Ash 1999; Fischer *et al.* 2004).
- Reptile habitat assessments and reptile searches targeted this habitat type (discussed below in Section 6.2.2). Three reptile species were observed within this habitat type.
- All of the ridge tops surveyed were heavily grazed, had little remaining top soil, were very dry (even under rocks) and most had extensive patches of exotic forbs (thistles and nettles). The soil was also considerably dry at all ridge sites despite receiving recent rains. These factors may account for the low species richness of the reptile species recorded in this habitat type.

Ridges

- Raptors utilise ridge systems for navigation and for gliding on thermal air currents or upward deflections of winds. Ridges and standing timber can also be suitable perching points for raptors for spying prey in the valleys below. Lambs were observed to venture up to the ridges during lambing time providing abundant prey for raptors. Raptors observed on or above ridges or side slopes include Wedge-tailed Eagle, Nankeen Kestrel, Australian Hobby and Collared Sparrow-hawk.
- Ground debris such as fallen and standing dead timber is present on some ridges, including Cluster 7a and Cluster 10. Debris on cleared ridges creates structural diversity, providing perching points and refuge sites for fauna.
- The treeless ridges are unlikely to provide high quality habitat given that they are highly disturbed by grazing, clearing and weed invasion and carry little foraging resources or refuge for use by fauna to protect from prevailing winds, sun or predation.
- No threatened species were observed on ridges. Species observed include raptors and common open country species such as Richard's Pipit, Australian Magpie and Galah. Smaller insectivorous birds such as the Buff-rumped Thornbill and Striated Pardalote were observed within the canopy of scattered eucalypts.

Other rare or limiting habitat features

Box-Gum Woodland

Woodland habitats have been extensively cleared and modified for agriculture throughout the region. Box-Gum Woodland, and the similar community Dry Grass Forest, occur in a number of locations, in a variety of condition states over the site. Approximately 890 hectares of Box Gum Woodland vegetation occurs within the development envelope. Woodland provides important feed and habitat resources for specialists such as the threatened Koala and the Regent Honeyeater.

Hollow-bearing and mature trees

Mature trees with hollows provide an essential habitat resource for many arboreal mammals (such as gliders, possums and bats) and birds (Gibbons and Lindenmayer 2002). Large hollow-bearing trees have been depleted by clearing for agriculture throughout the district and are a limiting habitat resource for dependent species in this landscape

Mature trees are generally rare across the study area and tend to occur only in disturbed woodland remnants, such as along Whitefields Road and on the edges of the woodland below Cluster 7, or as scattered paddock trees. Most trees in larger forest patches are regrowth that are yet to reach hollow-forming age. Only a small number of hollow-bearing trees occur within the proposed development envelope on Cluster 10, Cluster 3 north, on the edges of woodland below Cluster 7a, in paddock trees in low lying areas within transmission envelopes between Clusters 5 and 7a, and also adjacent to Whitefields Road. Hollow-bearing trees are also present on Cluster 6, however in a very small and isolated ridge top patch that is highly disturbed by grazing and weed invasion (European Nettle). Many less mature trees on ridges within the development envelope appear to be in poor health and may develop cavities as they become more senescent.

An exception however is the proposed COP (A) Substation transmission line route, where hollow-bearing trees are abundant along the plains, gullies and lower slopes. Although these hollow-bearing trees occur in disturbed habitats, they are likely to be of high importance for more mobile hollow-dependent species (such as microbats) given the paucity of this resource within the locality.

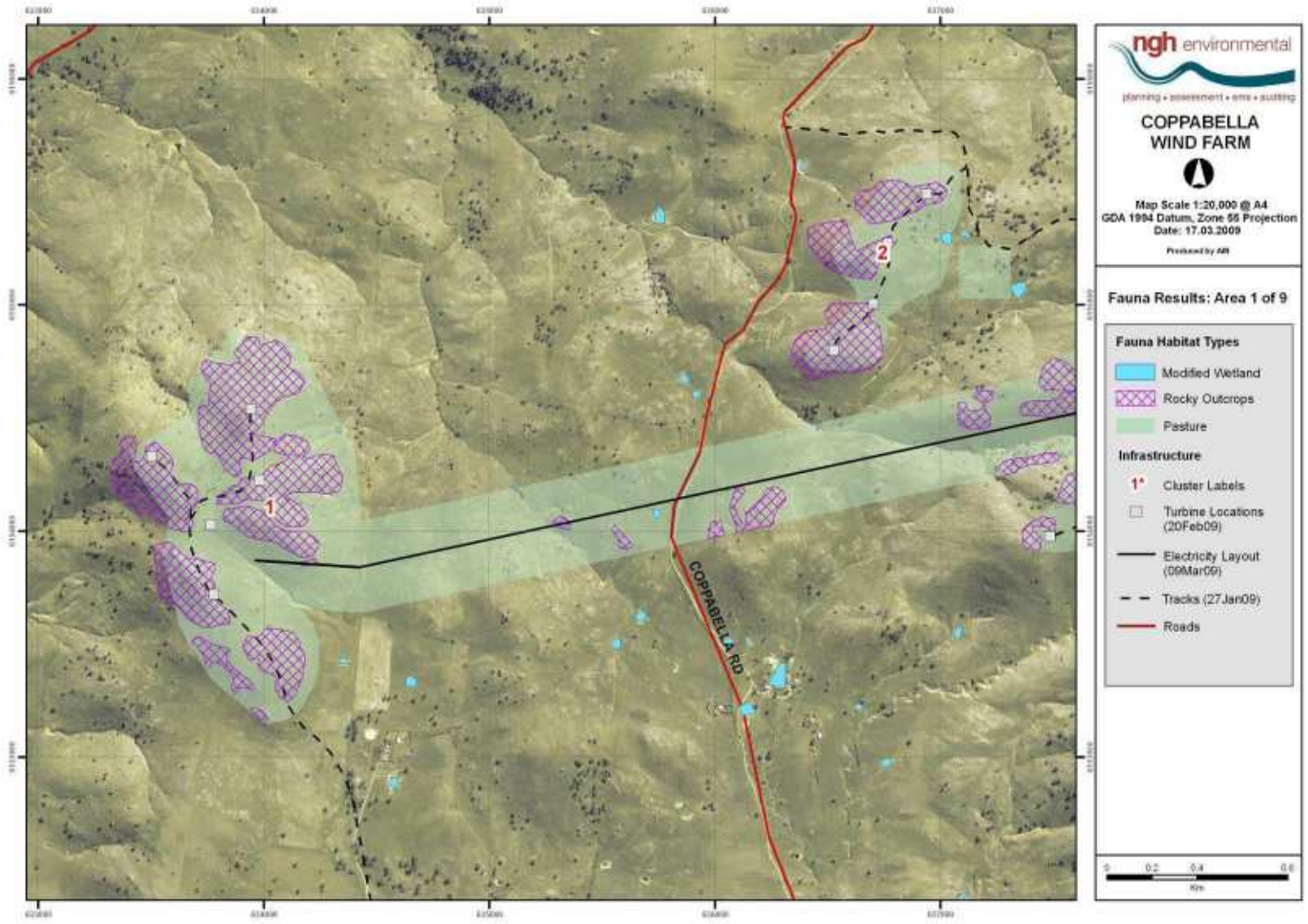
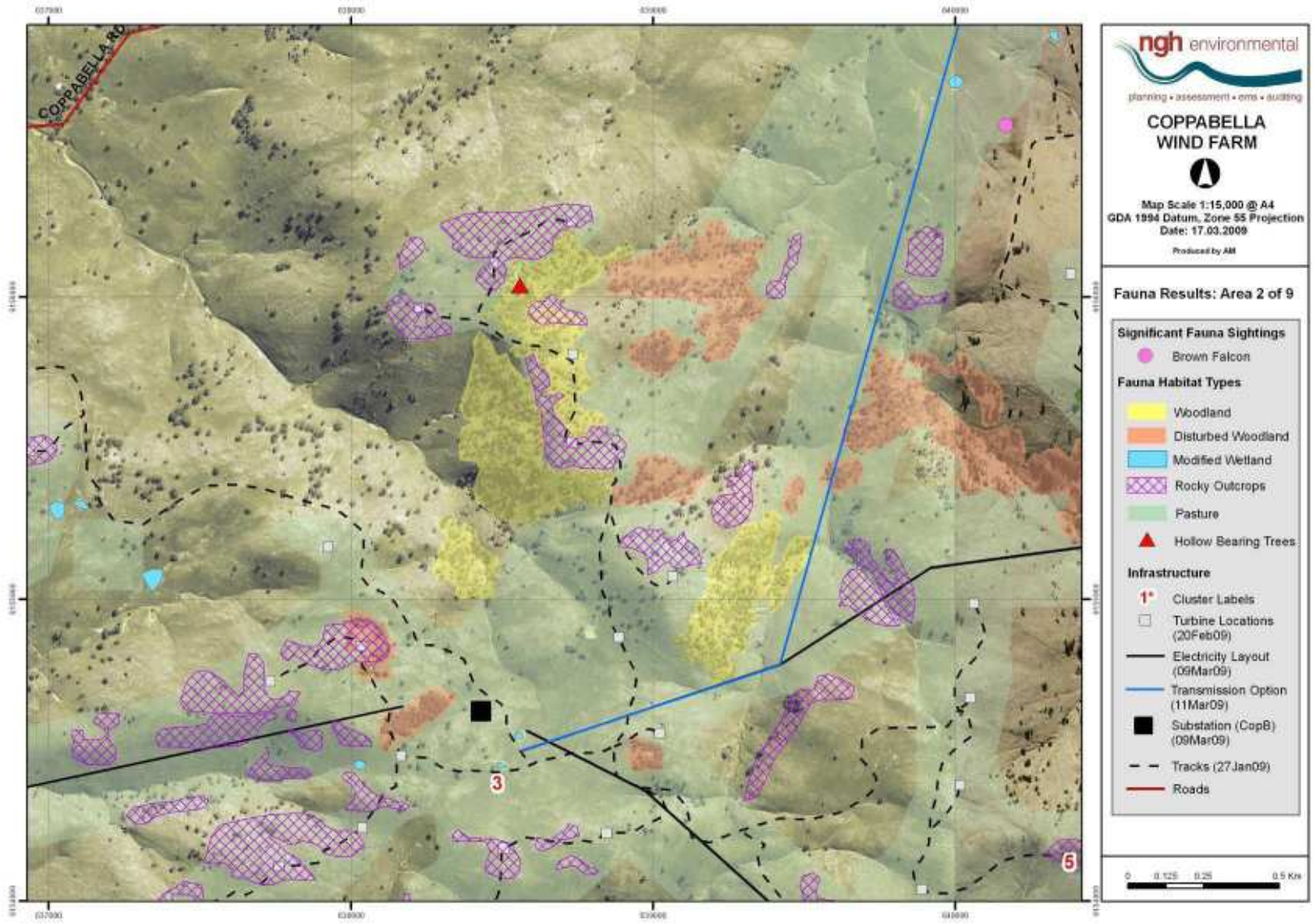
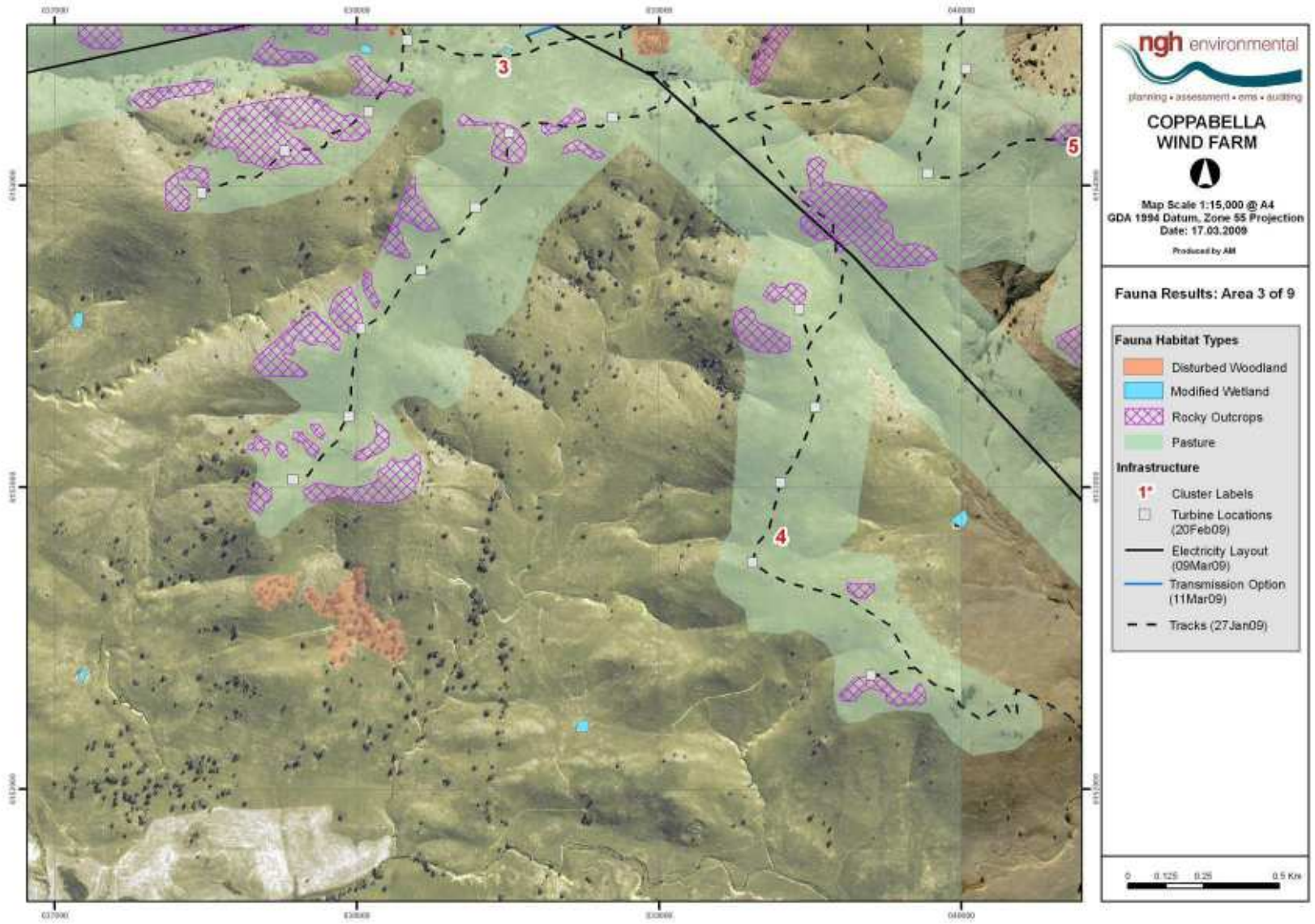
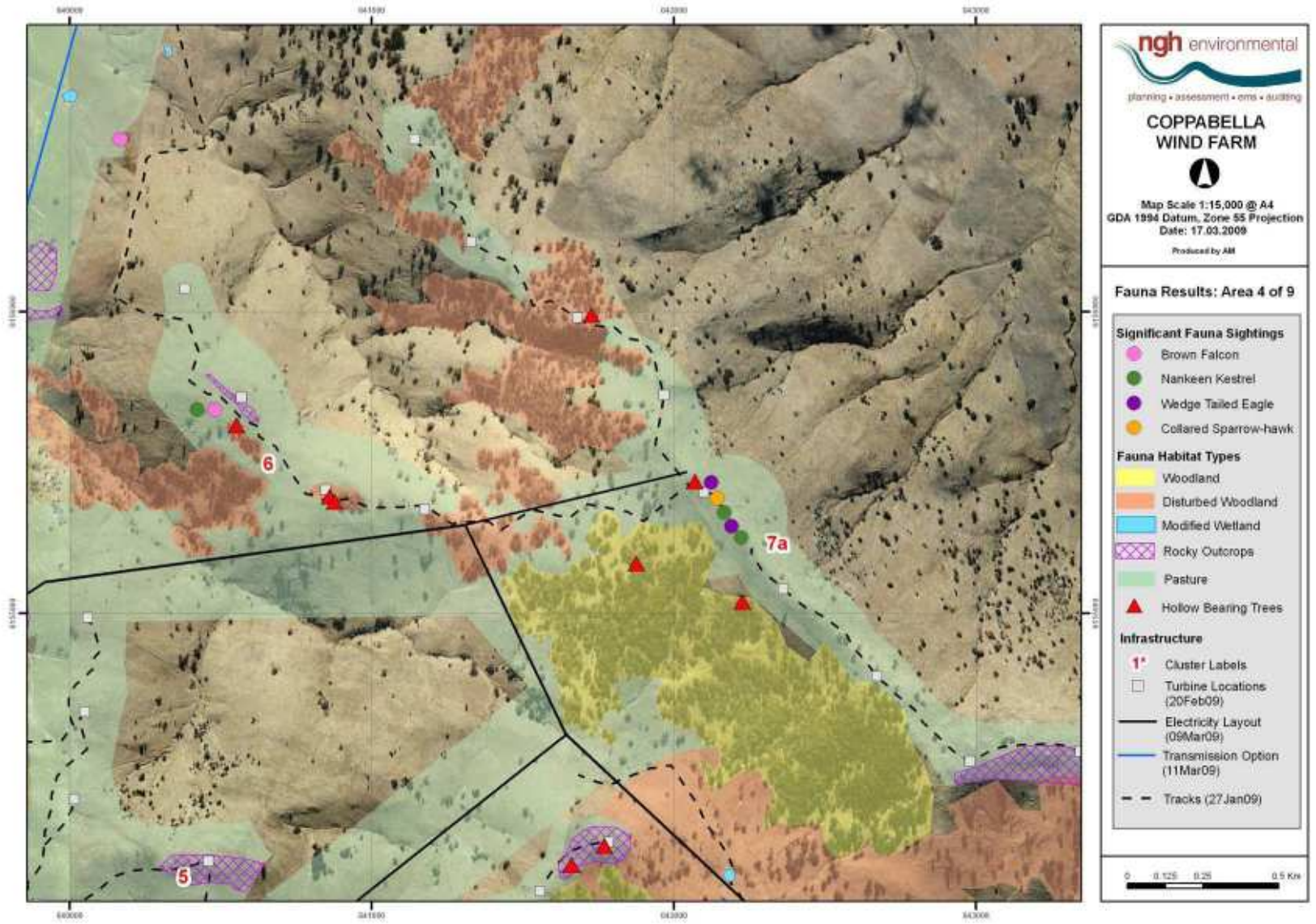
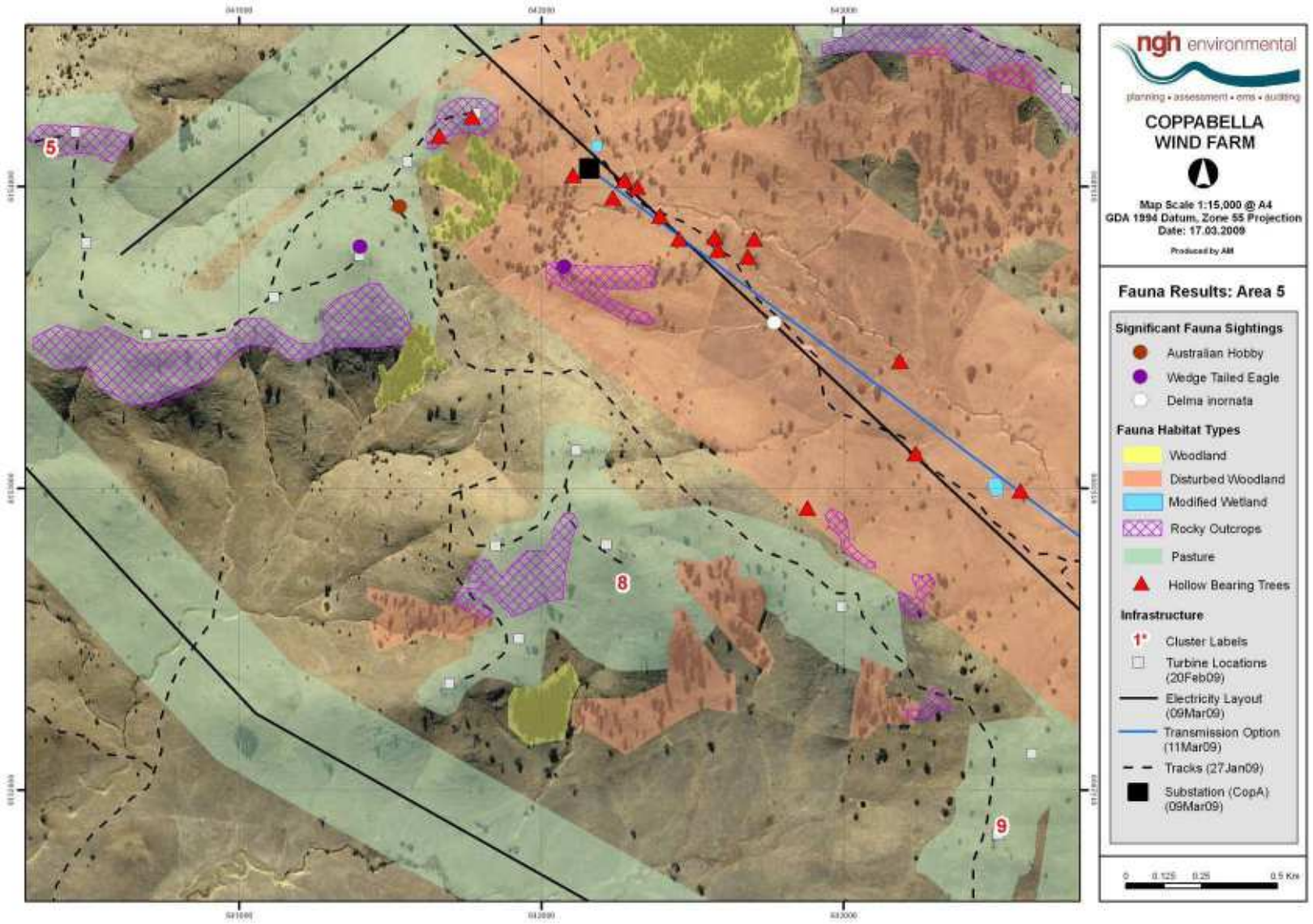


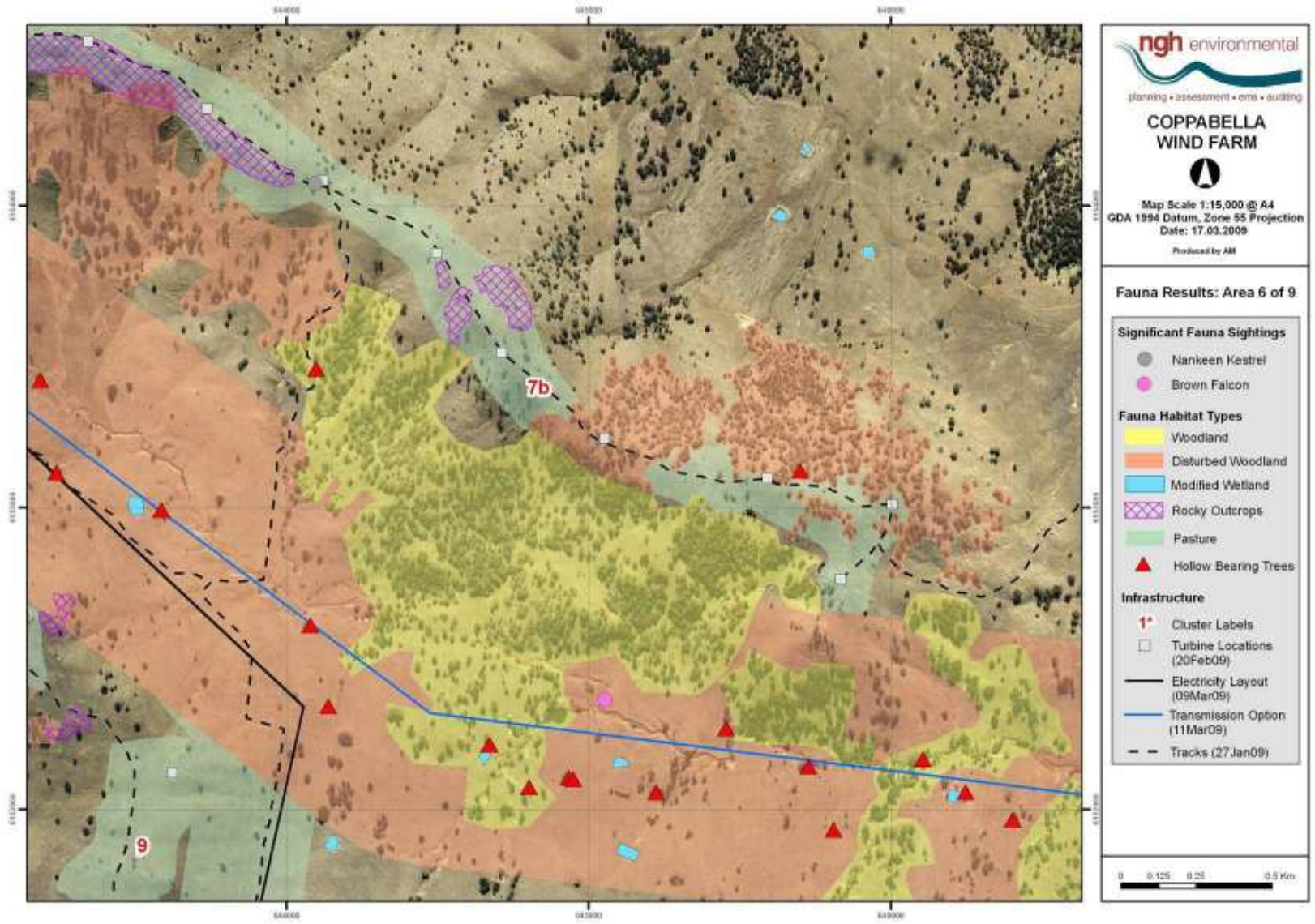
Figure 6-1 Fauna results, map set (9 maps in total)

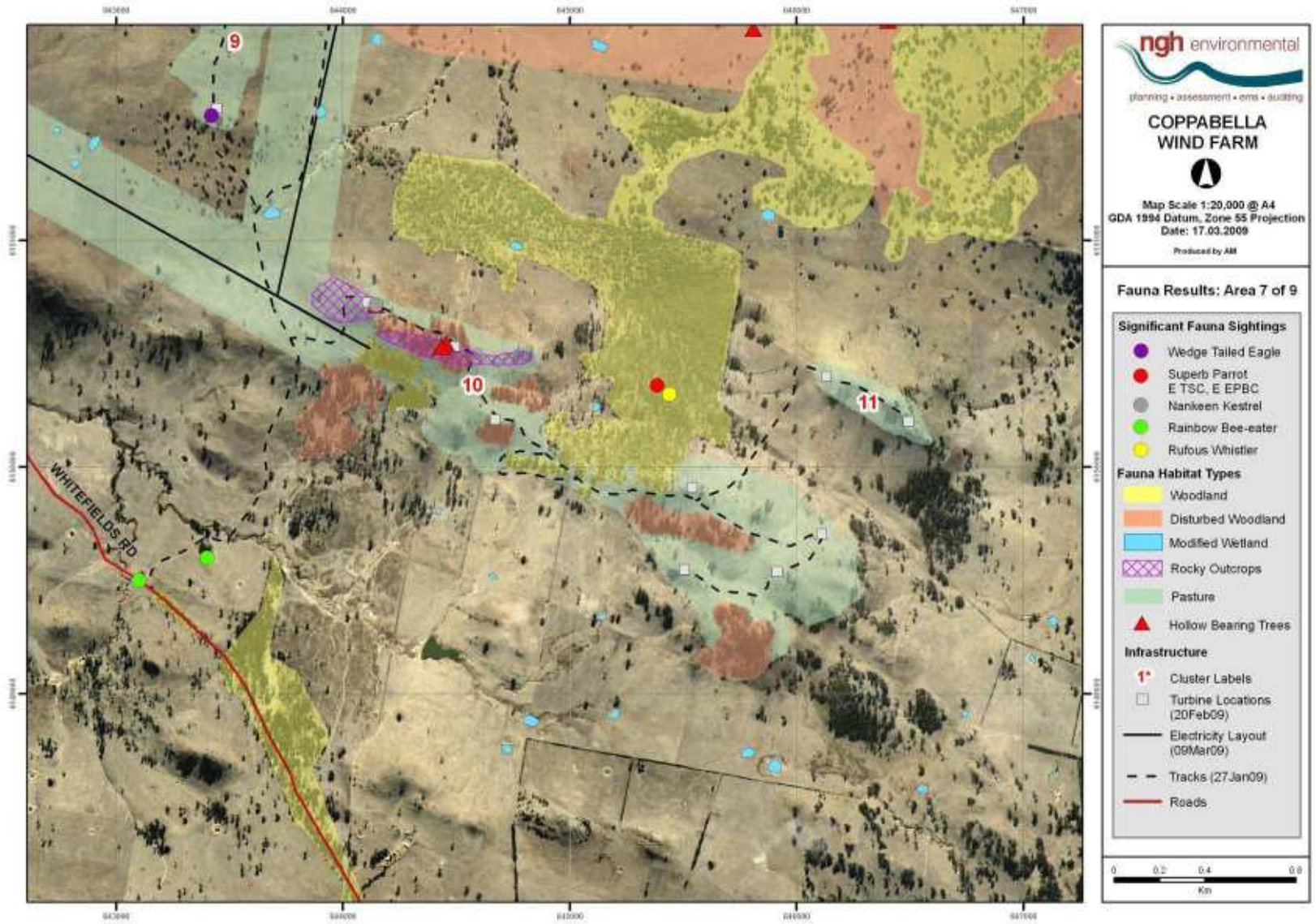

COPPABELLA RD
ngh environmental
planning • assessment • ems • auditing
COPPABELLA
WIND FARM
Map Scale 1:15,000 @ A4
GDA 1994 Datum, Zone 55 Projection
Date: 17.03.2009
Produced by AM
Fauna Results: Area 2 of 9
Significant Fauna Sightings
Brown Falcon
Fauna Habitat Types
Woodland
Disturbed Woodland
Modified Wetland
Rocky Outcrops
Pasture
Hollow Bearing Trees
Infrastructure
1* Cluster Labels
Turbine Locations (20Feb09)
Electricity Layout (09Mar09)
Transmission Option (11Mar09)
Substation (CopB) (09Mar09)
Tracks (27Jan09)
Roads
0 0.125 0.25 0.5 Km
3
5

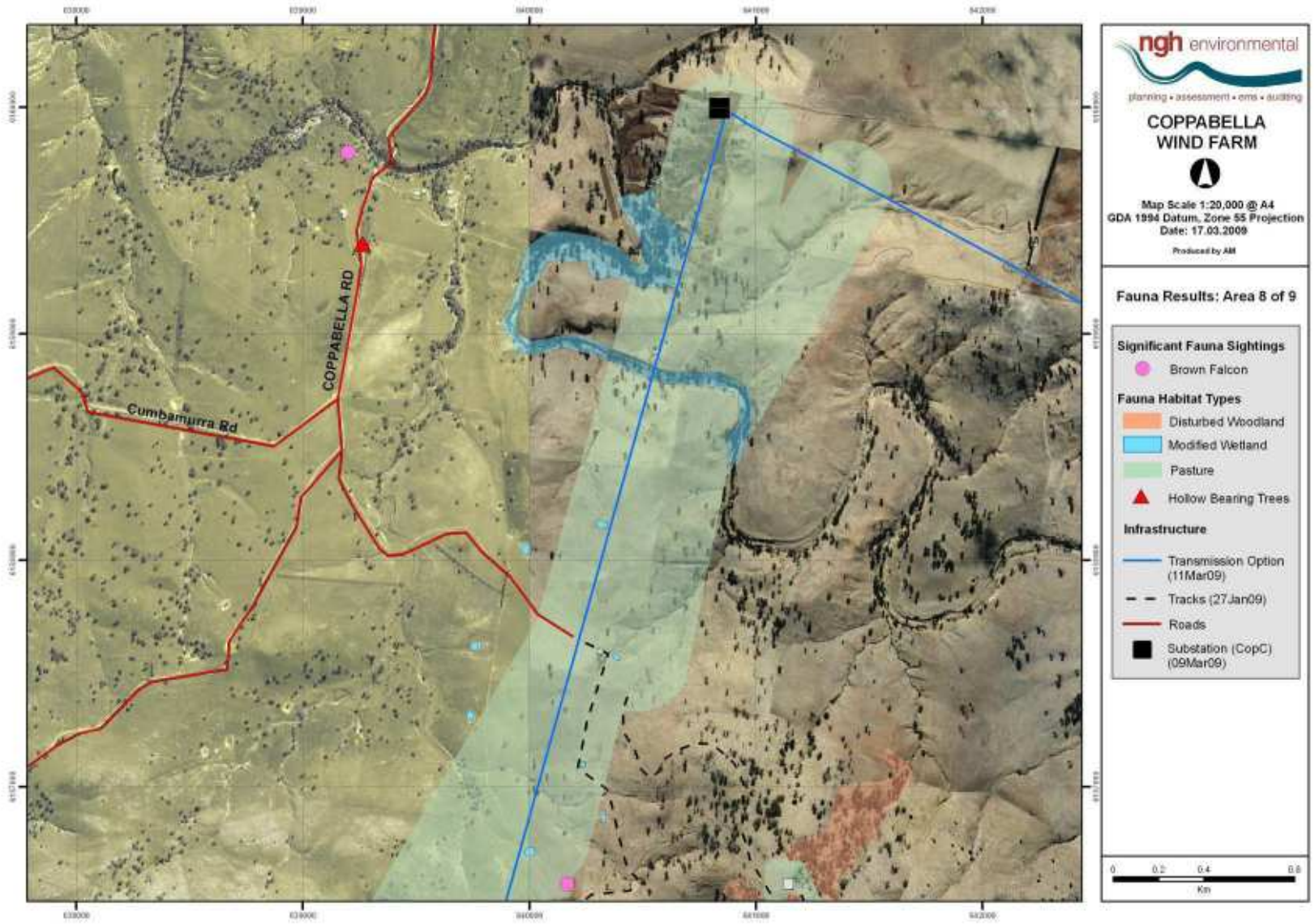

3
5
4
ngh environmental
planning • assessment • ems • auditing
COPPABELLA
WIND FARM
Map Scale 1:15,000 @ A4
GDA 1994 Datum, Zone 55 Projection
Date: 17.03.2009
Produced by AM
Fauna Results: Area 3 of 9
Fauna Habitat Types
Disturbed Woodland
Modified Wetland
Rocky Outcrops
Pasture
Infrastructure
1* Cluster Labels
Turbine Locations (20Feb09)
Electricity Layout (09Mar09)
Transmission Option (11Mar09)
Tracks (27Jan09)
0 0.125 0.25 0.5 Km


ngh environmental
planning • assessment • ems • auditing
COPPABELLA
WIND FARM
Map Scale 1:15,000 @ A4
GDA 1994 Datum, Zone 55 Projection
Date: 17.03.2009
Produced by AM
Fauna Results: Area 4 of 9
Significant Fauna Sightings
Brown Falcon
Nankeen Kestrel
Wedge Tailed Eagle
Collared Sparrow-hawk
Fauna Habitat Types
Woodland
Disturbed Woodland
Modified Wetland
Rocky Outcrops
Pasture
Hollow Bearing Trees
Infrastructure
Cluster Labels
Turbine Locations (20Feb09)
Electricity Layout (09Mar09)
Transmission Option (11Mar09)
Tracks (27Jan09)
0 0.125 0.25 0.5 Km
6
7a
5


ngh environmental
planning • assessment • ems • auditing
COPPABELLA
WIND FARM
Map Scale 1:15,000 @ A4
GDA 1994 Datum, Zone 55 Projection
Date: 17.03.2009
Produced by AM
Fauna Results: Area 5
Significant Fauna Sightings
Australian Hobby
Wedge Tailed Eagle
Delma inornata
Fauna Habitat Types
Woodland
Disturbed Woodland
Modified Wetland
Rocky Outcrops
Pasture
Hollow Bearing Trees
Infrastructure
1* Cluster Labels
Turbine Locations (20Feb09)
Electricity Layout (09Mar09)
Transmission Option (11Mar09)
Tracks (27Jan09)
Substation (CopA) (09Mar09)
0 0.125 0.25 0.5 Km
5
8
9


ngh environmental
planning • assessment • ems • auditing
COPPABELLA
WIND FARM
Map Scale 1:15,000 @ A4
GDA 1994 Datum, Zone 55 Projection
Date: 17.03.2009
Produced by AM
Fauna Results: Area 6 of 9
Significant Fauna Sightings
Nankeen Kestrel
Brown Falcon
Fauna Habitat Types
Woodland
Disturbed Woodland
Modified Wetland
Rocky Outcrops
Pasture
Hollow Bearing Trees
Infrastructure
1* Cluster Labels
Turbine Locations (20Feb09)
Electricity Layout (09Mar09)
Transmission Option (11Mar09)
Tracks (27Jan09)
0 0.125 0.25 0.5 Km
7b
9


9
10
11
WHITEFIELDS RD
ngh environmental
planning • assessment • ems • auditing
COPPABELLA
WIND FARM
Map Scale 1:20,000 @ A4
GDA 1994 Datum, Zone 55 Projection
Date: 17.03.2009
Produced by AM
Fauna Results: Area 7 of 9
Significant Fauna Sightings
Wedge Tailed Eagle
Superb Parrot
E TSC, E EPBC
Nankeen Kestrel
Rainbow Bee-eater
Rufous Whistler
Fauna Habitat Types
Woodland
Disturbed Woodland
Modified Wetland
Rocky Outcrops
Pasture
Hollow Bearing Trees
Infrastructure
1* Cluster Labels
Turbine Locations
(20Feb09)
Electricity Layout
(09Mar09)
Tracks (27Jan09)
Roads
0 0.2 0.4 0.8
Km


COPPABELLA RD
Cumbamurra Rd
ngh environmental
planning • assessment • ems • auditing
COPPABELLA
WIND FARM
Map Scale 1:20,000 @ A4
GDA 1994 Datum, Zone 55 Projection
Date: 17.03.2009
Produced by AM
Fauna Results: Area 8 of 9
Significant Fauna Sightings
Brown Falcon
Fauna Habitat Types
Disturbed Woodland
Modified Wetland
Pasture
Hollow Bearing Trees
Infrastructure
Transmission Option (11Mar09)
Tracks (27Jan09)
Roads
Substation (CopC) (09Mar09)
0 0.2 0.4 0.8
Km

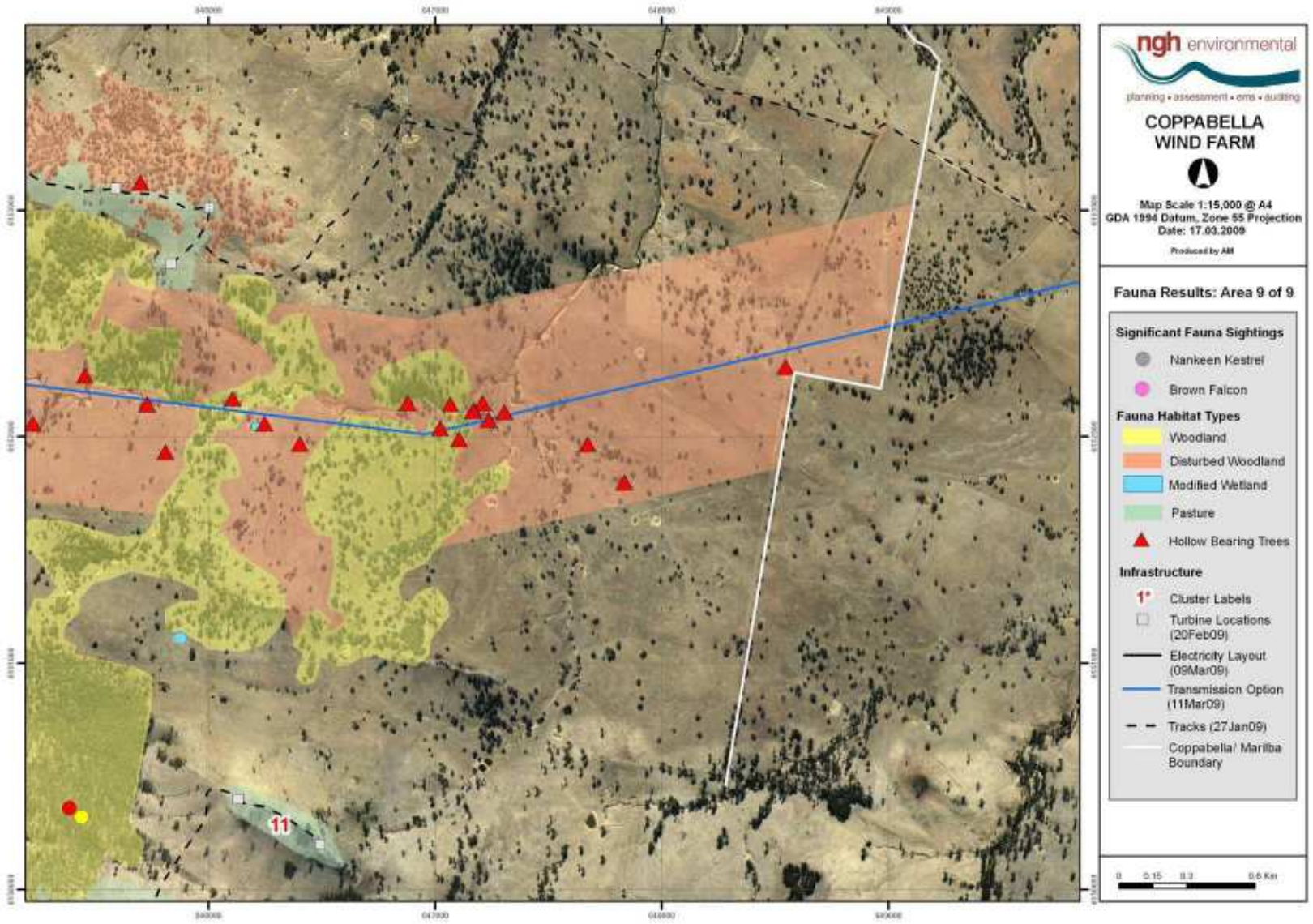

ngh environmental
planning • assessment • ems • auditing
COPPABELLA
WIND FARM
Map Scale 1:15,000 @ A4
GDA 1994 Datum, Zone 55 Projection
Date: 17.03.2009
Produced by AM
Fauna Results: Area 9 of 9
Significant Fauna Sightings
Nankeen Kestrel
Brown Falcon
Fauna Habitat Types
Woodland
Disturbed Woodland
Modified Wetland
Pasture
Hollow Bearing Trees
Infrastructure
Cluster Labels
Turbine Locations (20Feb09)
Electricity Layout (09Mar09)
Transmission Option (11Mar09)
Tracks (27Jan09)
Coppabella/ Marilba Boundary
11
0 0.15 0.3 0.6 Km

Table 6-4 Summary of habitat types and condition in study area

DESCRIPTION	APPROX. EXTENT WITHIN THE DE (HA)	LOCATION WITHIN THE DE	VEGETATION TYPES	CONDITION AND DISTURBANCE	FAUNA HABITAT RESOURCES	THREATENED OR SIGNIFICANT SPECIES RECORDED IN THIS HABITAT TYPE
Woodland						
Remnant and regrowth Box-Gum Woodland and dry grass forest patches with a relatively continuous overstorey cover	241.37	**Clusters**: 3 and 10, and small areas on 7 **Transmission**: between 6 and 7a, and on the eastern slope of 3 **Transmission line**: in the western portion and along watercourses	Box-Gum Woodland and dry grass forest	Low grazing pressure and clearing and predominately native groundcover.	Box-Gum Woodland with native grass groundcover and occasional shrubs. High structural diversity with abundant fauna refuge sites	Superb Parrot, Red-capped Robin, Varied Sitella
Disturbed Woodland						
Cleared and fragmented woodland areas that are disturbed by grazing and often weed invasion	780.75	**Clusters:** small areas on 7a and 7b, 3, 6, 8 and 10 **Transmission:** between 6 and 7a and north of 3 **Access:** adjacent to Whitefields Road **Transmission line**: Spread all over the proposed route between areas of woodland and pasture	Box-Gum Woodland and dry grass forest	Cleared, grazed and fragmented woodland with variable groundcover composition	Mature and hollow-bearing trees on road-side remnants and edges of woodland, moderate structural diversity with some refuge sites	Superb Parrot, Dusky Woodswallow
Pasture						
Mixed native and exotic pasture with only scattered mature eucalypts	1,834.7	All Clusters, transmission envelopes and access routes	Derived Box-Gum Woodland and pasture	Extensively cleared grazed and modified pasture areas. Most Clusters are dominated by exotic species	Variable native and exotic grass and forb groundcover feed resources, some ground refuge opportunities and scattered mature paddock trees.	*Delma inornata*, Raptors seen from ridge sites and flying over cleared valleys

DESCRIPTION	APPROX. EXTENT WITHIN THE DE (HA)	LOCATION WITHIN THE DE	VEGETATION TYPES	CONDITION AND DISTURBANCE	FAUNA HABITAT RESOURCES	THREATENED OR SIGNIFICANT SPECIES RECORDED IN THIS HABITAT TYPE
Modified wetland habitat						
Small dams and watercourses	11.27 (only Jugiong Creek)	Existing and proposed access roads pass over small ephemeral creeks; Proposed power and transmission line easements intercept Jugiong Creek, transmission line follows Bushrangers Creek and a number of smaller tributaries	Riparian forest	Generally cleared of tree cover and heavily degraded by weeds, streambed erosion and sedimentation	Watering sources, small areas of aquatic and riparian vegetation	Waterbirds: ducks, teals, plovers Microbats: *Nyctophilus, Mormopterus*
Ridges and rocky outcrops						
Exposed ridges on steep side slopes featuring extensive volcanic rock outcrops. Features predominately pasture with occasional areas of disturbed woodland and woodland.	197.56	All ridge tops and side slopes within the development envelope	Exotic and native pasture with scattered trees/Box-Gum Woodland	Generally in low condition from extensive sheep grazing, weed invasion and clearing. Features only scattered trees with no shrub or small tree layer. Areas are very dry with little or no top soil	Refuge and basking opportunities for reptiles. Navigation and thermal currents for raptor flight. Prey for raptors during lambing	Raptors: Wedge-tailed Eagle, Nankeen Kestrel, Australian Hobby and CollaredSparrow-hawk

6.2.2 Species recorded at the site

In total, 94 exotic and native vertebrate species were recorded during the surveys. This comprised of 65 bird, 17 mammal, 8 reptile and 4 frog species. The highest fauna species richness was recorded from woodland habitats (45 species), followed by wetland habitats (40 species), disturbed woodland (39 species) and lastly, ridges (19 species) (Table 6-5). Most species were recorded a multiple habitat types.

Table 6-5 Species richness recorded across all habitat types (note most species occurred in multiple habitat types; both exotic and native species counted)

HABITAT TYPE	BIRDS	MAMMALS	REPTILES	AMPHIBIANS	TOTAL
Woodland	34	8	3	0	**45**
Disturbed woodland	32	6	0	0	**38**
Pasture	19	6	4	0	**29**
Wetland habitats	24	2	2	4	**38**
Ridges and rocky outcrops	15	2	3	0	**20**

Birds

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

- Woodland: fantails, pardalotes, choughs, honeyeaters, gerygones, robins, thornbills, thrushes and treecreepers
- Disturbed woodland and on woodland edges: thornbills, parrots and rosellas, wattlebirds, currawongs, woodswallows and magpies
- Pasture with scattered trees on flats: open country species including pipits, parrots, galahs, cockatoos, swallows and tree martins
- Ridge top pasture areas with scattered trees: raptors and open country species
- Wetland habitats (dams and creeks): honeyeaters, cuckoos, and waterbirds including ducks, grebes, teals, plovers and Clamorous Reed Warbler

High avian species richness was recorded in woodland habitats (34 species), and particularly in the woodland remnant north of Cluster 10 (beyond the development envelope). Two threatened species were recorded in the study area: Superb Parrot (listed as Vulnerable on the TSC Act) was recorded flying in a flock of ten over the woodland patch to the north of Cluster 10. This species was also observed in disturbed road-side woodland remnants along Illalong Road, to the east of the site. Diamond Firetail was recorded in a flock of six feeding within a disturbed section of Bushranger's Creek along the proposed COP (A) Substation transmission line. One migratory bird species: Rainbow Bee-eater was observed on the site (listed on the EPBC Act) using burrows along the wooded banks of Bushranger's Creek.

Many of the woodland bird species recorded are specialist species and were not recorded in other habitats. Woodland bird species that have been listed as decliners in the wheat-sheep belt region of

NSW were identified on the site including Varied Sittella, Red-Capped Robin and Jacky Winter (all within woodland habitat) and Dusky Woodswallow (pasture and disturbed woodland).

On other, more disturbed sites, surveys showed that habitats were dominated by only a few generalist or aggressive species. For example, in scattered trees and small remnants the Crimson Rosella, Common Starling* and Australian Magpie were more abundant than any other species, and the Galah and Sulphur Crested Cockatoo were omnipresent in cleared pasture areas over the entire site.

Fourteen bird species recorded from pasture and rock outcrops on ridge tops, which included the raptors: Australian Hobby, Brown Falcon, Collared Sparrow-hawk, Nankeen Kestrel and Wedge-tailed Eagle.

Nocturnal birds recorded include the Boobook Owl, which was heard in the woodland below turbine Cluster 7a and a Barn Owl, observed along Jugiong Creek on Whitefields road, north of the site.

Seven wetland bird species were observed in vegetation along creeks (Clamorous Reed Warbler) and within farm dams (Eurasian Coot, Hardhead, Grey Teal, Australian Wood-duck, Hoary-headed Grebe and Masked Lapwing). These species may be impacted by the disturbance or infill of dams on the site, however are relatively common and would be able to relocate in the face of disturbance.

Mammals

The site is highly fragmented and impacted by grazing, clearing and weed invasion. These factors limit the site's capacity to provide habitat for mammalian species. The site generally features a reduced groundcover due to heavy grazing by sheep and many areas are dominated by exotic forbs and mixed grasses. Connectivity between woodland patches is limited to only scattered paddock trees and eroded riparian lines.

Tree Elliot trapping surveys targeted arboreal, hollow-dwelling mammals. These were placed on mature trees on the edges of the woodland on the upper slope of 7a. No arboreal mammals were captured. The limited number of hollows in this area and the lack of connectivity to other mature woodland patches likely limits the abundance and diversity of arboreal mammals that the site is able to support. Only one ringtail possum was observed in continuous woodland habitat on the lower slopes below 7a, where as spotlight surveys identified a high abundance of Ringtail Possums (seven) and Brushtail Possums (eleven) in remnant mature woodland in roadside vegetation where there are higher numbers of hollows and greater east-west connectivity. The high abundance recorded on the roadside may also reflect the vehicle survey method as surveys were able to cover much larger distances than a survey by foot.

The highest quality ground-dwelling mammal habitat on the site is located on the south-facing slopes below 7a and 7b and within the large woodland patch north of Cluster 10. These areas are the largest remnants on the site and are the least impacted by grazing and weed invasion. They feature an intact understorey, extensive areas of refuge (fallen debris and occasional rocky areas) and occasional small hollows. Ground Elliot and Cage trapping were undertaken within these areas and targeted small and medium-sized ground-dwelling mammals. An additional fifteen trap nights was undertaken on the ridge on Cluster 6 among disturbed remnant White Box woodland. Cluster 6 has a highly disturbed understorey (dominated by European Nettle*), although carries many mature trees with hollows.

No mammals were captured during the ground-trapping survey (only Australian Magpie and Shingleback Lizard were captured in the cage traps). The null result is considered to reflect the disturbed and fragmented nature of the landscape. Fragmentation and grazing are known to reduce

the capacity for the landscape to support small mammals (for example Bennett 1990; Lindenmayer *et al.* 2000), and is also likely to have consequences for larger fauna that prey on these species such as forest owls, foxes and potentially quolls, if locally present.

Multiple species of macropod were observed onsite (Eastern Grey Kangaroo, Euro, Red-necked Wallaby and Swamp Wallaby). Only Eastern Grey Kangaroo was observed in pasture habitats. Swamp Wallaby was observed only in gully woodland habitat on Cluster 3, where there was a continuous canopy cover, abundant ground refuge (fallen logs) and low grazing.

Exotic species observed included the sheep and cow (grazing stock), Red Fox, European Hare and European Rabbit. Foxes and rabbits were observed within all habitat types, and hares were observed only in pasture although are likely to occur in other habitats.

Macro and microchiropteran bats

Six species of microbats were recorded on the site (see Appendix B for Anabat results). These were identified foraging in woodland, over dams and around isolated paddock trees from two sites: in the valley between Clusters 6 and 7, and from Jugiong Creek.

Microbats require specific foraging and roosting habitats, with many foraging in the forest canopy and using large hollow-bearing trees or caves for roosting (Pennay & Freeman 2005). Many microbat species also utilise multiple roosts to avoid predation and parasite loads (Kunz & Lumsden 2003 cited in Rhodes 2006).

Hollow-bearing paddock trees have been found to provide critical roosting and nesting resources for microbats (Gibbons and Boak, 2002; Manning et al., 2006). The site provides scattered hollow-bearing trees in paddocks and around the edges of larger patches. Hollows were observed on the northern end of Cluster 10 and 6, on the edges of woodland habitat on site 7a and b, as well as in road side remnants along Whitefields Road and along the proposed COP (A) Substation transmission line route.

Reptiles

Eight species of reptile were observed during the survey period.

Abundant volcanic rock outcropping is present on ridges and side slopes within the development envelope (discussed above). The quality of these habitats for reptiles is related to the extent of exotic grass and forb cover and grazing pressure (see example

Figure 6-2). These factors have been negatively correlated to reptile diversity on rock outcrops ecosystems in Australia (Fischer *et al.* 2004; Michael *et al.* 2008). Rocky outcrops on ridge tops and side slopes, in particular were the most heavily disturbed areas on the site.

Reptile searches (rock rolling) targeted rock outcropping on different aspects, and in different vegetation types and conditions. Searches on rocky ridges and slopes within the proposed development envelope identified only three individuals: Eastern Brown Snake, Shingleback Lizard and Cunningham's Skink (all basking on rocks). No small reptiles were identified on rocky outcrops despite the extensive survey effort (approximately 1078 rocks/logs rolled, Figure 5-1). The low reptile species richness recorded is likely to be related to the disturbed condition of the ridge tops and upper slopes within the development envelope.

Rock rolling revealed that black ants occurred under 5-40% of the rocks rolled, however there were no clear differences in the percentage of ants between the Clusters (Table 6-6), or between the different slope aspects.

Reptile searches were also undertaken in woodland, and anthropogenic habitats such as under tin, fence posts, tyres and other refuge. Eastern Bearded Dragon and *Delma inornata* were found around anthropogenic habitat on pasture flats. Copper-tailed Skink was uncovered under a rock in woodland habitat on the slope below 7b.

Table 6-6 Reptile survey summary

TURBINE CLUSTER/ LOCATION	AV. % ROCKS W/ BLACK ANTS	AV. NO. ROCKS, LOGS OR REFUGE ROLLED	NUMBER OF SURVEYS	EFFORT (ROCKS ROLLED)	REPTILE SPECIES OBSERVED, HABITAT TYPE AND OBSERVATION TYPE
1	15	45	1	45	Nil
3	23	41	6	246	Nil
4	15	63.5	2	127	Cunningham's Skink (rock outcrop on slope; basking)
6	15	75	1	75	Nil
7	19	33.6	5	168	Coppertail Skink (woodland on slope; under rock); Shingleback Lizard (rock outcrop on ridge; basking);
8	15	105	2	210	Nil
9	20	62	1	62	Nil
10	25	35	2	70	Eastern Brown Snake (rock outcrop on ridge; basking); Shingleback Lizard (woodland; cage trap); Bearded Dragon (woodland on flat; opportunistic record)
Flat (around habitation)	15	15	5	75	Bearded Dragon and *Delma inornata* (pasture)
Aquatic habitat	-	-	-	-	Red-bellied Black Snake (creek), Eastern Long-necked Turtle (dam)
Total	-	-	25	1078	8 species

Figure 6-2 Examples of reptile habitat available at Coppabella Hills Precinct. Clockwise from top left, Clusters 3, 4, and 7.

Amphibians

Four amphibian species were recorded at the site: Eastern Sign-bearing Froglet (*Crinia parinsignifera),* Common Eastern Froglet (*Crinia signifera),* Southern Banjo Frog or Pobblebonk *(Limnodynastes dumerilii)* and Spotted Marsh Frog *(Limnodynastes tasmaniensis*) in creek and dam (wetland) habitats. All these habitats were located on flats, except for one small drainage line on the southern end of Cluster 3. All species are common with apparent tolerance to disturbance from grazing, sedimentation and erosion of aquatic habitats. Amphibian species were generally not recorded in highly eroded habitats, or areas lacking aquatic vegetation. It is likely that a greater diversity of frogs would have been recorded during warmer weather or immediately after rainfall.

6.3 PROFILE OF POTENTIAL BIRD AND BAT IMPACTS

6.3.1 Potential fauna movements

Local and regional fauna movements are not known, however potential paths may be discerned from an assessment of topography, regional habitat provision, site connectivity and historical species

records. Locally, the ridges on the site may concentrate hunting and foraging behaviour of fauna species in a north-west to south-easterly direction.

This section provides a profile of potential fauna movements within the locality which informs the risk assessments completed for threatened and non-threatened fauna potentially at risk of wind farm development. The risk assessments determine the level of risk of potential impacts arising from the construction and operation of the proposed wind farm (see Section 6.4).

Woodland Species

The Yass region has been extensively cleared and fragmented for agriculture. Larger woodland and forest remnants (100-200 hectares) are rare within the district and these are only intermittently linked by roadside and riparian corridors, smaller 'stepping-stone' woodland patches, planted wind-breaks and scattered paddock trees. Faunal movements between larger woodland remnants across the region would be largely limited to highly mobile birds and bats, as well as some ground-dwelling mammals that are less sensitive to disturbance and are able to use linear corridors and habitat stepping stones to move through the landscape.

Woodland habitat loss and fragmentation has been linked to the decline of many woodland birds, particularly species with low fecundity, poor dispersal or those that require specialised habitat resources such as hollow-bearing trees (Reid 1999). Many woodland birds that occur in the region are unlikely to venture far from large remnants and many more species, such as the Superb Parrot and Regent Honeyeater, rarely cross extensive open areas (Fischer and Lindenmayer 2002; Garnett and Crowley 2000).

The principal flight paths for woodland bird species are likely to follow slopes and lowland areas carrying remnant woodland and water sources. The Coppabella precinct area features 2 large woodland remnants which occur outside the development envelope:

- the long south west facing slope below Cluster 7 (approximately 124 hectares), and
- the flat north of Cluster 10 (approximately 100 hectares)

These woodland patches are likely to contribute to north-west to south-east fauna movement across the district. Only sparse, disturbed woodland remnants occur on the ridges where turbine Clusters have been proposed.

Intermittent woodland occurs along Jugiong Creek and its smaller tributaries which create a linear corridor to the Murrumbidgee River, and eventually to Lake Burrinjuck (approximately 25km from the site) and forest woodland reserves to the south. Whitefields Road roughly east-west on the southern edge of the subject site also carries intermittent woodland tree cover which could provide a dispersal path for woodland species. Birds and bats moving at tree canopy height through this corridor are unlikely to be affected by the wind turbines located on adjacent ridges.

Open country species, high-fliers and raptors

Open country and generalist species and raptors are potentially at higher risk of collision than woodland specialists as these species may utilise cleared ridge-top habitats.

Twelve of the 14 bird species recorded on ridge-top sites were observed at heights above 40m. These species are considered to be at risk of colliding with moving turbines blades which operate at 36m of the ground. High-flying bird species included the raptors as well as Australian Magpie, Australian

Raven, Brown Thornbill, Common Starling*, Crimson Rosella, Galah and Sulphur-crested Cockatoo. Raptor species with low fecundity that occur at low density in the landscape are particularly at risk from population-scale impacts as a result of collision mortalities. Such species include the Barking Owl, Square-tailed Kite, Brown Falcon, Nankeen Kestrel and Wedge-tailed Eagle. Night active birds, both hunting and migrating such as the Silvereye or owls are also considered to be at increased risk.

Other species observed flying above 40m in different habitat types (such as in woodland or on pasture flats) include Superb Parrot, Eastern Rosella, Crimson Rosella, Red-rumped Parrot, Silvereye, Australian Wood Duck, Laughing Kookaburra, Welcome Swallow, Dusky Woodswallow and Tree Martin. Many of these species are known to fly in flocks of greater than four and are therefore at risk of multiple collisions with turbine blades. Multiple collisions may result in impacts on a local population of the species.

Wetland birds

No wetlands occur within the study area. The closest large waterbodies include Lake Burrinjuck (25km to the south, Lake Bethungra (50km to the west) and Lake George (80km south-east). Local waterbodies include dams and creeks are small and largely ephemeral, and degraded by clearing, siltation and weeds. Given the absence of habitat, no large concentrations of migratory wetland species are expected to forage or breed in the local area.

Nomadic and migratory water birds may pass over the site during dispersal, migration between breeding and foraging grounds, or in response to seasonal availability of resources. Potential long-distance migration paths that intercept the site include east-west movements from larger wetland systems in the west to wetlands on the coast, and north-south movements between Lake Burrinjuck and Lake Cowal, Lachlan River and Lake Wyangala. However given that large wetland habitats do not occur locally, bird movements across the site are likely to be diffuse and irregular, rather than concentrated and seasonal. Long-distance migratory birds are likely to have attained a travelling altitude greater than the turbine height.

Some water bird species, including Ibis, Herons, Egrets and ducks, are known to utilise smaller ephemeral farmland waterbodies such as dams, creeks and inundated pastures which occur on the site. However, water birds are likely utilise lowland habitats and river systems rather than ridges to move between water bodies, thereby reducing the risk of collision with turbines.

Microchiropteran bats

There have been few studies of wind farm impacts on microbat species. Comparing available data with that on bird mortality, bat mortality events appear to be greater in number. Migratory bats comprise the majority of bat mortalities in all wind farm studies to date (Barclay *et al.* 2007; Erickson *et al.* 2002, Arnett 2005). A review of 30 North America wind farm monitoring studies found a mean of 6 bat mortalities per turbine per year where turbines are greater than 65m high (10 sites) (Barclay *et al.* 2007). The review also showed that mortality rates are highly variable between sites (range 0-13.6 fatalities/turbine) (Barclay *et al.* 2007). This is supported by other studies which report mixed results (Erickson *et al.* 2002, Arnett 2005; Kunz et al 2007).

The entire study area is likely to provide foraging resources for insectivorous bats as there are few other areas locally with vegetated upper slopes and ridges, where insects are likely to rise to with thermals. Of most concern at this site is Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*), listed as a vulnerable species in the *TSC Act* and recorded during surveys (See Section 6.4 below).

6.4 THREATENED AND SIGNIFICANT FAUNA SPECIES

6.4.1 Threatened and Migratory Species

Two threatened fauna species: Superb Parrot, Diamond Firetail and one migratory species: Rainbow Bee-eater was identified on the site. Superb Parrot and Diamond Firetail are listed as Vulnerable on the TSC Act and the Commonwealth EPBC Act. Rainbow Bee-eater is listed as migratory on the EPBC Act.

Preliminary threatened species evaluation

A number of threatened and migratory fauna species have potential distribution ranges which include 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 D. A preliminary assessment was conducted as part of the evaluation to identify threatened and migratory species potentially at risk from impacts arising as a result of the wind farm development. Species with the potential to be present and determined to be at risk were then subject to Assessments of Significance pursuant to the TSC and EPBC Acts.

The assessment takes into account eight factors and assumes no mitigation measures are adopted. Potential impacts assessed include habitat removal and degradation, barotrauma and collision impacts. The following factors were considered:

1. The species is known to occur within the region
2. The species could breed onsite
3. Breeding habitat has the potential to be impacted
4. The species could forage onsite
5. Foraging habitat has the potential to be impacted
6. The species may fly at the height of the turbine blades (40m) and may therefore be at risk of collision or barotrauma
7. The species is a flocking or colonial species (individuals cluster in groups)
8. The species is migratory or nomadic

All factors were weighted equally, except for presence of local records (weighted 2 units) as this was considered to be important to filter out species for which their known distribution range does not include the study area. Species with preliminary impact factors greater than four were considered to have the potential to be impacted by the proposed development.

Based on the evaluation, 27 species were considered to have potential to be impacted by the proposed activity. Three additional species (White-bellied Sea-eagle, Little Whip Snake and Eastern False Pipistrelle) were included as a precautionary measure. The full preliminary evaluation is provided in Appendix D.

Assessments of Significance and risk assessment

To properly characterise the impact of the proposal on threatened and migratory fauna that have been evaluated as being potentially at risk from the proposal, an EPBC Act 'Assessment of Significance'

was conducted for migratory and threatened fauna listed on the EPBC Act and a TSC Act 'Assessment of Significance' was conducted on species listed under this act pursuant to the *NSW Environmental Planning and Assessment Act* and the Commonwealth *Environmental Protection and Biodiversity Conservation Act*. These assessments are provided in Appendix E.

A qualitative risk assessment was completed in conjunction with the Assessments of Significance to determine the 'assessed risk' of the relevant threatened and migratory fauna species. 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 risk assessment takes into consideration the likelihood and consequence of habitat removal and collision or barotrauma impacts on a local population of the species. Likelihood incorporates biological, behavioural and environmental risk factors. Consequence includes the significance of habitat loss and collision in terms of habitat rarity and importance, population impacts, recovery potential and species conservation status.

The level of 'assessed risk' denotes the recommended degree of mitigation or further action required in order to ensure that the proposed wind farm development does not result in a significant impact on the species. The risk levels indicate:

- **Very low and low risk:** no further action required
- **Moderate risk:** mitigation measures should be applied
- **High risk:** further survey work required or avoidance of habitat

The potential impacts, preliminary impact factor, assessed risk and recommended mitigation measures for each threatened fauna species considered by the Assessments of Significance is summarised in Table 6-7 and discussed in Section 6.4.3.

Table 6-7 Summary of potential impacts, preliminary impact factor and assessed risk for threatened species with the potential to be impacted by the proposal

HABITAT AND DESCRIPTION ONSITE	POTENTIAL IMPACT	COMMON NAME AND CONSERVATION STATUS	PIF*	ASSESSED RISK (from Assessments of Significance Appendix E)		
				HABITAT REMOVAL	COLLISION/ BAROTRAUMA	MITIGATIONS (if risk greater than moderate)
COLLISION RISK WETLAND SPECIES						
Dams and adjacent pasture	Habitat removal and collision risk	Cattle Egret *Ardea ibis/ Bubulcus ibis* M EPBC CAMBA, JAMBA Marine overfly area	7	Very low	Low	-
AIRSPACE ONLY (no habitat available onsite)	Collision risk only	White-throated Needletail *Hirundapus caudacutus* M EPBC CAMBA JAMBA Marine overfly	6	Low	Low	-
		White-bellied Sea-Eagle *Haliaeetus leucogaster* M EPBC CAMBA Listed	4	Very low	Low	-
		Rainbow Bee-eater *Merops ornatus* M EPBC Marine overfly area	7	Low	Moderate	Target species for monitoring
		Blue-billed Duck *Oxyura australis* V TSC	5	Very low	Low	-
WOODLAND SPECIES						
Woodland	Habitat removal and collision impacts	Square-tailed Kite *Lophoictinia isura* V TSC	8	Low	Moderate	Target species for monitoring
		Painted Honeyeater *Grantiella picta* V TSC	6	Very low	Low	-
		Regent Honeyeater *Xanthomyza Phrygia* E TSC E EPBC M EPBC	7	Low	Low	-
		Brown Treecreeper (eastern subspecies) *Climacteris picumnus Victoriae* V TSC	5	Low	Very low	-

HABITAT AND DESCRIPTION ONSITE	POTENTIAL IMPACT	COMMON NAME AND CONSERVATION STATUS	PIF*	ASSESSED RISK (from Assessments of Significance Appendix E)		
				HABITAT REMOVAL	COLLISION/ BAROTRAUMA	MITIGATIONS (if risk greater than moderate)
Woodland and hollow-bearing trees	Habitat removal and collision impacts	Gang-gang Cockatoo *Callocephalon fimbriatum* V TSC	7	Low	Moderate	Target species for monitoring
		Swift Parrot *Lathamus discolour* E TSC E EPBC Marine overfly (may)	7	Low	Moderate	Target species for monitoring
		Turquoise Parrot *Neophema pulchella* V TSC	6	Low	Low	-
		Superb Parrot *Polytelis swainsonii* V TSC V EPBC	8	**High**	Moderate	**Avoid mature woodland and hollow-bearing trees** **Target species for monitoring**
		Barking Owl *Ninox connivens* V TSC	7	Low	Moderate	**Target species for monitoring**
Woodland and hollow-bearing trees	Habitat removal	Squirrel Glider *Petaurus norfolcensis* V TSC	6	Low	-	-
Woodland and adjacent grassy areas	Habitat removal	Diamond Firetail *Stagonopleura guttata* V TSC	7	Low	Low	-
		Hooded Robin (South eastern form)*Melanodryas cucullata cucullata* V TSC	6	Low	Very low	-
		Speckled Warbler *Pyrrholaemus saggitatus* V TSC	6	Low	Very low	-

HABITAT AND DESCRIPTION ONSITE	POTENTIAL IMPACT	COMMON NAME AND CONSERVATION STATUS	PIF*	ASSESSED RISK (from Assessments of Significance Appendix E)		
				HABITAT REMOVAL	COLLISION/ BAROTRAUMA	MITIGATIONS (if risk greater than moderate)
Woodland and paddock trees	Habitat removal	Koala *Phascolarctos cinereus* V TSC	6	Low	-	-
MICROBATS						
DAMS	Habitat removal, barotrauma and collision risks	Large-footed Myotis *Myotis adversus* V TSC	6	Low	Low	-
WOODLAND	Habitat removal, barotrauma and collision risks	Eastern Bent-wing Bat *Miniopterus schreibersii oceanensis* V TSC	8	Low	**High**	**Further assessment in January** **Target species for monitoring**
		Little Pied Bat *Chalinolobus picatus* V TSC	8	Low	Low	-
		Eastern False Pipistrelle *Falsistrellus tasmaniensis* V TSC	4	Low	Mod	-
		Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris* V TSC	6	Low	Low	-
ROCK OUTCROPS						
Rocky outcrops:	Habitat removal	Little Whip Snake *Suta flagellum* V TSC	4	Low	-	-
		Pink-tailed Legless Lizard or Worm Lizard *Aprasia parapulchella* V TSC V EPBC	6	Low	-	-
		Striped Legless Lizard *Delma impar* V TSC V EPBC	6	Low	-	-

*PIF = Preliminary Impact Factor

6.4.2 Non-listed species of concern

Research at wind farms across Australia and other parts of the world provide evidence to suggest non-threatened bird and bat species which may be at risk of collision and barotrauma impacts at wind farms (see Appendix G: *Windfarm Risks to Birds and Bats Addendum*).

A qualitative risk assessment for non-listed birds and bats of concern has been completed using the same risk assessment model, combining assessments of likelihood and consequence, used for the evaluation of threatened and migratory fauna. 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), as well as bats that were identified on the site. It assesses the potential impacts of collision and barotrauma on these species at a population level.

These species are not considered to be rare or threatened within the region and therefore are less likely to be at risk of population-scale impacts than listed species. A high to low risk rating for non-listed species indicates:

- **Very low and low risk:** no further action required
- **Moderate risk:** target monitoring of this species
- **High risk:** target monitoring and species-specific mitigation recommended.

Table 6-8 presents the summarised risk assessment results for populations of bird species considered to be of concern. The assessment, including details of relevant behavioural ecology and potential impacts of the wind farm proposal, is included as Appendix F.

Table 6-8 Summary of risk assessment for non-threatened species of concern

SPECIES	LIKELIHOOD	CONSEQUENCE	RISK (POP)
BIRDS			
Wedge-tailed Eagle *Aquila audax*	Possible	Moderate	High
Nankeen Kestrel *Falco cenchroides*	Possible	Insignificant	Low
Brown Falcon *Falco berigora*	Possible	Insignificant	Low
Australian Hobby *Falco longipennis*	Possible	Minor	Moderate
Black-shouldered Kite *Elanus axillaris*	Possible	Insignificant	Low
Black Kite *Milvus migrans*	Possible	Insignificant	Low
Whilstling Kite *Haliastur sphenurus*	Possible	Insignificant	Low
Swamp Harrier *Circus approximans*	Very rare	Insignificant	Low
Brown Goshawk *Accipiter fasciatus*	Rare	Insignificant	Low
Barn Owl *Tyto alba*	Possible	Minor	Moderate
Tawny Frogmouth *Podargus strigoides*	Very rare	Insignificant	Low
Peregrine Falcon *Falco peregrinus*	Possible	Minor	Moderate
White Ibis *Threskiornis molucca*	Rare	Minor	Low
White-winged Triller *Lalage tricolor*	Rare	Minor	Low
Australian Magpie *Gymnorhina tibicen*	Possible	Insignificant	Low

SPECIES	LIKELIHOOD	CONSEQUENCE	RISK (POP)
Silvereye *Zosterops lateralis*	Possible	Minor	Moderate
Galah *Cacatua roseicapilla*	Possible	Insignificant	Low
Sulphur-crested Cockatoo *Cacatua galerita*	Possible	Insignificant	Low
Crimson Rosella *Platycercus elegans*	Rare	Insignificant	Low
BATS			
Recorded bats *Chalinolobus gouldii* *Mormopterus* sp 4 *Nyctophilus* spp *Scotorepens balstoni* *Vespadelus* spp	Rare	Minor	Low

6.4.3 Conclusion

High risk

Threatened and migratory species

The above risk assessment conducted for threatened and migratory (Assessments of Significance, Appendix E) identified two threatened species as having high risk rating: **Superb Parrot** (key threat: habitat removal), **Eastern Bent-wing Bat** (key threat: barotrauma / collision).

Superb Parrots are known to nest locally in open Box-Gum Woodland or isolated paddock trees. Habitat removal, particularly the removal of hollow-bearing trees in mature woodland remnants, is considered to be a high risk for this species.

The study area is located c.45km (straight line distance) from a known maternity cave for Eastern Bent-wing Bats, near Wee Jasper. This maternity colony is thought to be the source population for the Murrumbidgee, Lachlan and parts of the Southern Rivers catchments (Dwyer 1968). Potential population-scale impacts from barotrauma and collision may occur during foraging while the species is at the maternity cave. Additional anabat survey work was undertaken during January 2009 to confirm the presence and distribution of the Eastern Bentwing Bat, Large-footed Myotis and Yellow-bellied Sheathtail Bat and other significant microbat species over the subject site. The results of this survey and further assessment of potential impacts to threatened microbats will be presented in the specialist bat survey report included in the Yass Wind Farm Environmental Assessment (**ngh**environmental 2009).

Further assessment and habitat avoidance measures should be conducted for these species to ensure that they are not significantly impacted by the proposal (discussed in Section 8.2.2 and 8.2.3 below).

Non-listed species

The above risk assessment for non-listed species of concern identified one species: **Wedge-tailed Eagle** (key threat: collision) as being at high risk of collision impacts during the operational phase of the development. Operational monitoring should target this species and species-specific mitigation measures should be implemented to reduce the risk to acceptable levels (see Section 8.2).

Moderate risk

No species were categorised as being at moderate risk from habitat removal.

Threatened and migratory species categorised as having a moderate risk from collision and barotrauma are:

Threatened and migratory:	**Rainbow Bee-eater, Square-tailed Kite, Gang-gang Cockatoo, Swift Parrot, Superb Parrot and Barking Owl**
Non-listed species:	**Australian Hobby, Barn Owl, Peregrine Falcon and Silvereye**

The proposal is not expected to significantly affect moderate or low-risk populations. Bird and bat monitoring should be undertaken to manage and mitigate against collision and barotrauma impacts. Monitoring should specifically target high and moderate risk species (see Section 8.2).

7 BIODIVERSITY CONSTRAINTS ANALYSIS

7.1 APPROACH AND METHODS

An environmental constraint, for the purposes of the assessment, is an environmental condition that reduces the capability of a site to accommodate development. Based on the survey findings and evaluation, the key biodiversity constraints that occur within the development envelope are summarised below and illustrated on Figure 7-1. The biodiversity constraints operating at the Coppabella Hills Precinct have been classified and mapped using a 'traffic light' model to display areas of high, moderate and low constraint. The constraint class maps consolidate a range of significant biodiversity values to enable project planners to avoid and minimise impacts. Suggested planning responses to the three constraint classes are indicated in Table 7-1. A summary of constraints is provided in Table 7-2.

Table 7-1 'Traffic light' constraints approach and recommended mitigation measures

LEVEL OF CONSTRAINT	COLOUR	RECOMMENDED MITIGATION MEASURES
High constraint	Red	Impacts on these areas and habitat resources are impossible or very difficult to offset and should be avoided
Moderate constraint	Orange	Impacts to these areas should be avoided or specific measures taken to mitigate impacts. Losses should be offset with similar or better condition examples
Low constraint	Green	No specific mitigation measures required

7.2 APPLICATION TO THE PROPOSAL

A two-stage process was used to firstly identify and map key biodiversity constraints at the Coppabella Hills Precinct, and secondly modify the proposal in response to these constraints. The final proposal is the result of numerous minor and more significant modifications, including the relocation of proposed infrastructure such as tracks, electricity transmission easements, turbines and the substation.

7.2.1 Constraining values

Biodiversity values that constrain the suitability of the Coppabella Hills Precinct for wind farm development and which have been included in the constraints mapping include woodland, pasture, wetland or riparian habitats and rocky outcrops. These are described below.

Woodland

Approximately 983 hectares of treed Box-Gum Woodland and Dry Shrub Forest occur within the development envelope, based on an indicative layout. Both these communities are listed as Box-Gum Woodland Endangered Ecological Community under the TSC Act. Of this total, approximately 265 hectares features high to moderate groundcover species diversity dominated by several native grass species, with some forb species present (good, moderate to good and moderate condition patches).

These areas are considered to be of higher conservation significance than the poor and poor-moderate treed areas.

Within the development envelope, good to moderate condition woodland occurs on Cluster 10, on the south facing slope below 7a and 7b, within saddles and east of the northern part of Cluster 3, within the proposed electricity envelope between Clusters 5, 6 and 7a, and on patches on the south facing slope of Cluster 3. Approximately 15 hectares of this community also falls under the EPBC Act listed Critically Endangered Ecological Community (in the valley between Clusters 6 and 7a and in the saddle on Cluster 10).

Woodland vegetation provides important habitat for woodland flora and fauna species, including the threatened Yass Daisy and Superb Parrot (recorded on the site).

All areas of moderate, moderate-good and good condition woodland EEC, and 'woodland' fauna habitat and hollow-bearing trees (threatened species habitat) that occur within the proposed development area are considered to be a high constraint for the proposed development and should be avoided.

Woodland EEC in poor and moderate to poor condition, or 'disturbed woodland' fauna habitat are considered to be a moderate constraint for the proposed development. Disturbance will require mitigation.

Pasture

Flora and ecological communities

Areas of pasture dominated by native grasses and a moderate diversity of forbs are likely to come under the TSC Act listed EEC definition. Areas of native pasture are irregularly interspersed between extensive areas of exotic dominated pasture. Native pasture EEC is considered to be a moderate constraint for the proposal, requiring mitigation.

The most disturbed and exotic-dominated areas tended to occur on the highest points (ridge crests). Surveyed areas that were dominated by exotics, and therefore of low development constraint include: all surveys on Clusters 1 (Figure 5-4), 2 (Figure 5-5) and 4, parts of 5 and 6 upper slope, parts of 7a and 7b ridge and upper slope; 3a upper slope; and parts of 10.

The composition of pasture areas is highly variable between sites and within small areas (Figure 5-2, Figure 5-3), and is likely to change over time depending on season, water availability and grazing pressure. To account for this spatial and temporal variability, native pasture areas and exotic pasture areas have been mapped as a single vegetation type 'pasture'. Although low diversity native pasture is included in the EEC definition (listed under the TSC Act), it is locally abundant, highly disturbed by grazing and weed invasion and is unlikely to have significant natural recovery potential. Therefore cleared pasture areas on the site are considered to be of relatively low conservation value and have been assessed as posing a low constraint for the proposed development.

Fauna

All pasture areas were heavily grazed at the time of the survey. Pasture areas provide only moderate to low quality habitat for fauna species. Fauna resources within cleared pasture habitats include rocky outcrops (discussed below), scattered paddock trees and standing and fallen dead timber. Scattered paddock trees and standing dead trees provide important habitat resources in modified landscapes.

Habitat resources (such as fallen timber or rocks) within these areas should be avoided or relocated in nearby similar habitats if they overlap the development footprint.

Disturbed wetland and riparian habitats

Although of poor quality, dams and creeks within the development envelope provide a habitat resource for aquatic and wetland species, a foraging resource for bats and a watering source for native fauna and domestic stock. These habitats are considered to be moderate constraints for the proposal.

Rocky habitats and ridge tops

Extensive rocky outcrops occur on all ridge tops and side slopes within the development envelope, however these areas are highly disturbed by grazing and weed invasion. The proposal has the potential to introduce a hazard to aerial habitat above the ridges, in the form of collision and barotrauma risk for bird and bat species. Ground debris such as fallen and standing dead timber is present on ridges. For rock outcrop and ridge-top specialists, development of these habitats may reduce areas of habitat; however given the extent of this habitat on the site, the removal of this habitat at the construction phase is not likely to affect the viability of local populations. These areas therefore represent a low development constraint.

Table 7-2 Constraints summary

HABITAT OR HABITAT FEATURE THAT OCCURS WITHIN THE DEVELOPMENT ENVELOPE	EXTENT WITHIN DE (ha)	LOCATION WITHIN DE	CONSTRAINT
Woodland EEC in moderate, moderate-good and good condition	265.2	**Clusters:** 10, north west and central; 8, 6 slope and small areas on 5; southern edge of Cluster 7; 3 north and central north **Transmission:** gullies between 6 and 3, 6 and 7a, and between 5 and 7a; 3 east and north **Access:** adjacent to Whitefields Road	**High**
Woodland EEC in poor and poor-moderate condition	717.9	**Clusters:** 10 north west, central west and central east, 6 ridge, 7b far south east,7a far north west, 3 north and central **Transmission envelopes**: between 6 and 7a, below 10, north and east of 3 **Access:** along Whitefields Road	**Moderate**
Woodland fauna habitat (threatened species habitat)	241.4	**Clusters**: 3 and 10, and small areas on 7 **Transmission**: between 6 and 7a, and on the eastern slope of 3	**High**
Disturbed woodland fauna habitat	780.8	**Clusters:** small areas on 7a and 7b, 3, 6, 8 and 10 **Transmission:** between 6 and 7a and north of 3 **Access:** adjacent to Whitefields Road	**Moderate**
Pasture	1834.7	All cleared areas on the site	**Low**
Modified wetland habitats (creeks and dams)	11.27 (only Jugiong Creek)	Dams, creek crossing and Jugiong Creek	**Moderate**

HABITAT OR HABITAT FEATURE THAT OCCURS WITHIN THE DEVELOPMENT ENVELOPE	EXTENT WITHIN DE (ha)	LOCATION WITHIN DE	CONSTRAINT
Rocky outcrops	197.6	All ridge tops and side slopes within the development envelope	**Low**
Hollow-bearing trees and mature paddock trees	18 locations	Clusters 10, 3 north and 6; in paddock trees in low lying areas within transmission envelopes; and also adjacent to Whitefields Road	**High**
Threatened species habitat	-	Two threatened species were observed on the site: • Superb Parrot in woodland and mature road-side habitats • Yass Daisy in good condition Box-Gum Woodland	**High**

7.2.2 Biodiversity constraint mapping

The constraint classes have been mapped for the subject site, together with most recent wind farm infrastructure layout to show areas of potential impact. The biodiversity constraint class maps are provided in Figure 7-1. Constraint areas based on vegetation type and condition class have been extrapolated from survey plot data and air photographs. Note: This finalised infrastructure layout has undergone several revisions, based on the provision of constraints mapping, as discussed in Section 8.

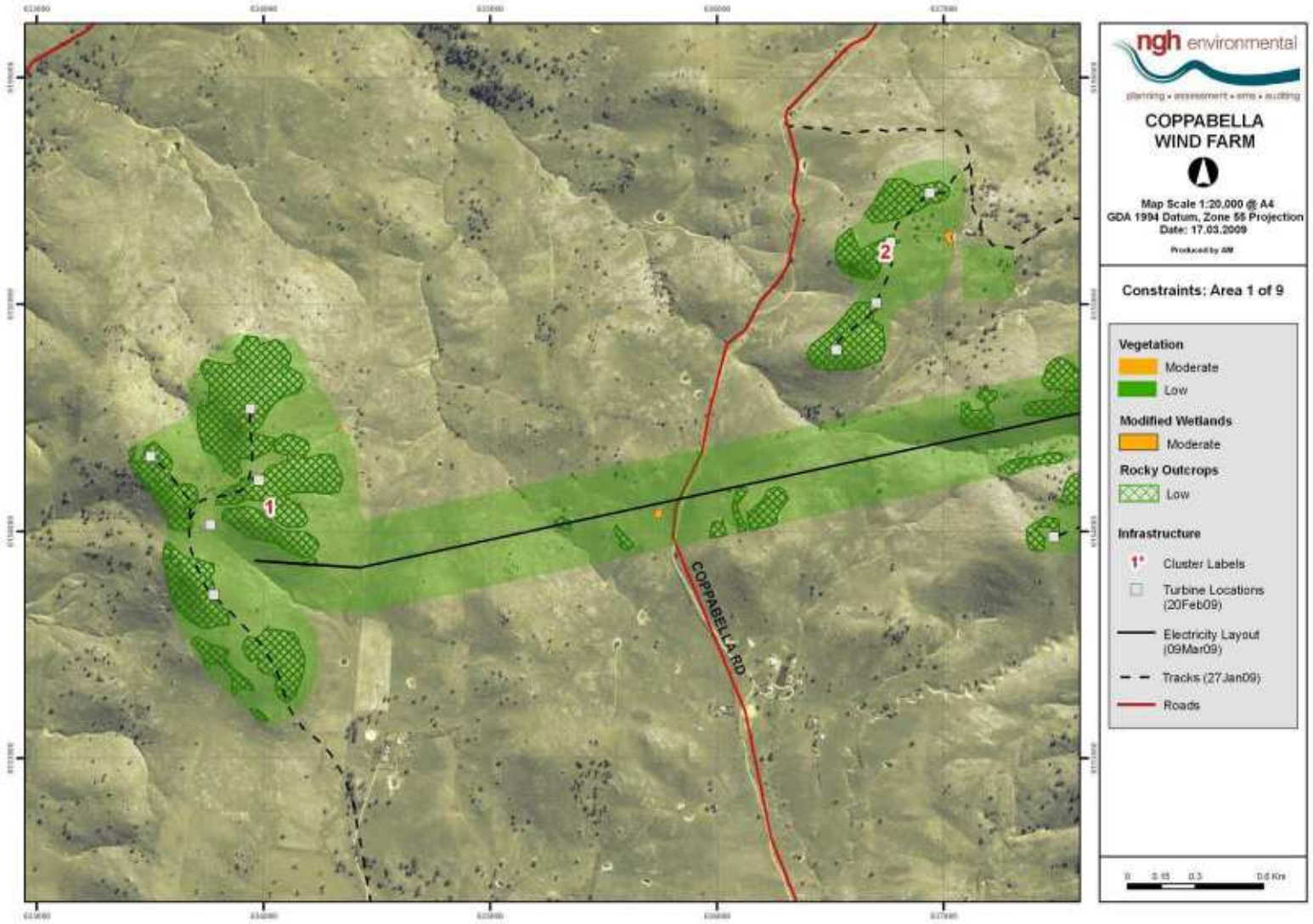
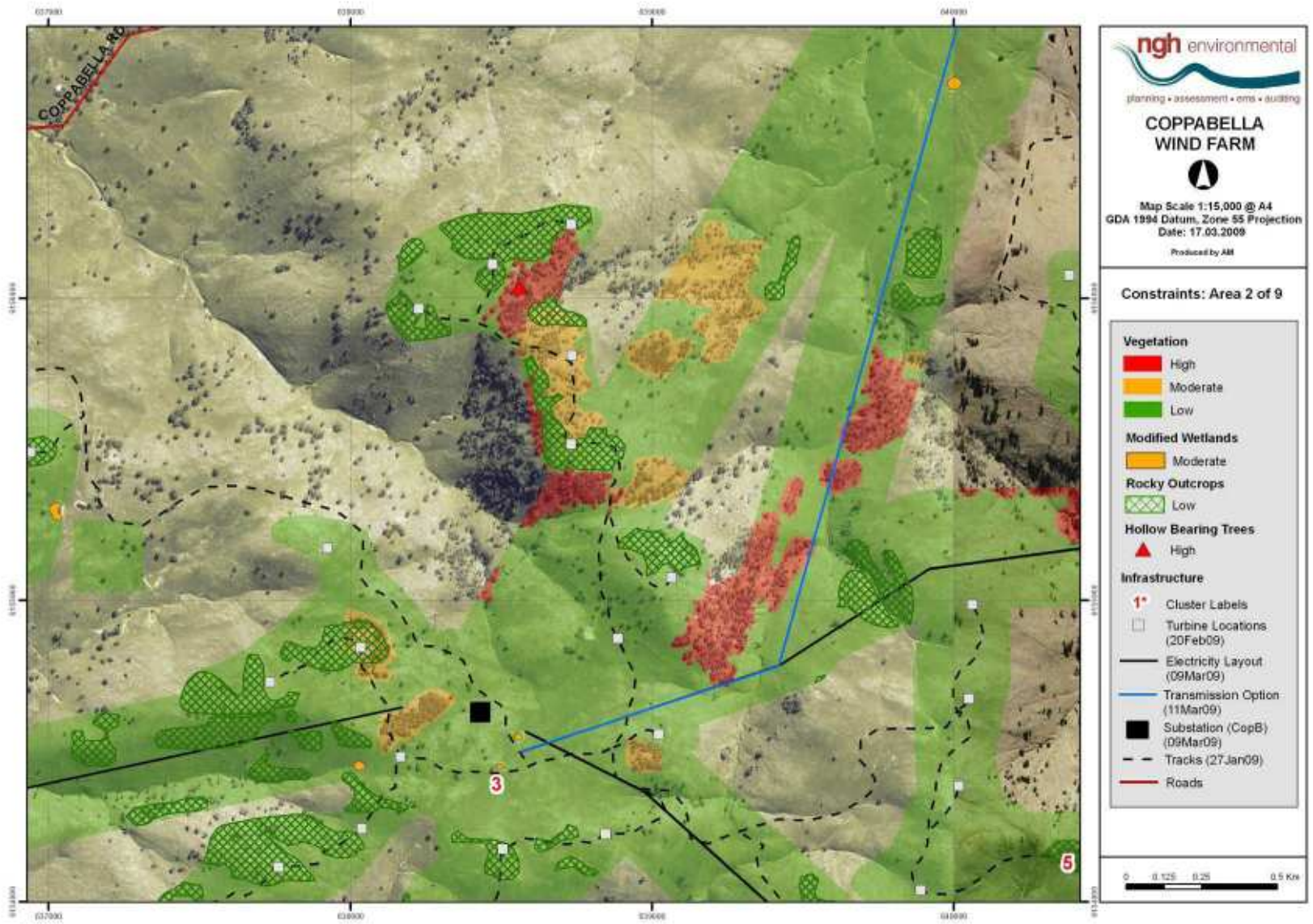
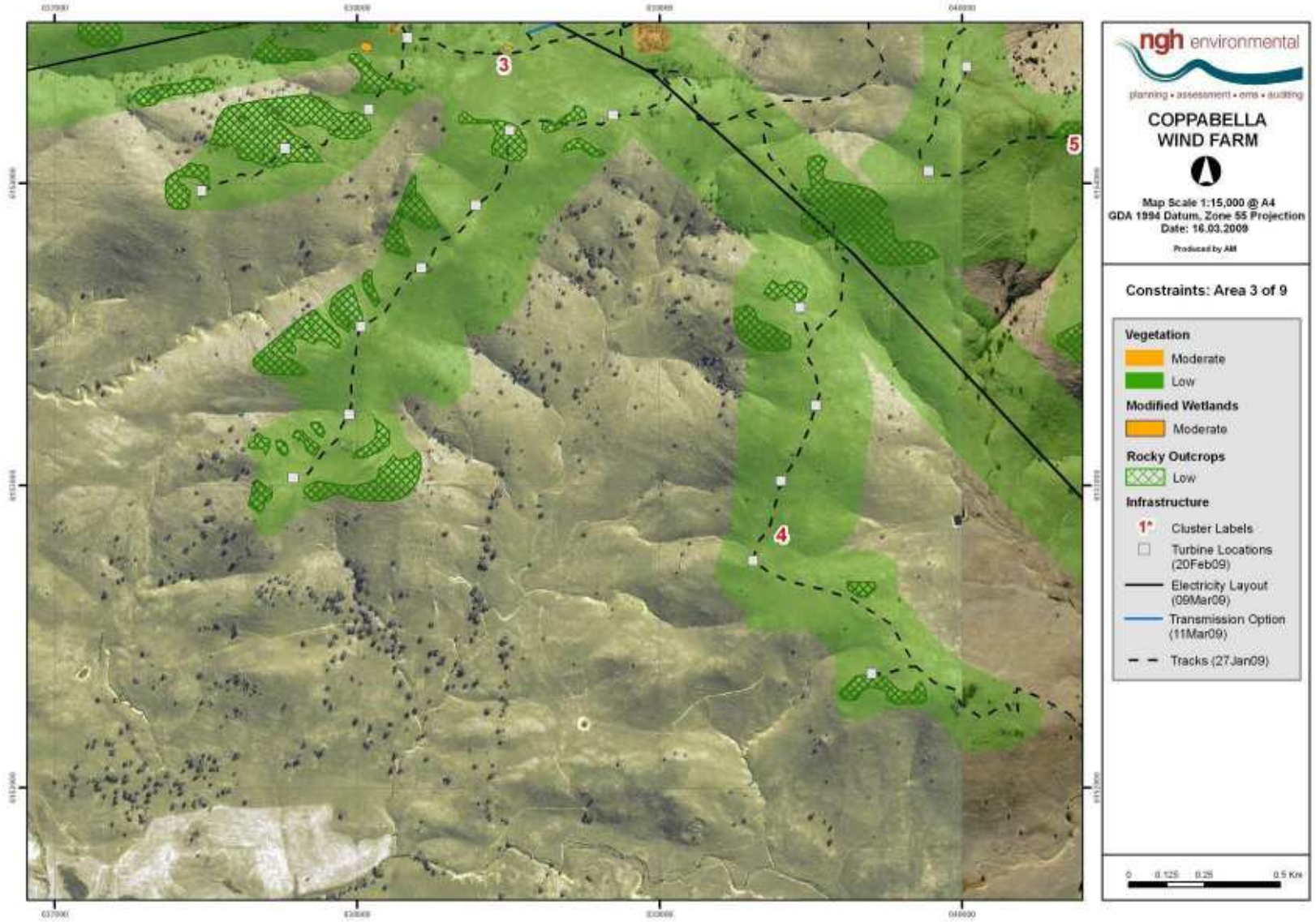
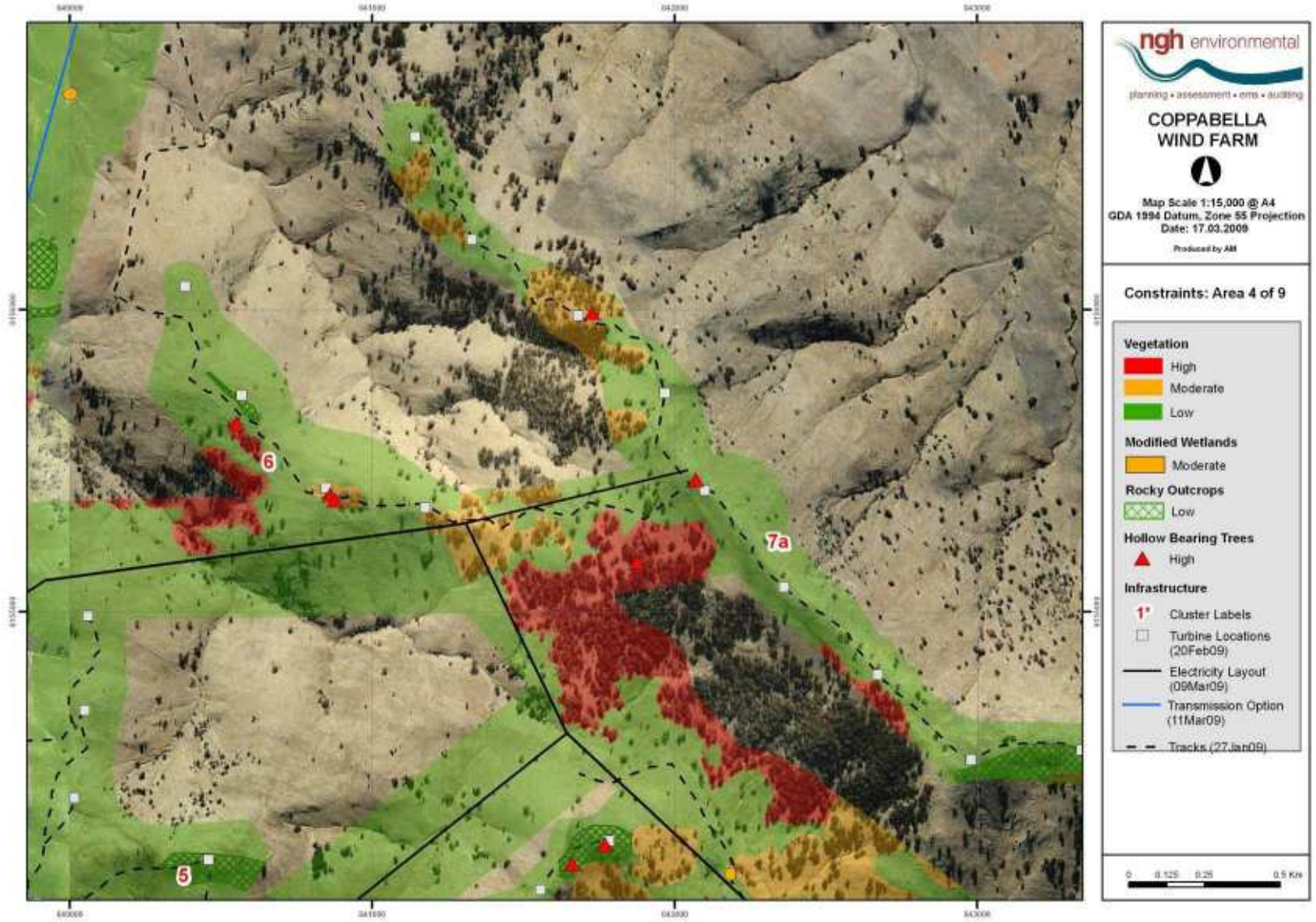
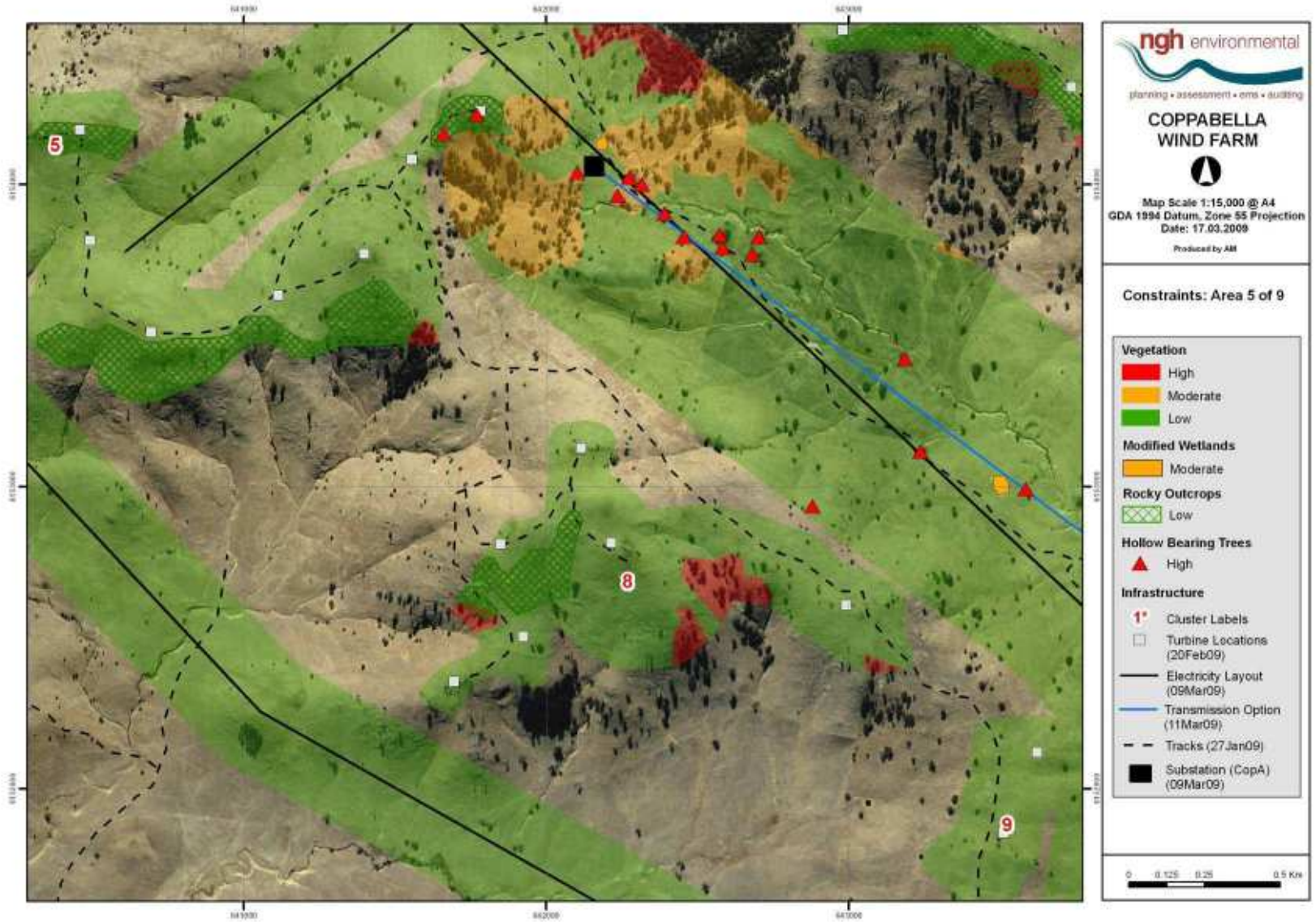


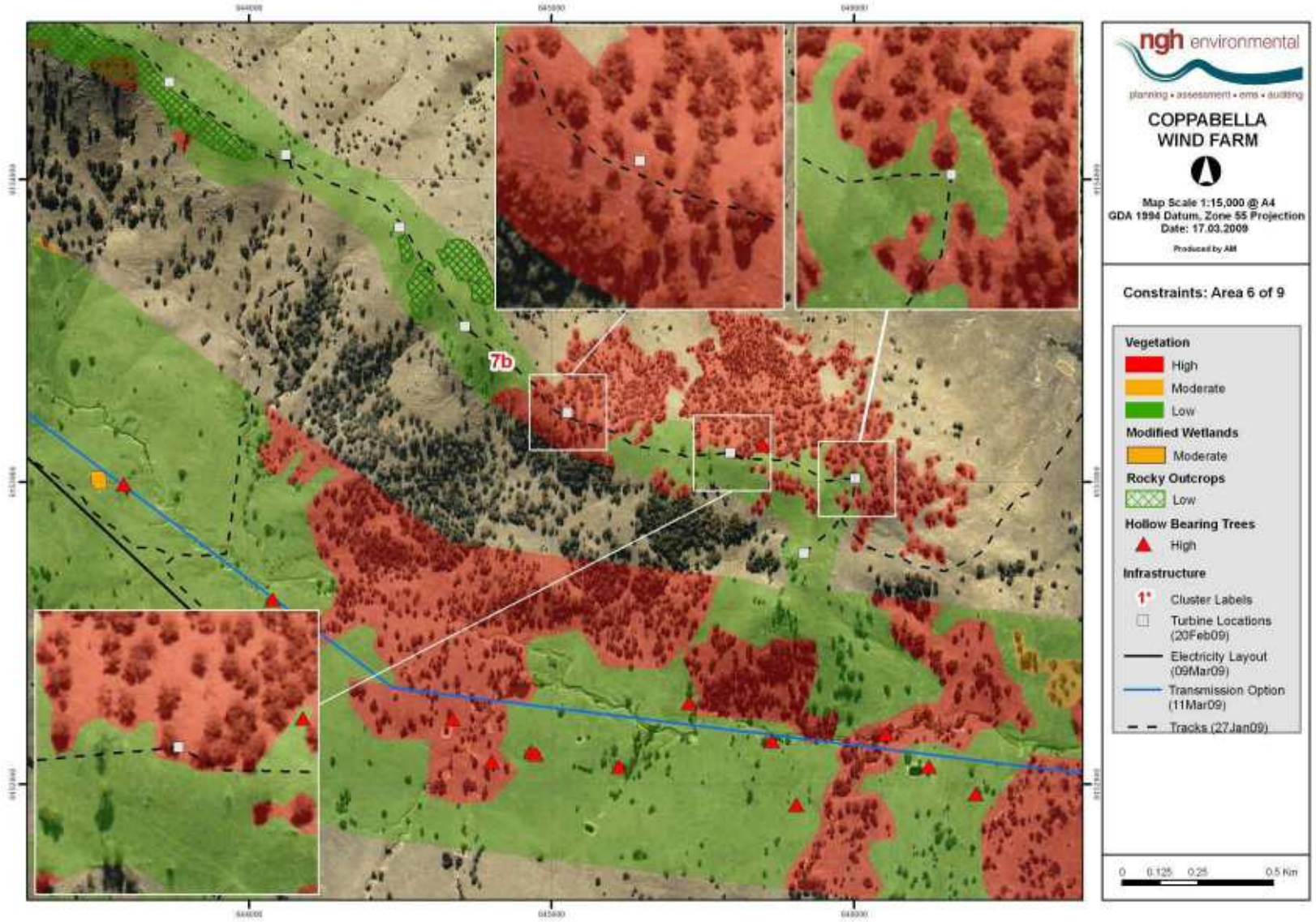
Figure 7-1 Constraints mapping, map set (9 maps in total)

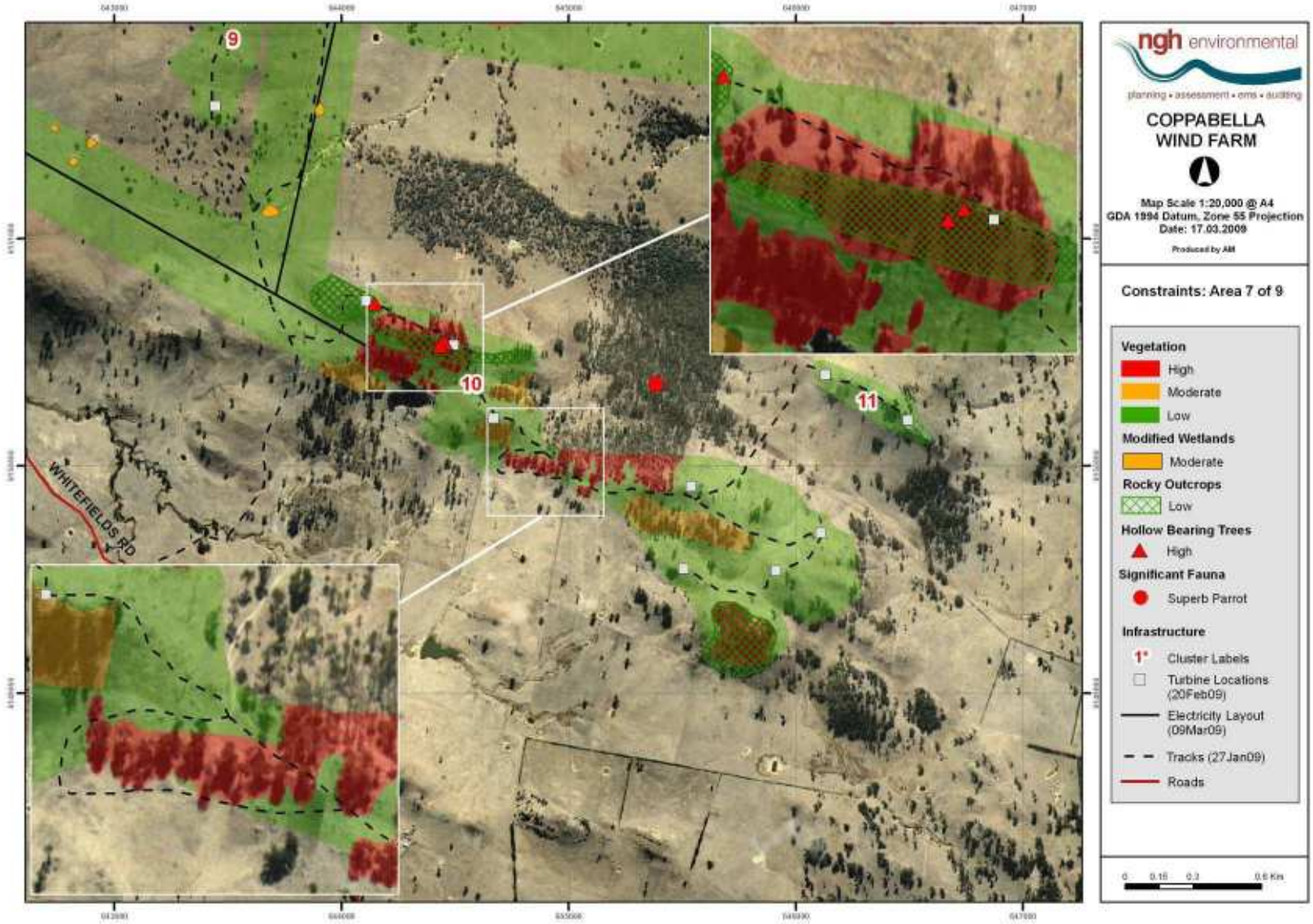

COPPABELLA RD
3
5
ngh environmental
planning • assessment • ems • auditing
COPPABELLA
WIND FARM
Map Scale 1:15,000 @ A4
GDA 1994 Datum, Zone 55 Projection
Date: 17.03.2009
Produced by AM
Constraints: Area 2 of 9
Vegetation
High
Moderate
Low
Modified Wetlands
Moderate
Rocky Outcrops
Low
Hollow Bearing Trees
High
Infrastructure
1* Cluster Labels
Turbine Locations (20Feb09)
Electricity Layout (09Mar09)
Transmission Option (11Mar09)
Substation (CopB) (09Mar09)
Tracks (27Jan09)
Roads
0 0.125 0.25 0.5 Km

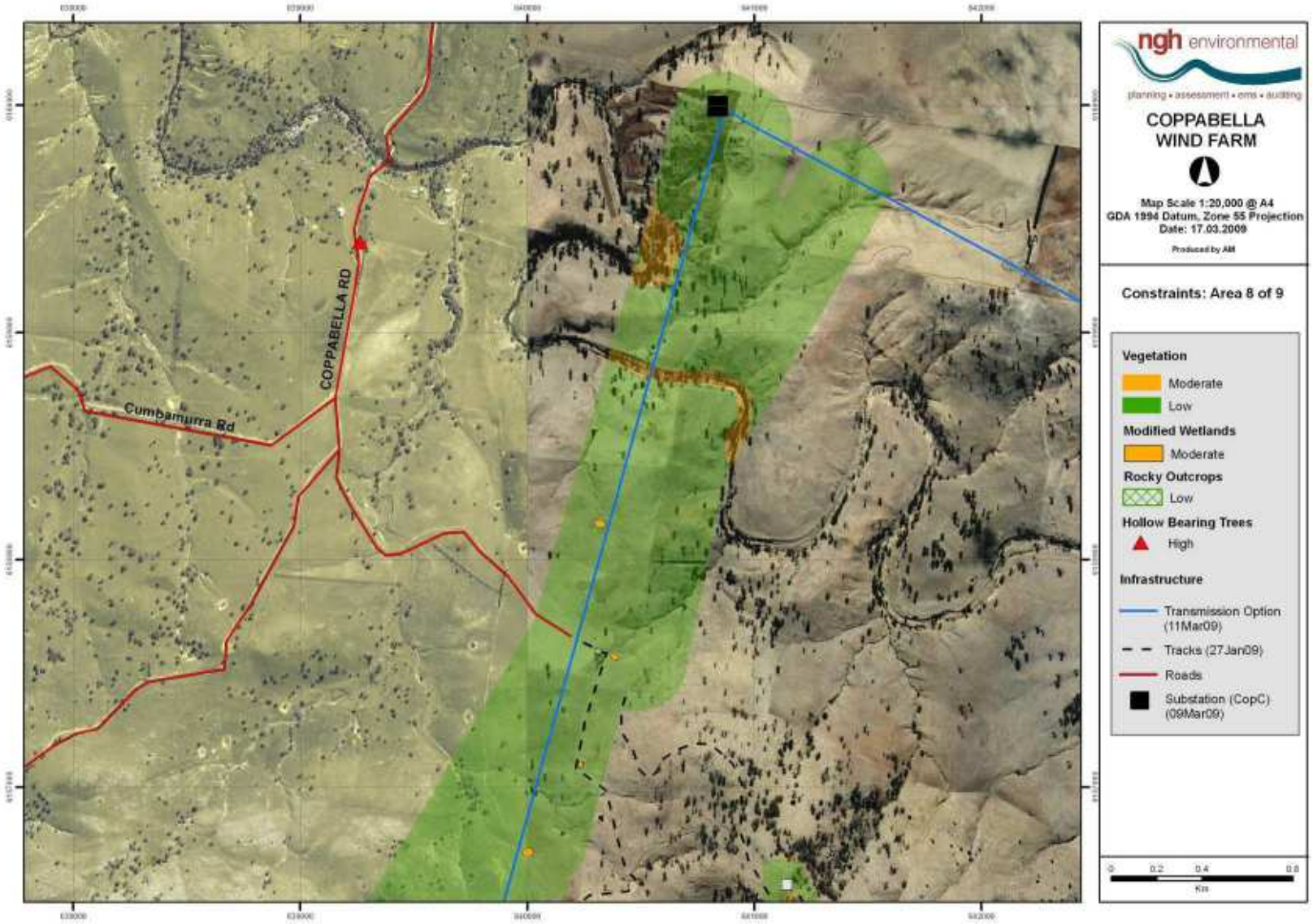

3
4
5
ngh environmental
planning • assessment • ems • auditing
COPPABELLA
WIND FARM
Map Scale 1:15,000 @ A4
GDA 1994 Datum, Zone 55 Projection
Date: 16.03.2009
Produced by AM
Constraints: Area 3 of 9
Vegetation
Moderate
Low
Modified Wetlands
Moderate
Rocky Outcrops
Low
Infrastructure
1* Cluster Labels
Turbine Locations (20Feb09)
Electricity Layout (09Mar09)
Transmission Option (11Mar09)
Tracks (27Jan09)
0 0.125 0.25 0.5 Km

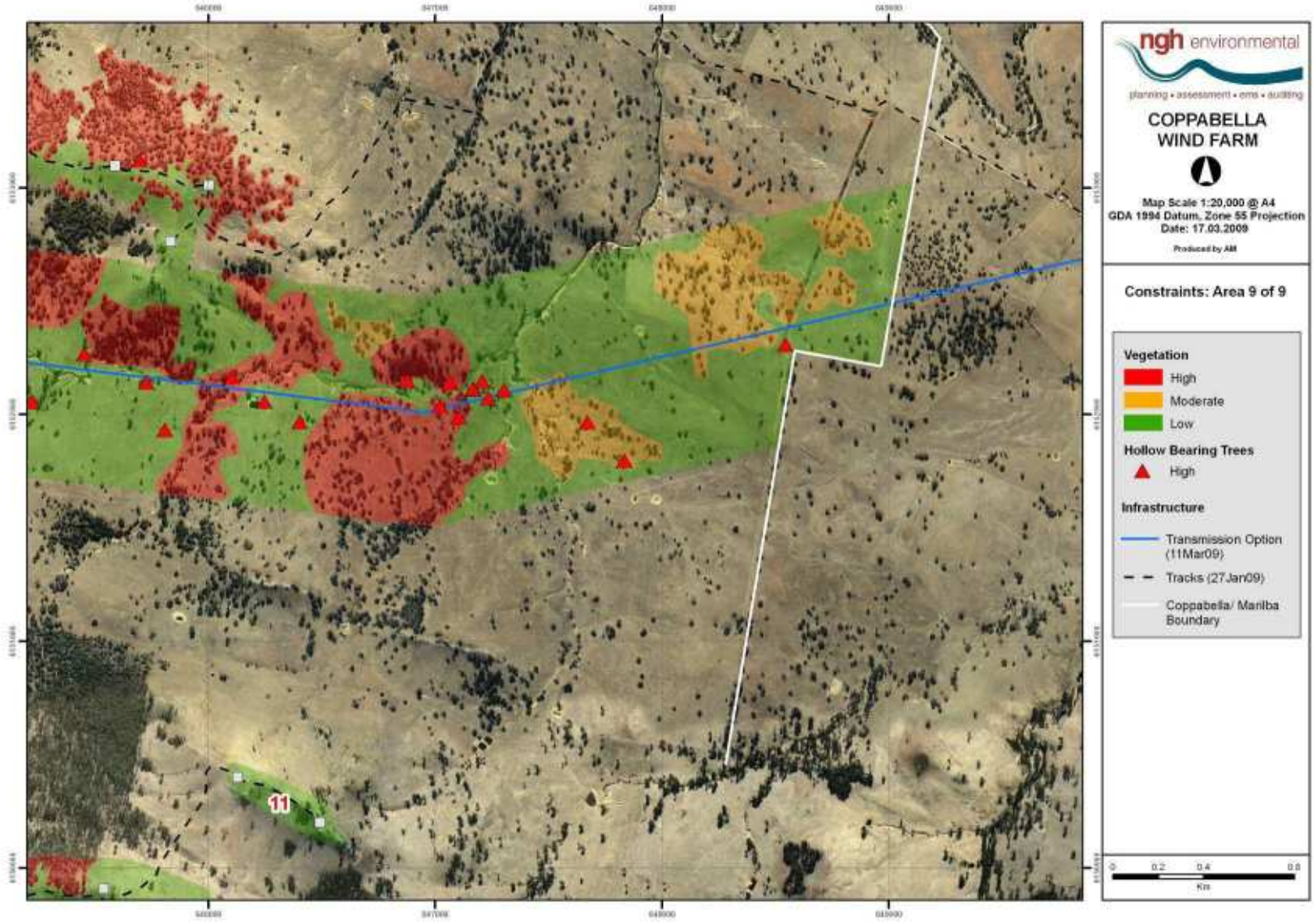

ngh environmental
planning • assessment • ems • auditing
COPPABELLA
WIND FARM
Map Scale 1:15,000 @ A4
GDA 1994 Datum, Zone 55 Projection
Date: 17.03.2009
Produced by AM
Constraints: Area 4 of 9
Vegetation
High
Moderate
Low
Modified Wetlands
Moderate
Rocky Outcrops
Low
Hollow Bearing Trees
High
Infrastructure
1° Cluster Labels
Turbine Locations (20Feb09)
Electricity Layout (09Mar09)
Transmission Option (11Mar09)
Tracks (27Jan09)
0 0.125 0.25 0.5 Km
6
7a
5


ngh environmental
planning • assessment • ems • auditing
COPPABELLA
WIND FARM
Map Scale 1:15,000 @ A4
GDA 1994 Datum, Zone 55 Projection
Date: 17.03.2009
Produced by AM
Constraints: Area 5 of 9
Vegetation
High
Moderate
Low
Modified Wetlands
Moderate
Rocky Outcrops
Low
Hollow Bearing Trees
High
Infrastructure
Cluster Labels
Turbine Locations (20Feb09)
Electricity Layout (09Mar09)
Transmission Option (11Mar09)
Tracks (27Jan09)
Substation (CopA) (09Mar09)
0 0.125 0.25 0.5 Km
5
8
9


ngh environmental
planning • assessment • ems • auditing
COPPABELLA
WIND FARM
Map Scale 1:15,000 @ A4
GDA 1994 Datum, Zone 55 Projection
Date: 17.03.2009
Produced by AM
Constraints: Area 6 of 9
Vegetation
High
Moderate
Low
Modified Wetlands
Moderate
Rocky Outcrops
Low
Hollow Bearing Trees
High
Infrastructure
1* Cluster Labels
Turbine Locations (20Feb09)
Electricity Layout (09Mar09)
Transmission Option (11Mar09)
Tracks (27Jan09)
7b
0 0.125 0.25 0.5 Km


9
10
11
WHITEFIELDS RD
ngh environmental
planning • assessment • ems • auditing
COPPABELLA
WIND FARM
Map Scale 1:20,000 @ A4
GDA 1994 Datum, Zone 55 Projection
Date: 17.03.2009
Produced by AM
Constraints: Area 7 of 9
Vegetation
High
Moderate
Low
Modified Wetlands
Moderate
Rocky Outcrops
Low
Hollow Bearing Trees
High
Significant Fauna
Superb Parrot
Infrastructure
1* Cluster Labels
Turbine Locations (20Feb09)
Electricity Layout (09Mar09)
Tracks (27Jan09)
Roads
0 0.15 0.3 0.6 Km


COPPABELLA RD
Cumbamurra Rd
ngh environmental
planning • assessment • ems • auditing
COPPABELLA
WIND FARM
Map Scale 1:20,000 @ A4
GDA 1994 Datum, Zone 55 Projection
Date: 17.03.2009
Produced by AM
Constraints: Area 8 of 9
Vegetation
Moderate
Low
Modified Wetlands
Moderate
Rocky Outcrops
Low
Hollow Bearing Trees
High
Infrastructure
Transmission Option (11Mar09)
Tracks (27Jan09)
Roads
Substation (CopC) (09Mar09)
0 0.2 0.4 0.8
Km


ngh environmental
planning • assessment • ems • auditing
COPPABELLA
WIND FARM
Map Scale 1:20,000 @ A4
GDA 1994 Datum, Zone 55 Projection
Date: 17.03.2009
Produced by AM
Constraints: Area 9 of 9
Vegetation
High
Moderate
Low
Hollow Bearing Trees
High
Infrastructure
Transmission Option (11Mar09)
Tracks (27Jan09)
Coppabella/ Manilba Boundary
0 0.2 0.4 0.8
Km
11

8 IMPACT ASSESSMENT AND MITIGATION STRATEGIES

8.1 CONSTRUCTION PHASE

Loss of habitat and habitat modification for the turbine towers and surrounding hardstand areas, control building, substation, new and widened access tracks and power-line poles are the key direct impacts of the construction phase. This vegetation would be removed for the life of the wind farm (up to 30 years). As set out in Section 3.2, the permanently removed development footprint of the proposed wind farm has been estimated as 70 hectares; additionally 29.04 would be maintained in transmission easements and 24.26 hectares could be rehabilitated post construction. The impact of this loss of habitat would be dependent on the type, quality and use of the habitat to be removed or modified.

The power-line between the substation and turbines would be constructed as an overhead cable on single wood or concrete poles approximately 17-22 metres high, spaced approximately 100 – 200 metres apart. Some temporary disturbance to vegetation would occur during construction of the power-line, and the poles would permanently displace a small area of ground layer vegetation at their base. The power-line would require a cleared easement of 20 metres and would be located to minimise clearing of trees. Where possible, the power-line route would avoid remnant Box-Gum Woodland, particularly large paddock trees and linear remnants beside roads and watercourses.

Grass cover may be restored over much of the permanent access routes running between the turbines to assist track stability and reduce runoff. Low gradient sections of the inter-turbine access tracks may be reinstated with grass cover following the works to reduce runoff and improve long term stability. Mitigation has been developed specific to the need to retain some flexibility in the final route location.

Additional indirect impacts from construction may arise as a result of erosion and sedimentation of waterways and adjacent habitats, weed establishment, noise and other disturbances associated with the construction phase.

8.1.1 Specific habitat types

Estimates of vegetation loss for each of the affected vegetation types and condition classes are presented in

Table 8-1 and 8-2. Estimates of woodland vegetation loss have been derived from the final infrastructure layout provided by the Proponent. They are based on a worst-case scenario and assume total loss of vegetation within the turbine footprint and crane operation area for all turbine locations within 50 metres of vegetation type, with no mitigation measures applied.

According to Tables 8-1 and 8-2, the works would permanently remove approximately 11.32 hectares of Box-Gum Woodland EEC, 0.59 hectares of which is considered to be high constraint woodland. Additionally, 53.44 hectares of native and exotic pasture, less than 0.01 hectares of Riverian River Red Gum forest (poor condition) and 5.15 hectares of rocky outcrops would be impacted by the proposal.

Table 8-1 Maximum impact areas within each vegetation community. Calculations are based on the indicative infrastructure layout provided by the proponent.

Coppabella Hills Precinct									
Infrastructure	**Quantity**	**Width (m)**	**Length (m)**	**Area (ha)**	**P**	**BGW**	**DSGF**	**RRGF**	**RO**
Turbine footing [a]	86.00	25.00	25.00	**5.38**	3.63	0.50	0.06	0.00	1.19
Crane hardstand [c]	86.00	22.00	40.00	**7.57**	5.11	0.70	0.09	0.00	1.67
Crane operation area (includes footing and hardstand) [c]	86.00	50.00	50.00	**21.50**	14.50	2.00	0.25	0.00	4.75
Tracks [a]	1.00	8.00	67063.65	**53.65**	42.67	6.95	0.07	0.00	3.96
Underground powerlines onsite [c]	1.00	2.00	21905.29	**4.38**	3.45	0.77	0.03	0.00	0.13
Overhead powerline cabling / easement [b]	1.00	20.00	14517.82	**29.04**	13.27	15.27	0.36	0.14	0.00
Overhead power pole footings [a]	145.18	1.00	1.00	**0.01**	0.01	0.01	0.00	0.00	0.00
Substation and control bldg [a]	3.00	2.00	18330.43	**11.00**	7.14	3.86	0.00	0.00	0.00
Concrete batch plant [c]	1.00	75.00	100.00	**0.75**	0.75	0.00	0.00	0.00	0.00
Construction compound, staging and storage [c]	1.00	300.00	100.00	**3.00**	3.00	0.00	0.00	0.00	0.00
Development envelope (DE)				**2829.10**					
Percentage of DE permanently removed				**2.48**					
Breakdown by impact type:									
a Permanent habitat loss (includes all footings and tracks)				**70.04**	53.44	11.32	0.13	0.00	5.15
b Habitat modification (transmission easement maintenance)				**29.04**	13.27	15.27	0.36	0.14	0.00
c Temporary habitat loss (areas that can be rehabilitated post construction)				**24.26**	18.08	2.27	0.22	0.00	3.69

P: Pasture, BGW:Box Gum Woodland, DSGF: Dry Shrub/Grass Forest, RRGF: Riparian River Red Gum Forest, RO: Rocky Outcrops

Table 8-2 Maximum impact areas on each woodland vegetation condition class and on high and moderate constraint Box Gum Woodland EEC[10].

Coppabella Hills Precinct							
Woodland vegetation types	**Permanent habitat loss [a] within each condition class**						**Total of each vegetation type within DE**
	Good	**Moderate / good**	**Moderate**	**Poor / moderate**	**Poor**	**Total**	
Box Gum woodland	0.17	0.17	0.21	2.95	7.84	**11.34**	892.11
Long-leaved box Dry Grass Forest	0.00	0.04	0.00	0.04	0.06	**0.13**	91.01
Riparian River Red Gum	0.00	0.00	0.00	0.00	0.00	**0.00**	11.27

Coppabella Hills Precinct		
Endangered Ecological Community (EEC)	**Permanent habitat loss [a] within each class**	
	High constraint EEC	**Moderate constraint EEC**
Box Gum Woodland EEC	0.59	2.99
Total area within the DE	**265.24**	**717.88**

[10] Endangered Ecological Community (EEC) Box-Gum Woodland includes both box-gum woodland and long-leaved box dry grass forest treed remnants. EEC of high conservation value are woodland remnants in good, moderate to good, and moderate condition. EEC of moderate conservation value are woodland remnants in poor to moderate and poor condition.

Woodland and threatened species habitat

Removal of moderate to good condition woodland EEC and mature forest patches with hollow-bearing trees has the potential to result in significant loss of habitat for Superb Parrot, Yass Daisy and for the EEC Box-Gum Woodland, (see Appendix E for detail).

Of particular concern are areas of suitable Superb Parrot habitat (mature woodland remnants with hollow-bearing trees) including:

- Road-side remnants adjacent to Whitefield's Road
- In the saddle and north west crest on Cluster 10
- In the transmission easement on the south-facing slope and saddle between Clusters 6 and 7a
- In hollow-bearing paddock trees and woodland that occur within the valley between Clusters 5 and 7a

Areas of high constraint moderate to good condition EEC including:

- Within the transmission envelope between Clusters 6, 5 and 7a
- Remnants on Cluster 10
- the woodland below Cluster 7b near the proposed turbine access track

Areas of Yass Daisy habitat including:

- On the steep slopes within the transmission easement between Clusters 6 and 7a
- Within the Box-gum Woodland remnant beginning in the centre of Cluster 10 and stretching to the north

Works in these areas should be avoided, or micro-sited with the assistance of an ecologist to avoid impacts on standing live and dead trees. Hollow-bearing trees should not be removed in these areas. A buffer should be established on large woodland remnants to ensure indirect impacts (such as noise and dust) are minimised.

Given the disturbed and fragmented nature of the site, and the extent of similar woodland vegetation of equal and greater conservation value, the removal of moderate constraint woodland habitat associated with the proposed development is not considered likely to result in significant impacts on flora, fauna or ecological communities within the locality, provided that the recommended mitigation measures outlined in Section 8.1.5 below are effectively implemented.

Pasture with scattered trees

Given the disturbed condition of the surveyed pasture areas, the majority of the impact area within pasture habitats is likely to be within exotic dominated pasture, with only occasional small removal of native pasture. Pasture habitat is not high quality and is abundant throughout the district. Removal of this vegetation and fauna habitat type as a result of the proposal is not likely to result in significant impacts on flora and fauna or ecological communities.

Existing groundcover may be retained over flatter sections of the route, although soils and vegetation would be locally affected by the passage of heavy vehicles. Disturbed areas would be revegetated with native grass species. Where possible, turbine sites would be located away from mature paddock trees.

Disturbed wetland and riparian habitats

There is not likely to be permanent impacts on modified wetland habitats within the locality. Impacts may occur for the construction and upgrade of creek crossings across the site. Erosion and hydrological issues should be considered when developing creek crossings, tracks and when disturbing soils for construction, including installing appropriate drainage systems, sediment traps, and revegetating disturbed areas with native species.

Should dams be required to be removed during site development, alternative watering points should be established to compensate for their loss.

Rocky habitats and ridge tops

Approximately 5.15 hectares of rocky outcrops would be removed by the construction of turbines and the access tracks. Disturbed rocks and woody debris should be relocated to nearby similar habitats to ensure suitable micro-habitat resources are maintained. Turbine sites should be micro-sited to avoid standing live and dead trees as far as is possible. Impacts on rock outcrops within high constraint woodland areas should be avoided. If avoidance is not possible, preclearance surveys should be undertaken in rock outcrops in high constraint areas prioir to disturbance.

8.1.2 Fragmentation

The proposed works are unlikely to result in fragmentation of woodland habitats given that the site is already highly fragmented and disturbed from grazing and clearing. Permanent habitat removal for wind turbines would occur primarily within marginal ridge-top woodland. Access to the turbine Clusters is via existing tracks and roads, along the edges of woodland habitats or within cleared and disturbed areas. Track and road widening would not dissect continuous patches, however may result in the reduction of habitat 'stepping stones' for use by mobile fauna. This is not considered likely to result in significant impacts on fauna in the locality given the limited extent of woodland habitat removal in relation to the extent of woodland that occurs on the site.

8.1.3 Indirect impacts

Dust, noise and vibration

The installation of tracks, turbines, cable laying and associated infrastructure would generate temporary impacts. The dust, noise, vibration and activity associated with the construction phase may affect the foraging behaviour of local fauna species, particularly birds and macropods.

Pasture areas contain livestock and their current management involves the operation of machinery and vehicles in largely cleared areas. The increased noise, vehicle emissions and dust expected during the construction phase are not anticipated to be cause for concern for fauna onsite. Temporarily de-stocking areas where construction works are underway would reduce potential for injury to stock during the construction phase. Adhering to predetermined access routes and low speeds (max. 40km/hr) would reduce the risk of vehicles colliding with stock or native fauna onsite.

Weed invasion

The invasion of native vegetation by exotic perennial grass has the potential to occur following the construction phase. The Box-Gum Woodland EEC in particular is vulnerable to the introduction and

spread of perennial grasses such as African Love Grass, Serrated Tussock, Phalaris, Cocksfoot, Yorkshire Fog and Paspalum. Machinery and vehicles should be washed down before being brought onto the site and unnecessary soil disturbance should be avoided, to minimise the risk of exacerbating weed invasion in the EEC remnants.

Other 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 concrete batch plant and associated flush pit, if used, would alter local subsoil conditions over the medium term.

Pollution risks are associated with the use of concrete, fuels and lubricants and construction chemicals. With appropriate safeguards and practices (refer to Environmental Assessment), 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 construction period. The limited duration of dust deposition is not expected to significantly affect vegetation or fauna or flora populations that occur at the site.

8.1.4 Offsetting

Under the Native Vegetation Act 2003, clearing of remnant vegetation or protected regrowth can only be approved when the clearing will improve or maintain environmental outcomes and ensure that there is no net loss of biodiversity values. To achieve this outcome an 'Offset Plan' can be developed which would specify offset targets to be managed for conservation outcomes in perpetuity. Offsetting is not a requirement for Part 3A Major Projects but would help to reduce the impacts associated with vegetation clearing for the proposal and also have beneficial outcomes through the conservation and ongoing management of existing woodland areas.

Offsetting targets must be met within the same vegetation type that would be cleared (Box-Gum Woodland and derived Box-Gum Woodland) and preferably within the locality (10-20km from the site). Further survey work would need to be undertaken once the final turbine layout has been determined in order to calculate offset targets for derived Box-Gum Woodland native pasture. Targets should be defined in order to preserve, and if possible, improve habitat connectivity across the locality. Dependant on the land tenure, it may be possible to achieve some of the offsetting within the woodland patch north of Cluster 10 and along the south west slope of the main ridge 7, for example.

8.1.5 Recommended management measures for construction phase

Planning and mitigation measures recommended for potential impacts during the construction phase are set out in Table 8-3 below.

Table 8-3 Planning and mitigation measures during construction

Risk	Recommendation
A. Habitat loss and modification	
A.1 High constraint areas	i. Infrastructure should avoid the high constraints identified in Figure 7-1. ii. Areas of particular concern are: • Suitable Superb Parrot habitat (mature woodland remnants with hollow-bearing trees) including: ○ Roadside remnants adjacent to Whitefield's Road ○ In the saddle and north west crest on Cluster 10 ○ In the transmission easement on the south-facing slope and saddle between Clusters 6 and 7a ○ In hollow-bearing paddock trees and woodland that occur within the valley between Clusters 5 and 7a • High constraint moderate to good condition EEC including: ○ Within the transmission envelope between Clusters 6, 5 and 7a (also listed under the EPBC Act) ○ Remnants on Cluster 10 ○ The woodland below Cluster 7b near the proposed turbine access track • Suitable Yass Daisy habitat including: ○ On the steep slopes within the transmission easement between Clusters 6 and 7a ○ Within the Box-gum Woodland remnant beginning in the centre of Cluster 10 and stretching to the north Works in these areas should be avoided, or micro-sited to avoid impacts on continuous woodland and standing live and dead trees. Hollow-bearing trees should not be removed in these areas. iii. Specific measures to avoid high constraint areas should include: ○ Road widening within mature woodland (moderate condition) on Whitefields Road is not recommended. ○ The proposed transmission corridor and access track in the valley between Clusters 5 and 7a should be micro-sited further south west to avoid intact

Risk	Recommendation
	Box-Gum Woodland. ○ The proposed transmission corridor between Clusters 6 and 7a should be micro-sited further north (to be on the saddle rather than slopes) to avoid intact Box-Gum Woodland. ○ Tracks and turbines on Cluster 10 should be micro-sited to avoid impacts on high constraint woodland. iv. Works should be sited outside known Yass Daisy population areas and Commonwealth-listed CEEC areas identified on Figure 5-6. v. A buffer on protected areas should be established to ensure indirect impacts (such as noise and dust) are minimised. An appropriate buffer width would be twice the tree drip line, for example. vi. A final site inspection should be carried out after road and electricity easements are finalised, to ensure that threatened species habitat and high constraint EEC vegetation has been avoided or that impacts are manageable. vii. Power-line and access track routes and turbine sites should be selected to avoid woodland remnants and individual mature and hollow-bearing trees in other areas, which provide habitat for threatened fauna and potential seed sources for future site rehabilitation.
A.2 Moderate and low constraint areas	i. Infrastructure should be confined to cleared areas, sparsely vegetated areas, and edges of woodland as much as possible. Installation of new access tracks through continuous woodland would not be appropriate. ii. Hollow-bearing and mature trees should not be removed where possible, particularly in areas adjacent to woodland patches (such as on Cluster 10, in the valley between 5 and 7a, and within the proposed transmission between 6 and 7a). If removed, they should be replaced with nest boxes. iii. Standing dead trees, stumps and woody debris should be avoided where possible. Where they require removal to allow for the tracks and hardstand areas, they should be placed adjacent to the impact areas, to retain these refugia in the immediate area. iv. Clusters of rocks and boulders should be avoided where possible. Where rocks and boulders cannot be avoided, they should be placed directly adjacent to the works area to preserve the availability of refuge. Where rocks are to be removed, pre-clearance for threatened reptiles should be undertaken by experienced personnel. v. Should dams be required to be removed during site development, alternative watering points should be established to compensate for their loss.

Risk	Recommendation
B. Indirect impacts	
B.1 Weed invasion and sediment erosion	i. Weed and sediment erosion controls should be implemented to prevent onsite habitat degradation during and following the proposed works. A Construction Environmental Plan would be the appropriate vehicle for these controls. This plan should include, but not be limited to: ○ Machinery and vehicles should be washed down before being brought onto the site and unnecessary soil disturbance should be avoided, to minimise the risk of exacerbating weed invasion in the EEC remnants. ○ All areas of disturbed soil should be rehabilitated progressively as soon as practicable after disturbance, in order to resist erosion and colonisation by weeds. Design and implementation of specific erosion and sediment controls will be required to ensure that landforms are not destabilised and erosion is not increased onsite. This may rely on physical controls such as netting to stabilise slopes. Landforms in many areas are steep and unstable. Means to trap soil and moisture and stabilise slopes will provide the best potential for natural regeneration in the long-term. ○ Site stabilisation, rehabilitation and revegetation will be undertaken without delay. ○ As a general rule, disturbed areas will be used for vehicle and machinery access, materials laydown, stockpiling of cleared vegetation and the deposition and retrieval of spoil whenever practicable. ○ Works will 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, will be avoided and remediated as necessary. ○ Excavated topsoil, subsoil and weathered rock will be stored separately and replaced in a manner that approximates the original profile as closely as possible. ○ Where practicable, whole sods will be removed with an excavator where these areas are well-vegetated with dense root systems. Sods will be stored in moist, shaded conditions and replaced following the works. Sod storage time will be minimised and sods will be replaced in a manner that maximises the chances of re-establishment.
B.2 Other indirect impacts	i. A buffer should apply to mature hollow-bearing trees to ensure indirect impacts (such as noise and dust) are minimised where practical. An appropriate buffer width would be twice the tree drip line, for example. ii. Additional risks to fauna may arise from collisions with construction and

Risk	Recommendation
	maintenance vehicles. Adhering to predetermined access routes and low speeds (max. 40km/hr off the public roads) would reduce the risk of vehicles colliding with stock or native fauna onsite. iii. Appropriate fire fighting equipment will be held on site when the fire danger is very high to extreme, and a minimum of one person on site will be trained in its use.
C. Offsetting	
	i. On finalisation of the development layout, an 'Offset Plan' should be developed in consultation with DECC and the CMA which would specify offset targets to be managed for conservation outcomes in perpetuity. ii. Further survey work would need to be undertaken once the final development layout has been determined in order to calculate offset targets for derived Box-Gum Woodland native pasture. iii. Appropriate areas for offsetting would carry the same vegetation (box-gum woodland) and ideally be within the locality (10-20km from the site) and contribute to woodland connectivity. Potential areas on the site include the woodland patch north of Cluster 10 and along the south west slope of the main ridge 7.

8.2 OPERATIONAL PHASE

8.2.1 Collision, barotrauma and avoidance impacts

The key operational impacts of wind farms have most relevance to species which fly in the path of operational turbines. There are three key impact types:

1. Collision with wind turbines: Within this investigation, 'collision' refers to mortality caused by direct collision with turbine blades or towers. The significance of the mortalities is species-specific. If the species is at low density in the landscape or susceptible to multiple collision events (such as for flocking species), collisions may threaten a local population. If the species is a top order predator or key stone species, there may be ecological ramifications of ongoing mortalities for other species.
2. Sudden decompression (barotrauma): Rapid or excessive air-pressure change near moving turbine blades has been linked to bat fatalities as a result of a haemorrhaging of the lungs (pulmonary barotrauma) (Baerwald *et al.* 2008). This is most relevant to bats.
3. 'Avoidance' behaviour caused by the presence of the turbines and associated infrastructure. Depending on where the turbines are located, this may affect foraging patterns, nesting, roosting or movements around the site. It equates to a loss of habitat, if

areas carrying infrastructure are avoided altogether, and therefore can have resultant impacts on the carrying capacity of the site.

The potential bladesweep area of the turbines range from approximately 44 (min) to 156 (max) metres above the ground. Raptors, migratory birds (such as Regent Honeyeater, Silvereye, Satin Flycatcher and Rufus Fantail), nocturnal species and bats are most at risk from these impacts, due to foraging behaviour, flocking or colonial movements, awkward flight characteristics, susceptibility to air pressure change, or night activities (Meredith *et al.* 2002; Airiola 1987 cited in Canada Bird Studies, 2001). These species may also utilise ridge systems for navigation and gliding and are therefore at increased risk of encountering wind turbines.

A literature review of collision and barotrauma impacts on birds and bats and potential mitigation and management options has been undertaken in Appendix G: *Windfarm Risks to Birds and Bats Addendum*. This resource has been used to evaluate species-specific impacts to threatened fauna and within Assessments of Significance (Section 6.4, Appendices D and E), and the non-listed fauna risk assessment (Section 6.4.2, Appendix F).

The risk assessment conducted for threatened and migratory (Assessments of Significance, Appendix E) identified one species: Eastern Bent-wing Bat as being at high risk from collision and barotrauma impacts during the operation of the wind farm.

The proposal has the potential to result in **significant** population-scale impacts from collision and/or barotrauma on the Eastern Bent-wing Bat. Further assessment has been recommended to be undertaken in **January**, coinciding with the peak activity at the Wee Jasper Eastern Bent-wing Bat maternity roost, to determine whether the site is used as a foraging area for the Eastern Bent-wing Bat. This assessment would aim to determine the significance of the risk to the survival of the local population and to develop appropriate risk mitigation measures to manage this risk. The results of this assessment would be documented in a separate report.

The risk assessment conducted for non-threatened species considered that the Wedge-tailed Eagle was at high risk from collision and barotrauma impacts. Species-specific mitigation measures should be implemented to reduce the risk to acceptable levels. This should include:

- Controlling food sources around the turbines. In particular, all carcasses of native, pest and domestic fauna within 200m of each turbine should be removed regularly.

Listed and non-listed species categorised as having a moderate risk from collision and barotrauma are:

Threatened and migratory:	**Rainbow Bee-eater, Square-tailed Kite, Gang-gang Cockatoo, Swift Parrot, Superb Parrot and Barking Owl**
Non-listed species:	**Australian Hobby, Barn Owl, Peregrine Falcon and Silvereye**

High and moderate risk species would be targeted for operational bird and bat monitoring (Section 8.2.2).

8.2.2 Bird and bat monitoring

A Bird and Bat Monitoring Plan would be developed in consultation with biodiversity and engineering consultants. This plan should be implemented prior to commencement of the operation phase and continue for the life of the proposed wind farm. The plan should be developed in coordination with other monitoring plans for the other two Yass Valley wind farm precincts and with other wind farms within the locality (see Section 8.4). The monitoring plan should aim to:

i. Ensure specific recommended mitigation measures outlined in this report are implemented and their effectiveness reviewed and adapted as necessary.

ii. Specify on-going monitoring procedures for the assessment and documentation of all collision and barotrauma-related injuries or mortalities, focusing in particular on moderate and high risk species. Timing for monitoring should be specific to the most at-risk target species.

iii. Specify procedures to investigate and implement adaptive measure to reduce impacts should injury or mortality be found to occur. Injury, mortality and habitat avoidance thresholds should be developed and used to trigger specific management responses to mitigate impacts. Thresholds should be developed with regard to having regard to species reproductive potential, conservation status and experiences at other Australian wind farms.

iv. Ensure that all injuries and mortalities of any threatened or migratory species are reported to DECC.

v. Ensure that all injured fauna are transported from the site and cared for by a suitably trained and experience wildlife carer, such as WIRES.

vi. Specify procedures to review adaptive mitigation measures to ensure their effectiveness at reducing collision and barotrauma related mortality.

vii. Coordinate the monitoring and adaptive actions for all wind farms within the regions to ensure cumulative impacts are appropriately documented and managed.

viii. Develop a standardised and publicly available database to increase the knowledge base on this subject.

Management responses to monitoring threshold exceedance would be dependent on the cause and the impact, but could include:

- Further research and consultation
- Detailed risk modelling and population assessments
- Adjustments or enhancements to turbines and associated infrastructure / implementing deterrents from the rotor impact zone. Examples may include:
    - Flight diversion or deterrent structures, lights, audio or sonar transmitters
    - Blade painting (refer Hodos *et al.* 2001)
    - Modifying habitat around turbines (removing water sources such as dams)
    - Removing local food sources (particularly carcasses) or insect attracting light sources
    - Compensatory off-site habitat protection or enhancement
    - Nest site protection

- Sponsoring the care of injured birds
- The periodic shutdown of one or more turbines to avoid high activity periods such as:
  - Outside of seasonal migration times and high activity seasons
  - in low wind (below 50km/h)
  - during the night (when nocturnal species are active)

8.2.3 Recommended management measures for operational phase

Planning and mitigation measures recommended for potential impacts during the operation phase are set out in Table 8-4.

Table 8-4 Planning and mitigation measures during the operational phase

Risk	Recommendation
A. High risk species	
A.1 Threatened species: Eastern Bent-wing Bat	i. The proposal has the potential to result in **significant** population-scale impacts from collision and/or barotrauma on the Eastern Bent-wing Bat. Further assessment on the Coppabella precinct has been undertaken in January 2009 during peak use of the maternity roost to determine the abundance of the Eastern Bent-wing Bat on the site. The results of the January report would be documented as a separate report. Its recommendations would be supplimentry to the recommendations of this report. ii. Monitoring should target impacts on this species and ensure that that mitigation measures are effective for reducing Eastern Bent-wing Bat mortalities.
A.2 Non-listed species: Wedge-tailed Eagle	i. Potential Wedge-tailed Eagle food sources around the turbines should be controlled. In particular, all carcasses of native, pest and domestic fauna within 200m of each turbine should be removed as often as possible. This could be done in conjunction with bird and bat monitoring, maintenance and general farm activities. ii. Monitoring should target impacts on this species and ensure that that carcass removal is effective for reducing Wedge-tailed Eagle mortalities.
B. Bird and bat monitoring	
	i. A Bird and Bat Monitoring Plan would be developed in consultation with biodiversity experts. This plan should be implemented prior to commencement of the operation phase and continue for the life of the proposed wind farm. The plan should be developed in coordination with other monitoring plans for the local wind farms. Potential aims of this plan are outlined above (Section 8.2.2). ii. Potential management responses to monitoring thresholds are discussed above (8.2.2).

Risk	Recommendation
C. General recommendations	
	i. Infrastructure placement should avoid the constraints identified in Figure 7-1. ii. Marker lights, if required should be minimised in number and fitted to reduce their ability to attract migrating birds and insects. Red lights are preferred, with the least number of flashes per minute. Cowls may also shield the light when viewed from the ground and reduce potential to attract wetland birds taking off at dusk. It is understood that CASA requirements will prevail. iii. Guy lines should not be fitted to towers or associated structures, where possible. iv. The turbine towers should not provide perching opportunities. v. Electrical connection lines should be installed underground where possible. vi. Power poles would be designed to minimise perching and roosting opportunities where practical. vii. Power poles and overhead transmissions would be designed to reduce impacts on birds (for example by using flags or marker balls, large wire size, wire insulation, wire and conductor spacing) in areas of elevated risk of bird strike.

8.3 DECOMMISSIONING PHASE

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. Access tracks would be upgraded as required. 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.

8.3.1 Recommended management measures for the decommissioning phase

Planning and mitigation measures recommended for potential impacts during the construction phase are set out in Table 8-5.

Table 8-5 Planning and mitigation measures during decommissioning phase

Risk	Recommendation
Decommissioning	i. A flora and fauna assessment should be undertaken prior to decommissioning to identify biodiversity constraints and develop specific impact mitigation measures. ii. Weed and sediment erosion control principles should be developed and implemented. iii. Disturbed ground should be stabilised and rehabilitated as soon as practicable after works.

8.4 CUMULATIVE IMPACTS

The Coppabella Hills Precinct forms part of the Yass Valley Wind Farm proposal involving two other project sites; Marilba Hills c. 5 kilometres to the east and Carroll's Ridge c.20 kilometres to the south-east. Together, these three precincts total up to 185 turbines, 109.22 kilometres of transmissions and 129.3 kilometres of access tracks. The impacts associated with these projects have been assessed separately in Biodiversity Assessments for each precinct.

There are several other wind farms proposed and operating in the region. Most of these are well to the east of the subject site, located near Gunning, Crookwell and Lake George.

The operational and proposed wind farm localities in the district may involve overlapping raptor territories and bird and bat migration routes. Continuing losses of some raptor species with low reproductive rates (such as Wedge-tailed Eagles) could represent a 'mortality sink' which has the potential to affect region-level populations (Jonzen et al. 2005).

The impacts of the wind farm on biodiversity values would combine with existing impacts resulting from land clearing, agricultural activities, weeds and hazards. It is important to recognise that the district has experienced extensive losses to ecosystem integrity and stability. Woodland and grassland communities in particular, which coincide with prime agricultural land, and riparian and wetland

communities have been heavily impacted. It is likely that many woodland flora and fauna species have become locally extinct, and many are in continuing decline. There is a time lag, or 'extinction debt', operating which will mean that decline and extinction will continue for many species for decades to come, regardless of management responses. Further impacts on lowland environments are expected from soil and water salinisation, soil erosion and sedimentation, weed invasion and spread, disruption to river hydrology due to farm dam construction and water extractions and habitat fragmentation and clearing resulting from residential sub-division and building.

The presence of the turbines and transmission easements would provide additional obstacles and hazards to birds and bats. Existing hazards include electricity transmission lines, and air, rail and road traffic. The ongoing monitoring and assessment of the operational impacts of wind farms operating in the region should be consistent, centrally analysed and published to ensure cumulative impacts remain within acceptable limits.

When the cumulative impacts of all disturbances are considered, it is clear that any significant addition to stresses experienced by flora and fauna in the region needs to be avoided. The location of the proposed wind farm turbines on a largely cleared ridgetop sites, and avoiding impacts to natural woodland communities and habitats, should restrict the potential to affect declining woodland or wetland species. Via the offset plan, there is scope to secure and improve some of these habitats on private property.

8.4.1 Recommended management measures for cumulative impacts

Planning and mitigation measures recommended for potential impacts for managing cumulative impacts are set out inTable 8-6.

Table 8-6 Planning and mitigation measures for managing cumulative impacts

Risk	Recommendation
Cumulative impacts	i. Bird and Bat Monitoring should be consistent for all proposed and existing wind farms within the region, centrally analysed and published to ensure cumulative impacts remain within acceptable limits. ii. Approval of any proposed wind farms should take into account the impacts of existing operational wind farms as well as the potential impacts of other proposed in the district.

9 MODIFYING THE PROPOSAL

Following consultation with **ngh**environmental, modifications were made to the original infrastructure layout to address concerns highlighted in the biodiversity constraints and impact assessments presented above (Sections 7 and 8). The modifications seek to implement specific recommendations outlined in Section 8.1.5 to reduce habitat loss and modification of high constraint areas and values. They involved either avoiding areas of high constraint or micro-siting infrastructure. The modifications help to reduce overall impacts on biodiversity values as a result of the proposal and ensure that the development maintains or improves environmental outcomes.

To demonstrate the amount of refinement the proposal has undergone, the original infrastructure layout is supplied in Appendix I. Where layouts have been refined, additional constraints mapping refinement has also been undertaken to assist avoidance or minimization of impacts in high and moderate constraint areas. All maps and impact area calculations within this report are based on the final infrastructure layout provided by the proponent.

9.1 REVISIONS, GENERAL

While the majority of infrastructure avoids treed areas, the site's understorey is also of concern in many areas. The mosaic nature of better condition understorey, changing seasonally, means that it is impossible to entirely avoid. A commitment to using an ecologist to help micro-site the infrastructure away from better quality areas of understorey is required. This allows the Proponent the flexibility to move infrastructure within the envelope. The additional assessment would occur in the detailed design phase and may require minor route or location revisions.

Specific areas where infrastructure layout revision was undertaken are discussed below. Areas 1-9 correspond to the constraints map sheets provided in Figure 7-1. For comparison, the original infrastructure layout is provided in Appendix I (map sheets 1-8).

9.2 REVISIONS, SPECIFIC

Area 2, northern end of Cluster 3

Two tracks were indicated in areas of high constraint woodland at the northern end of this cluster (shown in Appendix I, map zone 2). Additionally, a transmission easement is required in this area.

Widening the track is possible as the groundcover is not of significance in this area. Tree removal should be avoided, particularly impacts on hollow bearing trees. Track width should be minimized. Tracks and powerlines should be aligned to reduce the overall amount of clearing required. More detailed mapping was undertaken to facilitate micro-siting the tracks to minimize impacts.

These tracks have now been rerouted to minimise impacts.

Area 2, transmission easement east of Cluster 3

This easement heads north east from the centre of Cluster 3. If centred on the easement development envelope (shown in Appendix I, map zone 2), it would dissect a high constraint area. Potential exists

here to straighten the transmission line and avoid high constraint areas by micro-siting the poles. Trees are the constraint in this area.

The Area 2 constraints map now indicates the transmission line at the southern edge, rather than within this high constraint area.

Area 4, transmission easement between Clusters 5 and 7

This easement heads south east between Clusters 5 and 7. If centred on the easement development envelope (shown in Appendix I, map zone 2), it would dissect a high constraint area. Clearing for tracks or power line poles or trenches would impact this area of EEC and it is strongly advised to avoid this area. Threatened fauna issues are also relevant here.

The Area 4 constraints map now indicates the transmission line has been routed south to avoid this area.

Area 7, Cluster 10 turbines

The current layout shows that two turbines are located near hollow-bearing trees and rocky outcrops in this area (Area 7, Cluster 10). Clearing would be required for these turbines, affecting hollow-bearing trees and the rocky outcrops. Nearly all the trees in this area are hollow bearing and pose a threatened fauna issue; groundcover is not a constraint. The rocky outcrop has been assessed as a low constraint however, preclearance reptile surveys are recommended if this area cannot be avoided. It is strongly advised to avoid all hollow bearing trees. If these cannot be avoided, further work (stag watching, spotlighting and anabating) should be undertaken to determine the level of use of these hollows. Wildlife handlers would be required during the felling of hollows and hollows should be replaced with nest boxes at a more suitable distance from the turbine, to retain this resource type. Offsetting should also be undertaken.

The Proponent has advised that the contours of the site in this area make avoidance impossible. An offsetting strategy, and the recommendations stated above would be undertaken in this area.

Area 7, middle of Cluster 10 track and turbine

At the midsection of Cluster 10, a track and turbine are shown dissecting a high constraint area in the original layout (shown in Appendix I, map zone 7). The groundcover in this area is of high diversity and is a constraint.

In the final turbine layout (Area 7), the track has moved east to avoid the constraint and an optional track is being investigated. If a track is required through the high constraint, it should be micro-sited with an ecologist and minimised in width. It would require offsetting.

Area 7, southern end of Cluster 10 turbine

At the midsection of Cluster 10, a turbine is shown dissecting a high constraint area in the original layout (shown in Appendix I, map zone 7). It would be preferable to move this turbine into a cleared area to avoid the moderate condition Long-leaved Box--Red Stringybark woodland remnant. This area has no hollow bearing trees. This area is also very steep and rocky.

In the final turbine layout (Area 7), the turbine has been moved to avoid the constraint.

Area 6, southern end of Cluster 7b, turbines and track

This area is of high constraint; it has been increased in area since the original constraints mapping (Appendix 1, Zone 6). The groundcover as well as the overstorey are a constraint in this area; minimising track width and avoiding trees are required. As the area would qualify as EEC there would be very large offset ratios required for any disturbance. Mitigation here would need to include minimised track width and disturbance if it cannot be avoided altogether. Furthermore, the location of a turbine within a woodland fragment increases collision risks.

Close-ups in Figure 7-1, Area 6 have been used to show the ability of the turbines to be sited in clearings however, minimizing understorey disturbance will also be required. The Proponent has advised that the contours of the site in this area make avoidance impossible. An offsetting strategy, and the recommendations stated above in Section 8 would be undertaken in this area.

10 CONCLUSIONS

10.1 SUMMARY OF BIODIVERSITY VALUES

Three threatened species: Yass Daisy, Superb Parrot and Diamond Firetail and a threatened ecological community Box-Gum Woodland were detected within the study area. Potential habitat for threatened species was also detected. Assessments of Significance (TSC and EPBC Act) were undertaken for 27 fauna, 2 flora species and 1 ecological community. The proposed project infrastructure layout largely avoids these areas, and therefore the proposal is not expected to have a significant impact on threatened flora species or ecological communities.

Risk assessments identified two threatened species as being at high risk of significant population-scale impacts arising from the development: Superb Parrot (habitat removal) and Eastern Bent-wing Bat (barotrauma and collision impacts). There is also likely to be a high risk to local populations of the non-threatened Wedge-tailed Eagle. Habitat avoidance and further monitoring and mitigation measures discussed will ensure that these impacts will be minimised to acceptable levels.

The proposal is **not considered likely to result in a significant impact** on threatened or migratory fauna provided that the recommendations outlined in Section 8 of this report are effectively implemented.

The *Microbat Study* undertaken in January and documented in a separate report will inform the adoption of measures specific to microbats at Coppabella Hills Precinct.

10.2 SUMMARY OF RECOMMENDATIONS

Direct and indirect impacts on flora, fauna and their habitats can be minimised by avoiding sensitive features and undertaking the recommended mitigation measures (Section 8). High constraint areas include moderate to good condition Box-Gum Woodland EEC, threatened species habitat, and mature woodland remnants.

Areas of particular concern include:

- Within the transmission envelope between Clusters 5 and 7a
- Remnants on Cluster 10
- Woodland below Cluster 7b along the proposed turbine access track

Alterations to the proposal have been made by the proponent that address these issues, either avoiding areas of high constraint or undertaking to micro-site infrastructure to ensure impacts to biodiversity values area minimized (refer to Section 9). The considerations informing this outcome include the potential impact on threatened flora and fauna, the contribution of the proposal to a number of key threatening processes, as well as the locally important habitat features these areas provide.

For the remaining areas within the development envelope (moderate to low constraint) the final infrastructure layout will determine the precise amount of clearing required, and the specific offset requirements. It is recommended to secure offsetting for areas of habitat permanently removed by the proposal. In due course, formal agreements should be sought with the relevant land owners.

It is concluded that the project is able to maintain or improve environmental outcomes by locating infrastructure in cleared paddocks, obtaining offsets and by avoiding highly constrained areas. The proposal should also be viewed in terms of the wider environmental benefits of establishing renewable energy generation in a rural area, which has significant broad level environmental benefits.

The key mitigation strategies considered necessary to reduce the potential operational impacts to an acceptable level include the following (full details are found in Section 8):

- Avoidance of high constraint areas, indicated on Constraints Mapping, Figure 7-1.
- Mitigation (by offsetting and application of general measures) of impacts within moderate constraint areas.
- A Bird and Bat Monitoring Plan should be designed to document mortalities, remove carcasses and assess the effectiveness of controls. Standardised and publicly available data should be collected to increase the knowledge base on this subject. If mortalities exceed a pre-determined threshold (set out in the monitoring program), additional mitigation measures should be considered, such as diversion structures, blade painting (refer Hodos *et al.* 2001), turning off turbines at critical times, further turbine ridge habitat modification and enhancement of off-site habitats.

11 ASSESSMENT PERSONNEL

Personnel	Role	Qualifications	Expertise and experience
Eleanor Stalenberg	Fauna survey and site assessment Report writing and research	Bachelor of Science (Zoology) Honours	Eleanor has experience in comprehensive fauna survey in southern NSW. She has undertaken a number of biodiversity assessments and EIA reports in a wide range of habitats on the Southern Tablelands, Cooma Monaro and South Coast of NSW. These reports have included threatened floral and faunal species assessments, research, field work and GIS components.
Jackie Miles	Flora site assessment and report writing	Bachelor of Science (Honours)	Jackie is **ngh**environmental's naturalist, specialising in botanical and zoological surveys. Jackie has worked on a number of large assignments including extensive fauna surveys for the Comprehensive Regional Assessment program, and botanical surveys including CRA full floristic surveys, field validation for the Parks & Wildlife Division - Dept. of Environment and Conservation Vegetation Map for South East Forests, botanical surveys for mapping of all NSW ski resort areas, surveys of significant remnant grassy vegetation for Bega Valley Shire Council.
Paul McPherson	Flora and site assessment	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.
Nick Graham-Higgs	Senior review	B Sc (EIANZ Certified Environmental Practitioner)	Nicholas has worked as an environmental planning and resource consultant since 1992, specialising in natural resource management. A wide range of assignments covering diverse natural and modified environments, have enabled Nick to develop a broad knowledge base in the area of natural resource planning and management. Nick is accredited as a Certified Environmental Practitioner by the Environment Institute of Australia and New Zealand.
Brooke Marshall	Senior review	B Natural Resources (Hons)	Brooke graduated as a first class honours Natural Resources graduate of the University of New England (UNE). Since joining **ngh**environmental, Brooke has prepared impact assessment reports relating to a variety of infrastructure development (including roads, wind farms, telecommunications, water supply management and residential development) as well as river modification and prescribed burning works. These reports have included threatened floral and faunal species assessments, research, fieldwork and GIS components.
Steven Sass	Senior Review	B App Sci (Env Sci) (Hons) EIANZ Certified Environmental Practitioner	Steven is an experienced ecologist having undertaken more than 500 aquatic and terrestrial threatened flora and fauna surveys and habitat assessments. As a Certified Environmental Practitioner by the Environment Institute of Australia and New Zealand and as Senior Ecologist, Steven provides technical advice and peer-review to the **ngh**environmental ecology team.

Personnel	Role	Qualifications	Expertise and experience
Bianca Heinze	Editing Fauna technical assistant	B AppSc (ERM/Coastal Mgt)	Since joining **ngh**environmental Bianca has focused on biodiversity assessment and field work across a variety of ecosystems. Prior to joining **ngh**environmental, Bianca was employed with the Department of Sustainability & Environment, Victoria, in the field of fire management. During her 2 years, she was involved with fire operations planning, community engagement and fire suppression.

12 REFERENCES

Ahern, L. & van der Ree, R. (2003) *Action Statement No. 166 Squirrel Glider* Petaurus norfolcensis, Department of Sustainability & Environment, Victoria, accessed at http://www.dse.vic.gov.au/CA256F310024B628/0/533F686E722A2E14CA2570ED001AF9B4/$File/166+squirrel+glider+2002.pdf

Arnett, E. B. (ed.) (2005) *Relationships between bats and wind turbines in Pennsylvania and West Virginia: an assessment of bat fatality search protocols, patterns of fatality and behavioural interactions with wind turbines*. A final report submitted to the Bats and Wind Energy Cooperative. Bat Conservation International. Austin, Texas, USA.

ATSB (2002) *Galahs: managing bird strike risk at Australian airports,* Australian Transport Safety Bureau.

AUSWEA (2002) *Best Practice Guidelines for Implementation of Wind Energy Projects in Australia*. Australian Wind Energy Association (Ed.), Australian Greenhouse Office.

Baerwald, E. F., D'Amours, G. H., Klug, B. J. and Barclay, R. M. R. (2008). "Barotrauma is a significant cause of bat fatalities at wind turbines." *Current Biology* 18 (16): 1173-1268.

Baker-Gabb, D. J. (1984) The Feeding Ecology and Behaviour of Seven Species of Raptor Overwintering in Coastal Victoria. *Aust. Wildl. Res.,* 11**,** 517-23.

Barrett, G. W., Ford, H. A. & Recher, H. F. (1994) Conservation of woodland birds in a fragmented rural landscape. *Pacific Conservation Biology* 1**,** 245-256.

Blakers, M., Davies, S.J.J.F. & Reilly, P. N. (1984). *The Atlas of Australian Birds*. Royal Australasian Ornithologists Union, Melbourne.

Brett Lane & Associates (2003) *Bald Hills Wind Farm - Flora, fauna and avian assessment (Appendix 1 to Environmental Effects Statement)* Unpublished report No. 2002.17(3.3). Wind Power Pty Ltd,.

Cameron, M. (2007) *Cockatoos,* Australian Natural History Series, CSIRO Publishing, Victoria

Chan, K. (1995) 'Diurnal and Nocturnal Patterns of Activity in Resident and Migrant Silvereyes Zosterops lateralis' *Emu,* 95**,** 41-46.

Churchill, S (1998) *Australian Bats*, Reed New Holland, Frenchs Forest, Australia

Cooney, S. J. N. & Watson, D. M. (2005) 'Diamond Firetails (Stagonopleura guttata) preferentially nest in mistletoe' *Emu,* 105**,** 317-322.

Cooper, C. B. & Walters, J. R. (2002) 'Independent effects of woodland loss and fragmentation on Brown Treecreeper distribution' *Biological Conservation,* 105**,** 1-10.

Cropper, H. (1993) *Management of Endangered Plants* CSIRO Publishing, Melbourne

DEWHA (2008) *Species profile and threats database*. Australian Government Department of the Environment, Water, Heritage and the Arts,. http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

Dorrough, J. & ASH, J. E. (1999) Using past and present habitat to predict the current distribution and abundance of a rare cryptic lizard, Delma impar (Pygopodidae). *Australian Journal of Ecology,* 24**,** 614-624.

Douglas, S. (2006) Endangered Plant Discovered, in *Australian Flora Foundation Newsletter No. 4*, August 2006

Dwyer, P D (1964) "Seasonal Changes in Activity and Weight of *Miniopterus schreibersi blepotis* (Chiroptera) in North-eastern New South Wales", Australian Journal of Zoology, Vol 12. Pp 52-69

Dwyer, PD (1968) 'Population Ranges of *Minopterus schreibersii* (Chiroptera) in South-eastern Australia', *Australian Journal of Zoology* 17:665-686

Emison, W.B., Beardsell, C.M., Norman, F.I., Loyn, R.H. & Bennett, S. (1987). *Atlas of Victorian Birds*.

Environment Australia (2000) *Revision of the Interim Biogeographic Regionalisation for Australia (IBRA) and development of Version 5.1 – Summary Report*. Environment Australia, Canberra.

Erickson, W.P., Johnson, G.D., Strickland, M.D., Young, D.P., Sernka, K.J. and Good, R.E. (2001) *Avian collisions with wind turbines: a summary of existing studies and comparisons to other sources of avian collision mortality in the United States*, Resource Document of the national Wind Coordinating Committee, Washington

Fallding, M (2002) *Planning Framework for Natural Ecosystems of the ACT and NSW Southern Tablelands,* Natural Heritage Trust, NSW National Parks and Wildlife Service and Land and Environment Planning

Fischer, J. and Lindenmayer, D. B. (2002) The conservation value of paddock trees for birds in a variegated landscape in southern New South Wales. 1. Species composition and site occupancy patterns*. Biodiversity and Conservation* 11, 807-832

Fischer, J., Lindenmayer, D. B. & Cowling, A. (2004) The challenge of managing multiple species at multiple scales : reptiles in an Australian grazing landscape. *Journal of Applied Ecology,* 41**,** 32-44.

Friends of Grasslands (2006) *Endangered plant discovered.* News of Friends of Grasslands. Nov-Dec 2006.

Friends of Grasslands (2006) Tarengo Reserve. *News of Friends of Grasslands*. Jan-Feb 2006.

Gardner, J. L. (2002a) Breeding biology of the speckled warbler (*Chthonicola sagittata*). *Australian Journal of Zoology,* 50**,** 169-181.

Garnett, S. (1992). *Threatened and extinct birds of Australia*. Royal Australasian Ornithologists Union and Australian National Parks and Wildlife Service, Report 82

Garnett, S.T. & Crowley, G.M. (2000) *The Action Plan for Australian Birds*, accessed at http://www.environment.gov.au/biodiversity/threatened/publications/action/birds2000/

Gellie, N. J. H. (2005) Native vegetation of Southern forests: South-East Highlands, Australian Alps, South-West Slopes & South-East Corner bioregions, . *Cunninghamia* 9**,** 219-254.

Genelly, R. E. (1978) Observations of the Australian Kestrel on Northern Tablelands on New South Wales, 1975. *Emu,* 3**,** 137 - 144

Gibbons, P. & Boak, M. (2000) *The importance of paddock trees for regional conservation in agricultural landscapes.* A discussion paper for consideration by Riverina Highlands Regional Vegetation Committee. NSW National Parks and Wildlife Service, Southern Directorate unpublished report.

Gibbons, P. & Lindenmayer, D. (2000) *Tree hollows and wildlife conservation in Australia,* Collingwood, Victoria, CSIRO Publishing.

Gibbons, P. and Lindenmayer, D. (2002). *Tree hollows and wildlife conservation in Australia*. Canberra, CSIRO Publishing.

Gordon, G., Brown, A.S, Pulsford, T. (1988) 'A koala *(Phascolarctos cinereus)* population crash during drought and heatwave conditions in south-western Queensland' *Australian Journal of Ecology* 13: 451-461

Griffioen, P. A. & Clarke, M. F. (2002) Large-scale bird-movement patterns evident in eastern Australian atlas data. *Emu,* 102**,** 99-125.

Hall, L.S., and Richards, G.C. (1979) *Bats of Eastern Australia*, Queensland Museum Booklet 12. 66pp.

Harden G.J. (ed) *Flora of New South Wales*, Vols. 1-4, 1990-93, UNSW Press.

Higgins P.J. & Davies S.J. (Eds) (1996). *Handbook of Australian, New Zealand and Antarctic Birds.* Volume 3: Snipe to Pigeons. Oxford University Press, Melbourne.

Hodos, W., A. Potocki, T. Storm, & M, Gaffney. 2001. Reduction of motion smear to reduce avian collisions with wind turbines. Pp. 88-105. *In* S. S. Schwartz, (ed.) *Proceedings of the National Avian- Wind Planning Meeting IV*. Prepared for the Avian Subcommittee of the National Wind Coordinating Committee by RESOLVE, Inc. Washington, DC.

Hogendyk, G. (2008) 'Woody weeds and woodland birds', *Wingspan* 18(2) 18-19

James, C.D. (2003) 'Response of vertebrates to fenceline contrasts in grazing intensity in semi-arid woodlands of eastern Australia'*, Austral Ecology* 28:137-151

Joint ANZECC-MCFFA National Forest Policy Statement Implementation Sub-committee (JANIS) (1997) *Nationally agreed criteria for the establishment of a comprehensive, adequate and representative reserve system for forests in Australia*, prepared by the Technical Working Group on Reserve Criteria

Kunz, T, Arnett,E, Cooper,B, Erickson,W, Larkin,R, Mabee,T Morrison,M, Strickland, M, Szewczak, J 2007 Assessing Impacts of Wind-Energy Development on Nocturnally Active Birds and Bats: A Guidance Document." *Journal of Wildlife Management, vol 71 (8)* pp2449-2486.

Manning, A. D., Fischer, J. and Lindenmayer, D. B. (2006a). "Scattered trees are keystone structures – Implications for conservation." *Biological Conservation* 132(3): 311-321.

Manning, A. D., Lindenmayer, D. and Barry, S. C. (2004). "The conservation implications of bird reproduction in the agricultural ''matrix'': a case study of the vulnerable superb parrot of south-eastern Australia." *Biological Conservation* 120(3): 363-374.

Manning, A.D., Lindenmayer, D.B, Barry, S.C., Nix, H.A. (2006b) 'Large scale spatial and temporal dynamics of the vulnerable and highly mobile superb parrot' *Journal of Biogeography* 34: 2: 289-304

McAlpine C., Bowen M.E., Callaghan J.G., Lunney D., Rhodes J.R, Mitchell D.L., Pullar D.V., Poszingham H.P. (2006) ' Testing alternative models for the conservation of koalas in fragmented rural–urban landscapes' *Austral Ecology* 31**:** 529-544

McDonald, P. G., Olsen, P. D. & Baker-Gabb, D. J. (2003) Territory fidelity, reproductive success and prey choice in the Brown Falcon, *Falco berigora*: a flexible bet-hedger? *Australian Journal of Zoology,* 51**,** 399-414.

Menkhorst, P. & Knight, F. (2004) *A field guide to the mammals of Australia,* South Melbourne, Oxford University Press.

Menkhorst, P., Schedvin, N. & Geering, D. (1999) *Regent Honeyeater* (Xanthomyza phrygia) Recovery Plan 1999-2003. In Australian Department of Natural Resources and Environment (Ed.) East Melbourne.

Meredith, C., Venosta, M. & Ressom, R. (2002) *Codrington Wind Farm Avian Avoidance Behaviour Report*. Biosis Research.

nghenvironmental (2006) *Proposed Development of a Wind Farm at Conroys Gap, New South Wales – Biodiversity Assessment*, prepared for Taurus Energy Pty Ltd, June 2006

Olsen, P. (1998) 'Australia's Raptors: Diurnal Birds of Prey and Owls, *Wingspan* **8:** 3: supplement

Olsen, P., Weston, M., Tzaros, C., Silcocks, A. (2005) 'The State of Australia's Birds 2005: Woodlands and Birds, *Wingspan* 15:4: supplement

Osborne, W. S. & Jones, S. R. (1995) Recovery plan for the Pink-tailed Worm Lizard (Aprasia parapulchella). IN ACT Parks and Conservation Service (Ed.) *Technical Report 10.* Tuggeranong, Department of Environment, Land and Planning.

Pennay, M and Freeman, J 2005 "Day Roost of Little Pied Bat Chalinolobus picatus (Gould) (Microchiroptera:Vespertilionidae) in north Inland New South Wales, Australia", *Australian Zoologist, Vol 33(2).* Pp166-167

Pizzey, G., Knight, F. & Menkhorst, F. (2003) *A field guide to the birds of Australia*, Harper Collins Publishers Pty.

Pizzey, G., Knight, F. & Menkhorst, F. (2006) *A field guide to the birds of Australia,* Sydney, Harper Collins Publishers Pty.

Plowright, H. (2002) *A Field Guide to Australian Birdsong*. IN Plowright, H., Buckingham, R. & Jackson, L. (Eds.) Nunawading, Vic, Bird Observers Club of Australia.

Prober, S.M. & Thiele, K.R. (1993) The ecology and genetics of remnant grassy white box woodlands in relation to their conservation. *Victorian Naturalist* 110, 30-36.

Quin, D. G. (1995) Population ecology of the squirrel glider (Petaurus norfolcensis) and the sugar glider (P. breviceps) (Maruspialia : Petauridae) at Limeburners Creek, on the central north coast of New South Wales. *Wildlife Research,* 22**,** 471-505.

Ree, R. & Bennett, A. (2003) Home range of the squirrel glider (*Petaurus norfolcensis*) in a network of remnant linear habitats. *Journal of Zoology,* 259**,** 327-336.

Reid, J. (1999) *Threatened and declining birds in the New South Wales sheep-wheat belt: Diagnosis, characteristics and management* IN ECOSYSTEMS, C. S. (Ed.) Canberra, NSW National Parks and Wildlife Service.

Rhodes (2001) *Bat Survey of proposed windfarm site, Musselroe Bay, North-east Tasmania*, 4-6 December 2001. A report to Hydro Tasmania.

Schodde, R. and Tidemann, S. C., Eds. (2007). *Readers Digest Complete Book of Australian Birds*, Reader's Digest, Sydney.

Sharp, A., Norton, M. & Marks, A. (2001) Breeding activity, nest site selection and nest spacing of Wedge-tailed Eagles (Aquila audax) in western New South Wales. *Emu,* 101**,** 323-328.

Smales, I. (2005) Modelled cumulative impacts on the Swift Parrot of wind farms across the species' range in south-eastern Australia. IN RESEARCH, B. (Ed.) Melbourne, Department of Environment and Heritage.

Smith, W. & Robertson, P. (1999) *National recovery plan for the Striped Legless Lizard* (Delma impar) 1999-2003. in NSW National Parks and Wildlife Service & Wildlife Profiles Pty Ltd (Ed.) Canberra, ACT, Department of the Environmental, Water, Heritage and the Arts.

Strahan, R. (1995) *The Mammals of Australia*, Strahan ed., Australian Museum/Reed Books.

Strahan, R. (Ed.) (1983) *The Australian Museum Complete Guide to Australian Mammals,* Sydney, Angus & Robertson Publishers.

Stuart, D. (1998) 'Australian Frog Calls: Subtropical East'. *Nature Sound.* Mullumbimby, NSW.

TAMS (2005) *Information Sheet: Hooded Robyn* Melanodryas cucullata, accessed at http://www.tams.act.gov.au/__data/assets/pdf_file/0004/58657/Hooded_Robyn.pdf

Thackway, R. and Cresswell, I.D. (1995) *An interim biogeographic regionalisation for Australia: a framework for setting priorities in the National Reserves System Cooperative Program, Version 4.0*. Australian Nature Conservation Agency, Canberra.

Thelander, C.G., Smallwood, K.S. and Rugge L. (2003) *Bird Risk Behaviors and Fatalities at the Altamont Pass Wind Resource Area Period of Performance: March 1998–December 2000* BioResource Consultants Ojai, California December 2003 NREL/SR-500-33829

URS AUSTRALIA (2004) *Crookwell II Wind Farm: Additional Raptor Survey and Assessment.* North Sydney.

Walters, J. R., Ford, H. A. & Cooper, C. B. (1999) The ecological basis of sensitivity of brown treecreepers to habitat fragmentation: a preliminary assessment. *Biological Conservation,* 90**,** 13-20.

Watson, J., David, F. & Paull, D. (2001) An Assessment of the Focal-Species Approach for Conserving Birds in Variegated Landscapes in Southeastern Australia. *Conservation Biology,* 15**,** 1364-1373.

Webster, R. & Ahern, L. (1992) *Management for conservation of the Superb Parrot (Polytelis swainsonii) in New South Wales and Victoria.* Department of Conservation and Environment (unpubl. draft report)

Webster, R. (1988) *The Superb Parrot —A survey of the breeding distribution and habitat requirements.* Report Series No. 12. Australian National Parks and Wildlife Service, Canberra

Wilkinson, G 1992 “Information Transfer at Evening Bat Colonies”, *Animal Behaviour Vol 44,*pp501-518.

Wintle, B.A., Elith, J., and Potts J.M. 'Fauna habitat modelling and mapping: a review and case study in the Lower Hunter CEntral Coast regino of NSW', *Austral Ecology* **30:** 7: 719-738

Yass Valley Council (2004) *2003/2004 State of the Environment Report Supplementary Report, Yass Valley*, Yass Valley Council accessed November 2005, http://www.yass.nsw.gov.au/files/2623/File/2004SupplementarySoEReport8-2.pdf

Appendix A **FLORA SURVEY**

A.1 FLORA SURVEY EFFORT

No.	X_Proj	Y_Proj	survey_type
1	639651	6152669	quadrat
2	642508	6154483	quadrat
3	640534	6155672	quadrat
4	641672	6154060	random meander
5	638560	6156039	random meander
6	637956	6152651	random meander
7	642070	6155434	random meander
8	642227	6155038	random meander
9	642395	6154327	random meander
10	640864	6155376	random meander
11	644096	6154073	random meander
12	642921	6152915	random meander
13	644146	6150715	random meander
14	640553	6155623	random meander
15	641771	6154231	random meander
16	645482	6150020	random meander
17	645701	6149386	random meander
18	641972	6152272	random meander
19	640869	6155385	random meander
20	641876	6155165	random meander
21	641742	6155016	random meander
22	645700	6153122	random meander
23	644124	6153486	random meander
24	644721	6153512	random meander
25	645089	6153207	random meander
26	642305	6154026	random meander
27	644145	6147936	random meander
28	642311	6150191	random meander
29	633863	6154253	spot check
30	639264	6159396	spot check
31	636821	6155410	spot check
32	638355	6156211	spot check
33	643526	6152076	spot check
34	638637	6155900	spot check
35	638663	6155914	spot check

No.	X_Proj	Y_Proj	survey_type
36	638768	6155507	spot check
37	637777	6152682	spot check
38	641610	6155358	spot check
39	644675	6150132	spot check
40	644434	6150529	spot check
41	645007	6150030	spot check
42	645558	6150890	spot check
43	645447	6149753	spot check
44	641726	6155990	spot check
45	645434	6153130	spot check
46	642020	6154106	spot check
47	647375	6152137	spot check
48	646878	6152150	spot check
49	646740	6152161	spot check
50	646015	6152118	spot check
51	648561	6152298	spot check

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

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

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

3 5 - < 20% cover

4 20 - < 50% cover

5 50 - < 75% cover

6 75 - 100% cover

Cover/abundance scores relate to general abundance over the entire site, not to representative quadrats.

*Introduced species are preceded by an asterisk.

"off site" refers to the woodland on the southern slope of site 7a, the potential offset area north of site 10, or the banks of Jugiong Creek outside the potential transmission crossing area.

A.2 COMPOSITE SPECIES LIST FOR THE SITE

SCIENTIFIC NAME	COMMON NAME	FAMILY	ABUNDANCE
TREES			
Acacia implexa	lightwood or hickory	Fabaceae	1
Allocasuarina verticillata	dryland drooping sheoak	Casuarinaceae	1
Brachychiton populneus	kurrajong	Sterculiaceae	1
Eucalyptus albens	white box	Myrtaceae	0-3
Eucalyptus blakelyi	Blakely's red gum	Myrtaceae	0-3
Eucalyptus bridgesiana	apple box	Myrtaceae	1 (off site)
Eucalyptus camaldulensis	river red gum	Myrtaceae	1
Eucalyptus goniocalyx	bundy, long-leaved box	Myrtaceae	0-3
Eucalyptus macrorhyncha	red stringybark	Myrtaceae	0-2
Eucalyptus melliodora	yellow box	Myrtaceae	0-3
Eucalyptus polyanthemos ssp *polyanthemos*	red box	Myrtaceae	0-2
SHRUBS, SUB-SHRUBS			
Acacia decora		Fabaceae	1
Amyema pendulum	a mistletoe	Loranthaceae	0-2
Callistemon ?sieberi	river bottlebrush	Myrtaceae	1
Dillwynia sericea		Fabaceae	1
Dodonaea viscosa ssp *angustissima*	hop bush	Sapindaceae	1
Hibbertia obtusifolia	guineaflower	Dilleniaceae	1
Melichrus urceolatus		Epacridaceae	1
Muellerina eucalyptoides	a mistletoe	Loranthaceae	1
Pultenaea foliolosa		Fabaceae	1

SCIENTIFIC NAME	COMMON NAME	FAMILY	ABUNDANCE
**Rosa rubiginosa*	briar rose, sweet briar	Rosaceae	1
**Rubus fruticosus* sp. agg.	blackberry	Rosaceae	1
FERNS			
Asplenium flabellifolium	necklace fern	Aspleniaceae	1
Cheilanthes austrotenuifolia		Sinopteridaceae	0-2
Cheilanthes distans	bristly cloak fern	Sinopteridaceae	0-2
Cheilanthes sieberi ssp *sieberi*	rock or mulga fern	Sinopteridaceae	0-2
Ophioglossum lusitanicum	adder's tongue	Ophioglossaceae	1
Pleurosorus rutifolius	blanket fern	Aspleniaceae	1
VINES AND TWINERS			
Convolvulus erubescens s. lat.	bindweed	Convolvulaceae	1
Glycine clandestina	twining glycine	Fabaceae	1
FORBS			
Acaena agnipila		Rosaceae	0-2
Acaena echinata		Rosaceae	1
**Acetosella vulgaris*	sheep sorrel	Polygonaceae	1-3
Ammobium craspedioides	Yass daisy	Asteraceae	0-2 (off site)
**Amsinckia calycina*	fiddleneck	Boraginaceae	1
**Anagallis arvensis*	scarlet pimpernel	Primulaceae	1
**Arctotheca calendula*	capeweed	Asteraceae	1-3
Arthopodium milleflorum	pale vanilla lily	Anthericaceae	1 (off site)
Asperula conferta	common woodruff	Rubiaceae	1
Brachyscome ciliaris		Asteraceae	1
Bulbine bulbosa	bulbine lily	Asphodelaceae	1
**Carduus tenuiflorus*	winged slender thistle	Asteraceae	1
**Carthamus lanatus*	saffron thistle	Asteraceae	0-4
**Centaurea* sp.	cockspur thistle	Asteraceae	1
**Cerastium* sp.	chickweed	Caryophyllaceae	1
Chamaesyce drummondii	caustic weed	Euphorbiaceae	1
**Cirsium vulgare*	black or spear thistle	Asteraceae	1
Cotula australis	carrot weed	Apiaceae	0-2
Craspedia variabilis		Asteraceae	1
Crassula decumbens		Crassulaceae	1
Crassula sieberiana	Australian stonecrop	Crassulaceae	0-2
**Crepis capillaris*	smooth hawk's beard	Asteraceae	1
Cymbonotus sp.	bear's ear	Asteraceae	1
Cynoglossum australe	hound's tongue	Boraginaceae	1

SCIENTIFIC NAME	COMMON NAME	FAMILY	ABUNDANCE
Daucus glochidiatus		Apiaceae	1 (off-site)
Desmodium varians	slender tick trefoil	Fabaceae	1
Dianella longifolia	blue flax lily	Phormiaceae	1
Dichondra repens	kidney weed	Convolvulaceae	1
Diuris chryseopsis	early snake orchid	Orchidaceae	0-2
Drosera peltata ssp *peltata*	sundew	Droseraceae	0-2
**Echium plantagineum*	Paterson's curse	Boraginaceae	0-4
Einadia nutans	berry saltbush	Chenopodiaceae	1
Epilobium billardierianum ssp *cinereum*	willow herb	Onagraceae	1
**Erodium brachycarpum*	heronsbill	Geraniaceae	0-2
**Erodium cicutarium*	common storksbill	Geraniaceae	0-2
Erodium crinitum	blue storksbill	Geraniaceae	1
**Erodium moschatum*	musky storksbill	Geraniaceae	0-2
Eryngium rostratum	blue devil	Apiaceae	1 (off site)
**Galium murale*	annual bedstraw	Rubiaceae	1
**Geranium molle*		Geraniaceae	0-2
Geranium solanderi var. *solanderi*		Geraniaceae	1
Glossodia major	waxlip orchid	Orchidaceae	1 (off site)
Gonocarpus tetragynus	raspwort	Haloragaceae	0-2
Haloragis heterophylla		Haloragaceae	1 (off site)
Hydrocotyle laxiflora	stinking pennywort	Apiaceae	1
Hypericum gramineum	native St Johns wort	Clusiaceae	1
**Hypochaeris glabra*		Asteraceae	0-2
**Hypochaeris radicata*	cat's ear, flatweed	Asteraceae	1-3
Hypoxis vaginata var. *brevistigmata*	yellow star	Hypoxidaceae	1
Hypoxis vaginata var. *vaginata*	yellow star	Hypoxidaceae	0-2
Isotoma axillaris	showy isotome	Lobeliaceae	1
**Lactuca serriola*	prickly lettuce	Asteraceae	1
Leptorhynchos squamatus ssp A	scaly buttons	Asteraceae	1
**Malva parviflora*	small-flowered mallow	Malvaceae	0-2
**Marrubium vulgare*	horehound	Lamiaceae	1
Microseris lanceolata	murnong, yam daisy	Asteraceae	1 (off site)
**Moenchia erecta*	erect chickweed	Caryophyllaceae	1
Montia fontana ssp *chondrosperma*		Portulacaceae	1
**Onopordum acanthium*	Scotch thistle	Asteraceae	0-4
Oreomyrrhis eriopoda	Australian carraway	Apiaceae	1 (off site)
**Orobanche minor*	broomrape	Scrophulariaceae	1

SCIENTIFIC NAME	COMMON NAME	FAMILY	ABUNDANCE
Oxalis ?perennans	oxalis	Oxalidaceae	0-2
*?*Papaver hybridum*	rough poppy	Papaveraceae	1
**Petrorhagia nanteuilii*	proliferous pink	Caryophyllaceae	1
Poranthera microphylla		Euphorbiaceae	1
Pterostylis curta	common greenhood	Orchidaceae	1 (off site)
Pterostylis nutans	nodding greenhood	Orchidaceae	1 (off site)
Ranunculus lappaceus	common buttercup	Ranunculaceae	1
Rumex brownii	native dock	Polygonaceae	1
**Rumex* sp.	dock	Polygonaceae	1
**Sanguisorba minor* ssp *muricata*	sheep's burnet	Rosaceae	1
Scleranthus biflorus	knawel	Caryophyllaceae	1
Scleranthus fasciculatus		Caryophyllaceae	1
Scutellaria humilis	soft skullcap	Lamiaceae	0-2
Senecio tenuiflorus		Asteraceae	1
**Silene gallica*	French catchfly	Caryophyllaceae	1
Solenogyne dominii		Asteraceae	0-2
**Sonchus asper*	prickly sow thistle	Asteraceae	1
Stackhousia monogyna	creamy candles	Stackhousiaceae	1 (off site)
**Stellaria media*	common chickweed	Caryophyllaceae	0-4
Stellaria pungens	prickly starwort	Caryophyllaceae	1
Stuartina ?muelleri		Asteraceae	1
**Taraxacum officinale*	dandelion	Asteraceae	1
Thysanotus patersonii	twining fringe-lily	Anthericaceae	1 (off site)
?Thysanotus/ Arthropodium sp.		Anthericaceae	0-2 (off site)
Tricoryne elatior	yellow rush-lily	Anthericaceae	1
**Trifolium arvense*	hare's foot clover	Fabaceae	1
**Trifolium subterraneum*	sub clover	Fabaceae	0-3
**Trifolium* sp.	clover	Fabaceae	0-4
Triptilodiscus pygmaeus		Asteraceae	1
**Urtica urens*	stinging nettle	Urticaceae	0-5
Veronica plebeia	common speedwell	Scrophulariaceae	1
Viola betonicifolia	narrow-leaved violet	Violaceae	1 (off site)
Wahlenbergia communis	tufted bluebell	Campanulaceae	1
Wahlenbergia stricta	tall bluebell	Campanulaceae	1
Wurmbea dioica	early nancy	Colchicaceae	0-2
Wurmbea latifolia	early nancy	Colchicaceae	0-2
GRASSES			

SCIENTIFIC NAME	COMMON NAME	FAMILY	ABUNDANCE
**Aira caryophyllea*	hair grass	Poaceae	1
**Anthoxanthum odoratum*	sweet vernal grass	Poaceae	1
Aristida ramosa var. *ramosa*		Poaceae	0-6
Austrodanthonia eriantha	wallaby grass	Poaceae	0-3
Austrodanthonia monticola	wallaby grass	Poaceae	1
Austrodanthonia racemosa var. *racemosa*	wallaby grass	Poaceae	1
Austrodanthonia spp.	wallaby grass	Poaceae	0-5
Austrostipa ?bigeniculata		Poaceae	1
Austrostipa ?densiflora		Poaceae	0-2
Austrostipa scabra ssp *falcata*	corkscrew grass	Poaceae	0-2
**Avena* sp.	wild oats	Poaceae	1
Bothriochloa macra	red-stem grass	Poaceae	0-3
**Briza maxima*	quaking grass	Poaceae	0-3
**Briza minor*	shivery grass	Poaceae	1
**Bromus racemosus*	soft brome	Poaceae	1
**Bromus sterilis*		Poaceae	0-3
Chloris truncata	windmill grass	Poaceae	1
Cymbopogon refractus	barbed wire grass	Poaceae	1
**Cynosurus echinatus*	dog's tail grass	Poaceae	0-2
Echinopogon ovatus	hedgehog grass	Poaceae	1
Elymus scaber	common wheat grass	Poaceae	0-2
Eragrostis sp.		Poaceae	1
**Hordeum leporinum*	barley grass	Poaceae	0-4
Joycea pallida	robust wallaby grass	Poaceae	1 (off site)
**Lolium perenne*	perennial ryegrass	Poaceae	0-4
Microlaena stipoides	weeping grass	Poaceae	0-4
**Nassella trichotoma*	serrated tussock	Poaceae	1?
Panicum effusum	hairy panic	Poaceae	0-2
**Poa annua*	winter grass	Poaceae	0-2
Poa sieberiana var. *sieberiana*		Poaceae	1 (off site)
Themeda australis	kangaroo grass	Poaceae	1
**Vulpia bromoides*	squirrel tail fescue	Poaceae	0-2
GRAMINOIDS			
Carex appressa	tall sedge	Cyperaceae	1
**Juncus acutus*	jointed rush	Juncaceae	1 (off site)
Juncus sp.		Juncaceae	1
Lomandra filiformis ssp *coriacea*		Lomandraceae	0-3

SCIENTIFIC NAME	COMMON NAME	FAMILY	ABUNDANCE
Lomandra filiformis ssp *filiformis*		Lomandraceae	1
Lomandra longifolia	spiny matrush	Lomandraceae	1
Luzula sp.		Juncaceae	0-2 (off site)

A.3 REPRESENTATIVE 20X20M QUADRATS

Exotic Pasture

Location: AGD 639650 6152700, elevation 570m. Site 4, saddle half way along this ridge.

Heavily grazed, 20% rock cover, very sparse Kurrajong (*Brachychiton populneus*) in vicinity.

SCIENTIFIC NAME	COMMON NAME	FAMILY	ABUNDANCE
FERNS			
Cheilanthes sieberi ssp *sieberi*	rock or mulga fern	Sinopteridaceae	1
FORBS			
**Acetosella vulgaris*	sheep sorrel	Polygonaceae	3
**Arctotheca calendula*	capeweed	Asteraceae	2
**Carthamus lanatus*	saffron thistle	Asteraceae	4
Crassula sieberiana	Australian stonecrop	Crassulaceae	1
Dichondra repens	kidney weed	Convolvulaceae	1
Einadia nutans	berry saltbush	Chenopodiaceae	1
**Erodium cicutarium*	common storksbill	Geraniaceae	2
**Erodium moschatum*	musky storksbill	Geraniaceae	1
**Geranium molle*		Geraniaceae	1
Hydrocotyle laxiflora	stinking pennywort	Apiaceae	1
**Hypochaeris radicata*	cat's ear, flatweed	Asteraceae	1
**Malva parviflora*	small-flowered mallow	Malvaceae	1
**Onopordum acanthium*	Scotch thistle	Asteraceae	1
Oxalis ?perennans	oxalis	Oxalidaceae	2
Rumex brownii	native dock	Polygonaceae	1
**Stellaria media*	common chickweed	Caryophyllaceae	1
**Trifolium subterraneum*	sub clover	Fabaceae	2
**Trifolium* sp.	clover	Fabaceae	4
GRASSES			
Austrodanthonia racemosa var. *racemosa*	wallaby grass	Poaceae	1
Austrostipa scabra ssp *falcata*	corkscrew grass	Poaceae	2

SCIENTIFIC NAME	COMMON NAME	FAMILY	ABUNDANCE
**Lolium perenne*	perennial ryegrass	Poaceae	4
Microlaena stipoides	weeping grass	Poaceae	3
**Poa annua*	winter grass	Poaceae	2

Native Pasture

Location: AGD 640534 6155672, elevation 650m. Site 6, ridge crest, northern end.

SCIENTIFIC NAME	COMMON NAME	FAMILY	ABUNDANCE
FERNS			
Cheilanthes sieberi ssp *sieberi*	rock or mulga fern	Sinopteridaceae	1
FORBS			
**Acetosella vulgaris*	sheep sorrel	Polygonaceae	1
**Arctotheca calendula*	capeweed	Asteraceae	2
**Carthamus lanatus*	saffron thistle	Asteraceae	1
**Cerastium* sp.	chickweed	Caryophyllaceae	1
Crassula sieberiana	Australian stonecrop	Crassulaceae	1
Dichondra repens	kidney weed	Convolvulaceae	2
**Echium plantagineum*	Paterson's curse	Boraginaceae	1
Einadia nutans	berry saltbush	Chenopodiaceae	1
**Erodium cicutarium*	common storksbill	Geraniaceae	3
**Erodium moschatum*	musky storksbill	Geraniaceae	1
**Hypochaeris radicata*	cat's ear, flatweed	Asteraceae	1
Oxalis ?perennans	oxalis	Oxalidaceae	2
Rumex brownii	native dock	Polygonaceae	2
Solenogyne dominii		Asteraceae	2
**Trifolium subterraneum*	sub clover	Fabaceae	2
**Trifolium* sp.	clover	Fabaceae	4
**Urtica urens*	stinging nettle	Urticaceae	1
GRASSES			
Austrodanthonia spp.	wallaby grass	Poaceae	4
Austrostipa scabra ssp *falcata*	corkscrew grass	Poaceae	2
?Bothriochloa macra	red-stem grass	Poaceae	1
Microlaena stipoides	weeping grass	Poaceae	3
**Poa annua*	winter grass	Poaceae	3

A.4 RANDOM MEANDER RESULTS

Woodland on Lower Slope

Location: AGD 637956 6152651, elevation 460m. Site 3, midslope, southern end.

Heavy grazing (sheep), rabbits, trees small with few or no hollows. Rock 5% cover.

SCIENTIFIC NAME	COMMON NAME	FAMILY	ABUNDANCE
TREES			
Eucalyptus albens	white box	Myrtaceae	1
Eucalyptus macrorhyncha	red stringybark	Myrtaceae	3
SHRUBS, SUB-SHRUBS			
**Rubus fruticosus*	blackberry	Rosaceae	1
FERNS			
Asplenium flabellifolium	necklace fern	Aspleniaceae	1
Cheilanthes austrotenuifolia		Sinopteridaceae	1
Cheilanthes sieberi ssp *sieberi*	rock or mulga fern	Sinopteridaceae	1
Pleurosorus rutifolius	blanket fern	Aspleniaceae	1
FORBS			
**Acetosella vulgaris*	sheep sorrel	Polygonaceae	1
**Arctotheca calendula*	capeweed	Asteraceae	2
**Carthamus lanatus*	saffron thistle	Asteraceae	1
?**Cerastium* sp.	chickweed	Caryophyllaceae	1
Cotula australis	carrot weed	Apiaceae	1
Crassula sieberiana	Australian stonecrop	Crassulaceae	1
Cymbonotus sp.	bear's ear	Asteraceae	1
**Erodium cicutarium*	common storksbill	Geraniaceae	1
**Geranium molle*		Geraniaceae	1
Geranium solanderi var. *solanderi*		Geraniaceae	2
Hydrocotyle laxiflora	stinking pennywort	Apiaceae	1
**Hypochaeris radicata*	cat's ear, flatweed	Asteraceae	2
Hypoxis vaginata var. *brevistigmata*	yellow star	Hypoxidaceae	1
**Marrubium vulgare*	horehound	Lamiaceae	1
Oxalis ?perennans	oxalis	Oxalidaceae	1
**Silybum marianum*	variegated thistle	Asteraceae	1
Solenogyne dominii		Asteraceae	1
**Stellaria media*	common chickweed	Caryophyllaceae	2
**Trifolium* sp.	clover	Fabaceae	2

GRASSES			
Austrodanthonia spp.	wallaby grass	Poaceae	2
Austrostipa ?densiflora		Poaceae	1
Austrostipa scabra ssp *falcata*	corkscrew grass	Poaceae	3
**Avena* sp.	wild oats	Poaceae	1
**Briza maxima*	quaking grass	Poaceae	1
Elymus scaber	common wheat grass	Poaceae	1
Eragrostis sp.		Poaceae	1
Microlaena stipoides	weeping grass	Poaceae	3
Panicum effusum	hairy panic	Poaceae	2

Woodland on Upper Slope

Location: AGD 638560 6156039, elevation 660m. Site 3, upper slope, northern end.

Heavy grazing (sheep), rabbits, trees mature and regrowth, 10-20cm DBH with few hollows. Rock 5% cover. Lower down slope tree canopy is just Long-leaved Box, Yellow Box (several) present in saddle 100m to south.

Most woodland remnants surveyed on crests/upper slopes are in similar condition to this example, or worse (e.g. *E. albens* 3, **Urtica urens* 5)

SCIENTIFIC NAME	COMMON NAME	FAMILY	ABUNDANCE
TREES			
Brachychiton populneus	kurrajong	Sterculiaceae	1
Eucalyptus albens	white box	Myrtaceae	3
Eucalyptus goniocalyx	bundy, long-leaved box	Myrtaceae	3
FERNS			
Cheilanthes austrotenuifolia		Sinopteridaceae	1
FORBS			
**Acetosella vulgaris*	sheep sorrel	Polygonaceae	1
**Amsinckia calycina*		Boraginaceae	1
**Arctotheca calendula*	capeweed	Asteraceae	2
**Carthamus lanatus*	saffron thistle	Asteraceae	1
**Cerastium* sp.	chickweed	Caryophyllaceae	1
**Echium plantagineum*	Paterson's curse	Boraginaceae	2
**Erodium brachycarpum*	heronsbill	Geraniaceae	1
**Erodium cicutarium*	common storksbill	Geraniaceae	2
**Erodium moschatum*	musky storksbill	Geraniaceae	2
**Geranium molle*		Geraniaceae	2
Geranium solanderi var. *solanderi*		Geraniaceae	1
**Hypochaeris radicata*	cat's ear, flatweed	Asteraceae	2

Oxalis ?perennans	oxalis	Oxalidaceae	1
Rumex brownii	native dock	Polygonaceae	1
**Rumex* sp.	dock	Polygonaceae	1
**Stellaria media*	common chickweed	Caryophyllaceae	2
**Trifolium subterraneum*	sub clover	Fabaceae	2
**Trifolium* sp.	clover	Fabaceae	2
**Urtica urens*	stinging nettle	Urticaceae	2
GRASSES			
Austrodanthonia spp.	wallaby grass	Poaceae	1
Austrostipa scabra ssp *falcata*	corkscrew grass	Poaceae	1
Bothriochloa macra	red-stem grass	Poaceae	1
**Cynosurus echinatus*	dog's tail grass	Poaceae	1
Elymus scaber	common wheat grass	Poaceae	1
Microlaena stipoides	weeping grass	Poaceae	4
Panicum effusum	hairy panic	Poaceae	1

Woodland on upper slope near saddle

Location: AGD 64914 6155146, elevation 700m, slope 10 º, aspect SSW. Saddle between sites 6 and 7a within transmission route envelope. Light grazing. Rock 5% cover.

SCIENTIFIC NAME	COMMON NAME	FAMILY	ABUNDANCE
TREES			
Eucalyptus goniocalyx	bundy, long-leaved box	Myrtaceae	3
Eucalyptus macrorhyncha	red stringybark	Myrtaceae	1
SHRUBS, SUB-SHRUBS			
Hibbertia obtusifolia	guineaflower	Dilleniaceae	1
FERNS			
Cheilanthes austrotenuifolia		Sinopteridaceae	1
Cheilanthes sieberi ssp *sieberi*	rock or mulga fern	Sinopteridaceae	0-2
VINES AND TWINERS			
Glycine clandestina	twining glycine	Fabaceae	1
FORBS			
Acaena agnipila		Rosaceae	2
Ammobium craspedioides	Yass daisy	Asteraceae	0-3
Arthopodium milleflorum	pale vanilla lily	Anthericaceae	1
Bulbine bulbosa	bulbine lily	Asphodelaceae	1
Cymbonotus sp.	bear's ear	Asteraceae	1
Daucus glochidiatus		Apiaceae	1

SCIENTIFIC NAME	COMMON NAME	FAMILY	ABUNDANCE
**Echium plantagineum*	Paterson's curse	Boraginaceae	1
Galium sp.		Rubiaceae	1
Hydrocotyle laxiflora	stinking pennywort	Apiaceae	2
Hypericum gramineum	native St Johns wort	Clusiaceae	1
**Hypochaeris glabra*		Asteraceae	1
**Hypochaeris radicata*	cat's ear, flatweed	Asteraceae	2
Oreomyrrhis eriopoda	Australian carraway	Apiaceae	1
**Orobanche minor*	broomrape	Scrophulariaceae	1
Oxalis ?perennans	oxalis	Oxalidaceae	2
**Petrorhagia nanteuilii*	proliferous pink	Caryophyllaceae	1
Poranthera microphylla		Euphorbiaceae	2
Rumex brownii	native dock	Polygonaceae	1
Scutellaria humilis	soft skullcap	Lamiaceae	2
Tricoryne elatior	yellow -lily	Anthericaceae	1
Triptilodiscus pygmaeus		Asteraceae	1
Wahlenbergia stricta	tall bluebell	Campanulaceae	2
Wurmbea sp.	early nancy	Colchicaceae	1
GRASSES			
**Anthoxanthum odoratum*	sweet vernal grass	Poaceae	0-2
Aristida ramosa	wiregrass	Poaceae	1
Austrodanthonia eriantha	wallaby grass	Poaceae	0-2
Austrodanthonia racemosa var. *racemosa*	wallaby grass	Poaceae	2-3
Austrostipa scabra ssp *falcata*	corkscrew grass	Poaceae	1
**Avena* sp.	wild oats	Poaceae	1
**Briza maxima*	quaking grass	Poaceae	0-2
**Briza minor*	shivery grass	Poaceae	0-2
**Bromus sterilis*		Poaceae	1
Elymus scaber	common wheat grass	Poaceae	2
Joycea pallida	robust wallaby grass	Poaceae	1
**Lolium perenne*	perennial ryegrass	Poaceae	1
Microlaena stipoides	weeping grass	Poaceae	0-2
Poa sieberiana var. *sieberiana*		Poaceae	1-3
GRAMINOIDS			
Juncus filicaulis		Juncaceae	1
Lomandra filiformis ssp *coriacea*		Lomandraceae	1
Lomandra filiformis ssp *filiformis*		Lomandraceae	1
Luzula sp.		Juncaceae	1

Open woodland on crest

Location: AGD 644146 6150715 and 500m to east, elevation 600-630m, slope 5-15º. Western third of site 10.

Heavy grazing (sheep and horse), trees all large and old at western end, to 1m DBH, all with multiple hollows. Rock 10% cover.

Groundcover is in better condition on the lower western, more sparsely treed, end of the site and deteriorates closer to the peaks, becoming much weedier. The large trees with hollows and proximity to a large tract of high quality vegetation on the flats to the north gives this vegetation conservation significance for fauna, but despite being box-gum woodland its botanical condition is poor-moderate.

SCIENTIFIC NAME	COMMON NAME	FAMILY	ABUNDANCE
TREES			
Brachychiton populneus	kurrajong	Sterculiaceae	1
Eucalyptus albens	white box	Myrtaceae	2
Eucalyptus blakelyi	Blakely's red gum	Myrtaceae	1-2
Eucalyptus goniocalyx	bundy, long-leaved box	Myrtaceae	1-2
Eucalyptus macrorhyncha	red stringybark	Myrtaceae	1
Eucalyptus melliodora	yellow box	Myrtaceae	1
Eucalyptus polyanthemos ssp *polyanthemos*	red box	Myrtaceae	1
FERNS			
Ophioglossum lusitanicum	adder's tongue	Ophioglossaceae	1
FORBS			
**Arctotheca calendula*	capeweed	Asteraceae	2
**Carthamus lanatus*	saffron thistle	Asteraceae	2
Crassula sieberiana	Australian stonecrop	Crassulaceae	1
**Echium plantagineum*	Paterson's curse	Boraginaceae	0-5
**Erodium* spp.	storksbill	Geraniaceae	3
**Hypochaeris radicata*	cat's ear, flatweed	Asteraceae	2
**Onopordum acanthium*	Scotch thistle	Asteraceae	1
Oxalis ?perennans	oxalis	Oxalidaceae	1
Rumex brownii	native dock	Polygonaceae	1
Solenogyne dominii		Asteraceae	1
**Stellaria media*	common chickweed	Caryophyllaceae	1
**Trifolium* spp.	clover	Fabaceae	3
**Urtica urens*	stinging nettle	Urticaceae	1
GRASSES			
Aristida ramosa var. *ramosa*		Poaceae	0-2
Austrodanthonia spp.	wallaby grass	Poaceae	0-5

Austrostipa scabra ssp *falcata*	corkscrew grass	Poaceae	0-3
Bothriochloa macra	red-stem grass	Poaceae	1
**Hordeum leporinum*	barley grass	Poaceae	2
Microlaena stipoides	weeping grass	Poaceae	0-2
**Poa annua*	winter grass	Poaceae	0-2

Regrowth woodland in saddle

Location: AGD 645170 6150012, elevation 570m, slope 5º. Saddle at centre of site 10.

Accessible to sheep and horses, but relatively lightly grazed despite that; trees all regrowth to 20cm DBH, with no hollows; some ringbarked older regrowth present. Rock 40% cover.

Groundcover is in better condition here than at any other elevated site surveyed, but becomes rapidly weedier on the knolls east and west of the saddle. This area could come under the *EPBC Act* definition of Box-Gum Woodland.

Scientific name	Common name	Family	Abundance
TREES			
Acacia implexa (dead)	lightwood or hickory	Fabaceae	1
Eucalyptus albens	white box	Myrtaceae	3
Eucalyptus blakelyi	Blakely's red gum	Myrtaceae	1
Eucalyptus macrorhyncha	red stringybark	Myrtaceae	3
Eucalyptus polyanthemos ssp *polyanthemos*	red box	Myrtaceae	1
SHRUBS, SUB-SHRUBS			
Hibbertia obtusifolia	guineaflower	Dilleniaceae	1
Melichrus urceolatus		Epacridaceae	1
**Rosa rubiginosa*	briar rose, sweet briar	Rosaceae	1
FERNS			
Cheilanthes austrotenuifolia		Sinopteridaceae	1
Cheilanthes sieberi ssp *sieberi*	rock or mulga fern	Sinopteridaceae	2
FORBS			
Acaena echinata		Rosaceae	1
Bulbine bulbosa	bulbine lily	Asphodelaceae	1
Crassula sieberiana	Australian stonecrop	Crassulaceae	1
Diuris chryseopsis	early snake orchid	Orchidaceae	1
Geranium solanderi var. *solanderi*		Geraniaceae	2
Hydrocotyle laxiflora	stinking pennywort	Apiaceae	3
**Hypochaeris radicata*	cat's ear, flatweed	Asteraceae	1
Oxalis ?perennans	oxalis	Oxalidaceae	2
**Petrorhagia nanteuilii*	proliferous pink	Caryophyllaceae	1

Scientific name	Common name	Family	Abundance
**Trifolium arvense*	hare's foot clover	Fabaceae	1
Wahlenbergia stricta	tall bluebell	Campanulaceae	1
Wurmbea dioica	early nancy	Colchicaceae	2
Wurmbea latifolia	early nancy	Colchicaceae	2
GRASSES			
Aristida ramosa var. *ramosa*		Poaceae	4
Austrostipa ?bigeniculata		Poaceae	1
Austrostipa ?densiflora		Poaceae	2
**Briza maxima*	quaking grass	Poaceae	2
Cymbopogon refractus	barbed wire grass	Poaceae	1
**Cynosurus echinatus*	dog's tail grass	Poaceae	1
Elymus scaber	common wheat grass	Poaceae	1
Themeda australis	kangaroo grass	Poaceae	2
GRAMINOIDS			
Lomandra filiformis ssp *coriacea*		Lomandraceae	3
Lomandra filiformis ssp *filiformis*		Lomandraceae	1

Regrowth woodland on crest

Location: AGD 645700 6149386 to 645876 6149290, elevation 570-600m, slope c. 5-20º. Wooded knoll at SE end of site 10.

Heavily grazed sheep camp; trees all regrowth 5-70cm DBH, with very few hollows. Rock 60% cover. Groundcover is more native than exotic, owing to the shallow rocky soils, but not very diverse.

Scientific name	Common name	Family	Abundance
TREES			
Acacia implexa	lightwood or hickory	Fabaceae	1
Brachychiton populneus	kurrajong	Sterculiaceae	1
Eucalyptus goniocalyx	bundy, long-leaved box	Myrtaceae	3
Exocarpos cupressiformis	native cherry	Santalaceae	1
SHRUBS, SUB-SHRUBS			
Hibbertia obtusifolia	guineaflower	Dilleniaceae	1
Melichrus urceolatus	urn heath	Epacridaceae	1
FERNS			
Cheilanthes austrotenuifolia		Sinopteridaceae	1
Cheilanthes distans	bristly cloak fern	Sinopteridaceae	1
Cheilanthes sieberi ssp *sieberi*	rock or mulga fern	Sinopteridaceae	1

Scientific name	Common name	Family	Abundance
FORBS			
Acaena echinata		Rosaceae	1
**Acetosella vulgaris*	sheep sorrel	Polygonaceae	1
**Arctotheca calendula*	capeweed	Asteraceae	2
**Carduus tenuiflorus*	winged slender thistle	Asteraceae	1
**Cirsium vulgare*	black or spear thistle	Asteraceae	1
Cotula australis	carrot weed	Apiaceae	1
Crassula sieberiana	Australian stonecrop	Crassulaceae	2
Desmodium varians	slender tick trefoil	Fabaceae	1
Einadia nutans	berry saltbush	Chenopodiaceae	1
**Erodium cicutarium*	common storksbill	Geraniaceae	2
**Geranium molle*		Geraniaceae	1
Hydrocotyle laxiflora	stinking pennywort	Apiaceae	1
**Hypochaeris glabra*		Asteraceae	2
Oxalis ?perennans	oxalis	Oxalidaceae	2
**Petrorhagia nanteuilii*	proliferous pink	Caryophyllaceae	1
Rumex brownii	native dock	Polygonaceae	1
Solenogyne dominii		Asteraceae	1
**Stellaria media*	common chickweed	Caryophyllaceae	1
**Trifolium subterraneum*	sub clover	Fabaceae	3
GRASSES			
Aristida ramosa var. *ramosa*		Poaceae	3
Austrodanthonia spp.	wallaby grass	Poaceae	3
Austrostipa scabra ssp *falcata*	corkscrew grass	Poaceae	1
Bothriochloa macra	red-stem grass	Poaceae	3
**Briza maxima*	quaking grass	Poaceae	1
Cymbopogon refractus	barbed wire grass	Poaceae	1
**Hordeum leporinum*	barley grass	Poaceae	2
Microlaena stipoides	weeping grass	Poaceae	3
Panicum effusum	hairy panic	Poaceae	1
GRAMINOIDS			
Lomandra filiformis ssp *coriacea*		Lomandraceae	3
Lomandra filiformis ssp *filiformis*		Lomandraceae	2

Woodland on north-facing upper slope

Location: AGD 645700 6153122, elevation 610m, slope 15º. Eastern end of site 7b.

Grazed by sheep; mature trees with no regrowth. Rock 5% cover.

Scientific name	Common name	Family	Abundance
TREES			
Brachychiton populneus	kurrajong	Sterculiaceae	0-3
Eucalyptus albens	white box	Myrtaceae	3
Eucalyptus melliodora	yellow box	Myrtaceae	0-3
FERNS			
Cheilanthes sieberi ssp *sieberi*	rock or mulga fern	Sinopteridaceae	1
FORBS			
**Carduus tenuiflorus*	winged slender thistle	Asteraceae	1
**Carthamus lanatus*	saffron thistle	Asteraceae	2
Crassula sieberiana	Australian stonecrop	Crassulaceae	1
Dichondra repens	kidney weed	Convolvulaceae	2
**Echium plantagineum*	Paterson's curse	Boraginaceae	0-2
**Geranium molle*		Geraniaceae	1
**Hypochaeris radicata*	cat's ear, flatweed	Asteraceae	1
**Onopordum acanthium*	Scotch thistle	Asteraceae	1
Oxalis ?perennans	oxalis	Oxalidaceae	2
**Petrorhagia nanteuilii*	proliferous pink	Caryophyllaceae	1
Rumex brownii	native dock	Polygonaceae	1
**Sonchus oleraceus*	sow thistle	Asteraceae	2
**Trifolium arvense*	hare's foot clover	Fabaceae	0-2
**Trifolium dubium*		Fabaceae	0-2
**Trifolium* sp.	clover	Fabaceae	0-2
GRASSES			
**Aira caryophyllea*	hair grass	Poaceae	1
Austrodanthonia racemosa var. *racemosa*	wallaby grass	Poaceae	0-3
Austrostipa scabra ssp *falcata*	corkscrew grass	Poaceae	0-2
**Avena* sp.	wild oats	Poaceae	3
**Briza maxima*	quaking grass	Poaceae	0-3
**Bromus racemosus*	soft brome	Poaceae	2
**Bromus sterilis*		Poaceae	0-3
**Cynosurus echinatus*	dog's tail grass	Poaceae	1
**Hordeum leporinum*	barley grass	Poaceae	1
Microlaena stipoides	weeping grass	Poaceae	0-4

A.5 COMPOSITE LISTS

More intact woodland on sheltered slope (two quadrats and one random meander)

Location: AGD 642279 6154581 and 642508 6154483, elevation 615/640m, slope 20-25º. Below site 7a, lower to midslope, central.

Occasional grazing (sheep), rabbits, trees mostly regrowth, occasionally to 60cm DBH, few hollows. Rock 5-15% cover.

Remnant vegetation on steep slopes generally appeared to be in relatively good condition with the main weeds being annuals (**Briza* spp, **Stellaria media*). Grazing pressure appears light. The upper edge of such remnants is more heavily grazed and weedier.

SCIENTIFIC NAME	COMMON NAME	FAMILY	ABUNDANCE
TREES			
Acacia implexa	lightwood or hickory	Fabaceae	1
Eucalyptus goniocalyx	bundy, long-leaved box	Myrtaceae	3
Eucalyptus macrorhyncha	red stringybark	Myrtaceae	1
Eucalyptus melliodora	yellow box	Myrtaceae	1/3
SHRUBS, SUB-SHRUBS			
Amyema pendulum	mistletoe	Loranthaceae	1
Hibbertia obtusifolia	guineaflower	Dilleniaceae	1
**Rosa rubiginosa*	briar rose, sweet briar	Rosaceae	1
FERNS			
Asplenium flabellifolium	necklace fern	Aspleniaceae	1
Cheilanthes austrotenuifolia		Sinopteridaceae	1
Cheilanthes sieberi ssp *sieberi*	rock or mulga fern	Sinopteridaceae	1
VINES AND TWINERS			
Glycine clandestina	twining glycine	Fabaceae	1
FORBS			
Acaena echinata		Rosaceae	2
**Acetosella vulgaris*	sheep sorrel	Polygonaceae	1
Ammobium craspedioides	Yass daisy	Asteraceae	0/2
**Anagallis arvensis*	scarlet pimpernel	Primulaceae	1
**Arctotheca calendula*	capeweed	Asteraceae	1
Arthopodium milleflorum	pale vanilla lily	Anthericaceae	2
Bulbine bulbosa	bulbine lily	Asphodelaceae	1
**Carduus tenuiflorus*	winged slender thistle	Asteraceae	1
**Centaurea* sp.	cockspur thistle	Asteraceae	1
**Cerastium* sp.	chickweed	Caryophyllaceae	1
**Cirsium vulgare*	black or spear thistle	Asteraceae	1
Crassula sieberiana	Australian stonecrop	Crassulaceae	1
Cymbonotus sp.	bear's ear	Asteraceae	2

SCIENTIFIC NAME	COMMON NAME	FAMILY	ABUNDANCE
Daucus glochidiatus		Apiaceae	1
Drosera peltata ssp *peltata*	sundew	Droseraceae	0/2
Epilobium billardierianum ssp *cinereum*	willow herb	Onagraceae	1
Geranium solanderi var. *solanderi*		Geraniaceae	1/2
Gonocarpus tetragynus	raspwort	Haloragaceae	1/2
Hydrocotyle laxiflora	stinking pennywort	Apiaceae	2
Hypericum gramineum	native St Johns wort	Clusiaceae	1
**Hypochaeris radicata*	cat's ear, flatweed	Asteraceae	2
Hypoxis vaginata	yellow stars	Hypoxidaceae	0/1
Leptorhynchos squamatus ssp A	scaly buttons	Asteraceae	0/1
Oreomyrrhis eriopoda	Australian carraway	Apiaceae	0/2
Oxalis ?perennans	oxalis	Oxalidaceae	1
Poranthera microphylla		Euphorbiaceae	0/2
Pterostylis curta	common greenhood	Orchidaceae	1
Pterostylis nutans	nodding greenhood	Orchidaceae	0/1
Ranunculus lappaceus		Ranunculaceae	1
Rumex brownii	native dock	Polygonaceae	1
Senecio tenuiflorus		Asteraceae	1
Solenogyne dominii		Asteraceae	1
**Sonchus oleraceus*	sow thistle	Asteraceae	1
**Stellaria media*	common chickweed	Caryophyllaceae	1/3
**Taraxacum officinale*	dandelion	Asteraceae	1
**Trifolium* sp.	clover	Fabaceae	1
Veronica plebeia	common speedwell	Scrophulariaceae	2
Viola betonicifolia	narrow-leaved violet	Violaceae	0/2
Wahlenbergia stricta	tall bluebell	Campanulaceae	2
Wurmbea dioica	early nancy	Colchicaceae	1
Wurmbea latifolia	early nancy	Colchicaceae	1
GRASSES			
Aristida ramosa var. *ramosa*		Poaceae	1/2
Austrodanthonia spp.	wallaby grass	Poaceae	2/4
Bothriochloa macra	red-stem grass	Poaceae	1
**Briza maxima*	quaking grass	Poaceae	1/3
**Cynosurus echinatus*	dog's tail grass	Poaceae	1/2
Echinopogon ovatus	forest hedgehog grass	Poaceae	1
Elymus scaber	common wheat grass	Poaceae	2/3
Microlaena stipoides	weeping grass	Poaceae	1/3

SCIENTIFIC NAME	COMMON NAME	FAMILY	ABUNDANCE
Panicum effusum	hairy panic	Poaceae	1
?Poa sieberiana var. *sieberiana*		Poaceae	1
GRAMINOIDS			
Lomandra filiformis ssp *coriacea*		Lomandraceae	1/2
Lomandra filiformis ssp *filiformis*		Lomandraceae	1
Luzula sp.		Juncaceae	1/2

Woodland on flat and mid-slopes (off-site, possible offset area, provided for comparison with more degraded ridge top sites) (two random meanders)

Location: AGD 645482 6150020 to 644246 6151295, elevation 570-500m, slope 0-10º. From 300m east of saddle at centre of site 10 down slope through large woodland remnant to gate at its western end.

Lightly grazed by sheep; trees mostly regrowth to 50cm DBH with occasional large trees to 1m DBH, occasional small hollows. Rock 0-5% cover.

Very little shrub layer (though more than anywhere else in the vicinity). Groundcover is in quite good condition and includes Yass Daisy and several geophytes. This area would definitely come under the *EPBC Act* definition of Box-Gum Woodland.

Scientific name	Common name	Family	Abundance
TREES			
Acacia implexa	lightwood or hickory	Fabaceae	1
Eucalyptus albens	white box	Myrtaceae	0-3
Eucalyptus blakelyi	Blakely's red gum	Myrtaceae	1-3
Eucalyptus bridgesiana	apple box	Myrtaceae	1
Eucalyptus goniocalyx	bundy, long-leaved box	Myrtaceae	1
Eucalyptus macrorhyncha	red stringybark	Myrtaceae	1
Eucalyptus melliodora	yellow box	Myrtaceae	0-3
Eucalyptus polyanthemos ssp *polyanthemos*	red box	Myrtaceae	0-3
SHRUBS, SUB-SHRUBS			
Acacia decora		Fabaceae	1
Amyema pendulum	a mistletoe	Loranthaceae	1
Dillwynia sericea		Fabaceae	1
Hibbertia obtusifolia	guineaflower	Dilleniaceae	1
Melichrus urceolatus		Epacridaceae	0-2
Pultenaea foliolosa		Fabaceae	1
FERNS			
Cheilanthes austrotenuifolia		Sinopteridaceae	1

Scientific name	Common name	Family	Abundance
Cheilanthes sieberi ssp *sieberi*	rock or mulga fern	Sinopteridaceae	2
VINES AND TWINERS			
Glycine clandestina	twining glycine	Fabaceae	1
FORBS			
Acaena echinata		Rosaceae	1-2
**Acetosella vulgaris*	sheep sorrel	Polygonaceae	1
Ammobium craspedioides	Yass daisy	Asteraceae	0-3
**Cirsium vulgare*	black or spear thistle	Asteraceae	1
Cotula australis	carrot weed	Apiaceae	1
Crassula sieberiana	Australian stonecrop	Crassulaceae	0-2
Cymbonotus sp.	bear's ear	Asteraceae	1
Daucus glochidiatus		Apiaceae	1
Dianella longifolia	blue flax lily	Phormiaceae	1
Dichondra repens	kidney weed	Convolvulaceae	1
Diuris chryseopsis	early snake orchid	Orchidaceae	0-2
Drosera peltata ssp *peltata*	sundew	Droseraceae	0-2
**Echium plantagineum*	Paterson's curse	Boraginaceae	1
**Erodium brachycarpum*	heronsbill	Geraniaceae	1
Eryngium rostratum	blue devil	Apiaceae	1
Geranium solanderi var. *solanderi*		Geraniaceae	0-2
Glossodia major		Orchidaceae	1
Gonocarpus tetragynus	raspwort	Haloragaceae	1
Haloragis heterophylla		Haloragaceae	1
Hydrocotyle laxiflora	stinking pennywort	Apiaceae	2
Hypericum gramineum	native St Johns wort	Clusiaceae	1
**Hypochaeris glabra*		Asteraceae	2
**Hypochaeris radicata*	cat's ear, flatweed	Asteraceae	2
Hypoxis vaginata	yellow star	Hypoxidaceae	2
**Lactuca serriola*	prickly lettuce	Asteraceae	1
Microseris lanceolata	murnong, yam daisy	Asteraceae	1
Oxalis ?perennans	oxalis	Oxalidaceae	2
Ranunculus lappaceus	common buttercup	Ranunculaceae	1
Rumex brownii	native dock	Polygonaceae	1
Senecio tenuiflorus		Asteraceae	1
Solenogyne dominii		Asteraceae	1
Thysanotus patersonii	twining fringe-lily	Anthericaceae	1
?Thysanotus sp./ *Arthropodium* sp.		Anthericaceae	0-2

Scientific name	Common name	Family	Abundance
**Trifolium arvense*	hare's foot clover	Fabaceae	1
Veronica plebeia	common speedwell	Scrophulariaceae	1
Viola betonicifolia	narrow-leaved violet	Violaceae	1
Wahlenbergia ?communis	tufted bluebell	Campanulaceae	1
Wurmbea dioica	early nancy	Colchicaceae	1
Wurmbea latifolia	early nancy	Colchicaceae	1
GRASSES			
Aristida ramosa var. *ramosa*		Poaceae	2-3
Austrodanthonia spp.	wallaby grass	Poaceae	2
Austrostipa scabra ssp *falcata*	corkscrew grass	Poaceae	2
Bothriochloa macra	red-stem grass	Poaceae	1-3
**Briza maxima*	quaking grass	Poaceae	1-4
**Briza minor*	shivery grass	Poaceae	1
Cymbopogon refractus	barbed wire grass	Poaceae	1
**Cynosurus echinatus*	dog's tail grass	Poaceae	2
Elymus scaber	common wheat grass	Poaceae	2
Microlaena stipoides	weeping grass	Poaceae	1-4
Panicum effusum	hairy panic	Poaceae	1
Poa ?labillardierei	river tussock	Poaceae	1
Poa ?sieberiana var. *sieberiana*		Poaceae	2
Themeda australis	kangaroo grass	Poaceae	0-2
GRAMINOIDS			
Carex appressa	tall sedge	Cyperaceae	0-2
Juncus sp.		Juncaceae	1
Lomandra filiformis ssp *coriacea*		Lomandraceae	1-3
Lomandra longifolia	spiny matrush	Lomandraceae	0-2

A.6 YASS DAISY (*Ammobium craspedioides*) RECORDS

Site	Easting	Northing
6-7a saddle (transmission route)	641914	6155146
6-7a saddle (transmission route)	641932	6155173
6-7a saddle (transmission route)	641735	6154976
6-7a saddle (transmission route)	641785	6154984
7a lower slope (off site)	642279	6154581
7a lower slope (off site)	642395	6154327
Potential offset area N of 10 (off site)	645190	6150964
Potential offset area N of 10 (off site)	644226	6151037

Appendix B **FAUNA SURVEY RESULTS**

B.1 FAUNA SURVEY EFFORT

E: Elaanor Stlenberg

A: Amy Currey

X_PROJ	Y_PROJ	Survey_type	EFFORT	Surveyor
BIRDS				
643496.83	6149694.96	bird	40	E & A
644702.47	6150193.62	bird	25	E & A
645431.29	6150333.65	bird	120	E & A
643420.71	6151550.32	bird	40	E & A
638435.55	6151724.88	bird	40	E & A
636724.83	6151937.90	bird	40	E & A
639866.93	6152336.33	bird	10	E & A
640923.25	6152385.03	bird	20	E & A
638009.41	6152671.00	bird	40	E & A
639544.80	6152733.39	bird	10	E & A
644336.09	6153384.12	bird	60	E & A
634086.48	6153498.27	bird	20	E & A
644363.14	6153503.90	bird	40	E & A
642076.39	6153734.53	bird	45	E & A
642152.72	6154201.12	bird	20	E & A
642016.76	6155200.35	bird	40	E & A
642144.00	6155353.71	bird	40	E & A
640864.87	6155376.29	bird	60	E & A
641588.42	6155458.39	bird	40	E & A
638755.40	6155535.00	bird	40	E & A
641945.73	6155689.96	bird	25	E & A
640109.76	6156023.14	bird	40	E & A
638316.24	6156135.98	bird	20	E & A
638355.37	6156211.59	bird	90	E & A
639389.26	6159730.09	bird	90	E & A
TRAPPING				
645431.29	6150333.65	ground elliot transect 1	10	E & A
645431.29	6150333.65	ground elliot transect 2	10	E & A
645431.29	6150333.65	Cage trap transect 1	5	E & A
641807.00	6155028.00	tree elliot	1	E & A
641773.00	6155084.00	tree elliot	1	E & A
641957.00	6155384.00	tree elliot	1	E & A
641983.00	6155286.00	tree elliot	1	E & A

641976.00	6155148.00	tree elliot	1	E & A
642016.76	6155200.35	ground elliot transect 3	10	E & A
642016.76	6155200.35	ground elliot transect 4	15	E & A
642016.00	6155200.00	Cage trap transect 2	5	E & A
640864.87	6155376.29	ground elliot transect 5	5	E & A
REPTILES				
634002.67	6153748.42	reptile search	20	E & A
637747.44	6153088.31	reptile search	10	E & A
638010.41	6152672.00	reptile search	20	E & A
638009.41	6152671.00	reptile search	40	E & A
638059.36	6157210.09	reptile search	20	E & A
638355.37	6156211.59	reptile search	20	E & A
638356.37	6156212.59	reptile search	15	E & A
638564.23	6156233.84	reptile search	20	E & A
639589.75	6152628.50	reptile search	40	E & A
639836.97	6152396.26	reptile search	30	E & A
640335.47	6157574.00	reptile search	20	E & A
640336.47	6157574.00	reptile search	20	E & A
640788.27	6155469.04	reptile search	40	E & A
640864.90	6152266.74	reptile search	60	E & A
641588.42	6155458.39	reptile search	40	E & A
642076.39	6153734.53	reptile search	45	E & A
642144.00	6155353.71	reptile search	40	E & A
642146.00	6155353.71	reptile search	20	E & A
642771.12	6153549.12	reptile search	20	E & A
643420.71	6151550.32	reptile search	30	E & A
643493.72	6149621.95	reptile search	10	E & A
644336.09	6153384.12	reptile search	40	E & A
644893.46	6150060.68	reptile search	20	E & A
645598.74	6150346.73	reptile search	10	E & A
HABITAT ASSESSMENT				
639389.26	6159730.09	aquatic	90	E & A
636724.83	6151937.90	aquatic	30	E & A
638435.55	6151724.88	aquatic	30	E & A
643496.83	6149694.96	aquatic	30	E & A
643039.49	6149533.90	aquatic	30	E & A
642153.32	6154141.28	aquatic	90	E & A
640748.58	6152403.88	aquatic	60	E & A
633949	6153507	habitat	point	E & A

636666	6154931	habitat	point	E & A
639655	6152653	habitat	point	E & A
639908	6159188	habitat	point	E & A
640565	6155697	habitat	point	E & A
640869	6155385	habitat	point	E & A
641662	6154167	habitat	point	E & A
641727	6155989	habitat	point	E & A
641748	6155016	habitat	point	E & A
641876	6155165	habitat	point	E & A
642070	6155437	habitat	point	E & A
642222	6155043	habitat	point	E & A
642274	6154629	habitat	point	E & A
642275	6153643	habitat	point	E & A
642295	6154551	habitat	point	E & A
642296	6154425	habitat	point	E & A
642318	6153999	habitat	point	E & A
642881	6152935	habitat	point	E & A
643297	6152328	habitat	point	E & A
644098	6153460	habitat	point	E & A
644168	6150706	habitat	point	E & A
644206	6153963	habitat	point	E & A
644455	6150544	habitat	point	E & A
644591	6151032	habitat	point	E & A
645700	6153122	habitat	point	E & A
642070	6155434	habitat	point	E & A
642020	6154106	habitat	point	BH
647375	6152137	habitat	point	BH
646878	6152150	habitat	point	BH
646740	6152161	habitat	point	BH
646015	6152118	habitat	point	BH
648561	6152298	habitat	point	BH
OPPORTUNISTIC				
643906	6151967	Incidental	point	J. Miles
643100	6149500	Incidental	point	J. Miles
644146	6150715	Incidental	point	J. Miles
645330	6149940	Incidental	point	J. Miles
642508	6154483	Incidental	point	J. Miles
644591	6151032	Incidental	point	J. Wellington

643336	6152317	Incidental	point	J. Miles
645305	6150200	Incidental	point	J. Miles
639650	6152669	Incidental	point	J. Miles
634200	6151750	Incidental	point	J. Miles
635720	6148900	Incidental	point	J. Miles
641531	6153932	Incidental	point	P. McPherson
641400	6153800	Incidental	point	P. McPherson
640168	6156570	Incidental	point	J. Miles
640534	6155672	Incidental	point	J. Miles
642070	6155434	Incidental	point	J. Miles
644096	6154073	Incidental	point	J. Miles
643400	6149600	Incidental	point	J. Miles
639200	6159800	Incidental	point	J. Miles
642227	6155038	Incidental	point	P. McPherson
NOCTURAL SURVEY				
643910.90529919	6148343.32502358	nocturnal	point	E & A
643301.62453757	6149334.78038422	nocturnal	point	E & A
639389.26242906	6159730.09252078	nocturnal	point	E & A
642153.32096534	6154141.27591236	nocturnal	point	E & A

B.2 FAUNA SPECIES LIST

SCIENTIFIC NAME	SPECIES	NUMBER	OBS. TYPE
BIRDS			
Falco longipennis	Australian Hobby		o
Alisterus scapularis	Australian King Parrot		O
Gymnorhina tibicen	Australian Magpie	multiple	h
Corvus coronoides	Australian Raven		o
Chenonetta jubata	Australian Wood Duck		o
Tyto alba	Barn Owl (probable)	1	o
Coracina novaehollandiae	Black-faced Cuckoo-shrike		h
Falco berigora	Brown Falcon		o
Acanthiza pusila	Brown Thornbill		o
Acanthiza reguloides	Buff-rumped Thornbill		o
Acrocephalus stentoreus	Clamorous Reed Warbler	1	o
Accipter cirrhocephalus	Collared Sparrow-hawk		o
Turdus merula	Common Blackbird		o
Sturnus vulgaris	Common Starling	multiple	o
Ocyphaps lophotes	Crested Pigeon	2	o
Platycercus elegans	Crimson Rosella		h
Stagonopleura guttata	Diamond Firetail	6	o
Tauniopygia guttata	Double-barred Finch	2	o
Artamus cyanopterus	Dusky Woodswallow		o
Platycercus eximius	Eastern Rosella		o
Fulica atra	Eurasian Coot		o
Cacomantis castaneiventris	Fantail Cuckoo	multiple	h
Petroica rodinogaster	Flame Robin		h
Cacatua rosicapilla	Galah		o
Rhipidura fuliginosa	Grey Fantail		o
Anas platyrhynchos	Grey Teal		o
Aythya australis	Hardhead		o
Poliocephalus poliocephalis	Hoary-headed Grebe		o
Passer montanus	House Sparrow		
Microeca fascinans	Jacky Winter		o
Dacelo novaeguineae	Laughing Kookaburra		h
Myiagra rubecula	Leaden Flycatcher		o
Cacatua sanguinea	Little Corella		o
Philemon citreogularis	Little Friarbird		h
Vanellus miles	Masked Laping		o
Falco cenchroides	Nankeen Kestrel	1	o
Philemon corniculatus	Noisy Friarbird		o
Cuculus pallidus	Pallid Cuckoo		o
Anas superciliosa	Pacific Black Duck		
Geopelia placida	Peaceful Dove	1	h
Cracticus nigrogularis	Pied Butcherbird		

SCIENTIFIC NAME	SPECIES	NUMBER	OBS. TYPE
Strepera graculina	Pied Currawong		O
Merops ornatus	Rainbow Bee-eater		o
Anthochaera carunculata	Red Wattlebird		h
Neochmia temporalis	Red-browed Finch	10	o
Petroica goodenovii	Red-capped Robin		h
Psephotus haaematonotus	Red-rumped Parrot		o
Anthus novaeseelandiae	Richard's Pipit		o
Pachycephala rufiventris	Rufous Whistler		h
Myiagra cyanoleuca	Satin Flycatcher		
Myzomela sanguinolenta	Scarlet Honeyeater		h
Zosterops lateralis	Silvereye	multiple	o
Ninox novaeseelandiae	Southern Boobook		
Pardalotus punctatus	Spotted Pardalote		h
Pardalotus striatus	Striated Pardalote		h
Acanthiza lineata	Striated Thornbill		h
Coturnix pectoralis	Stubble Quail		
Cacatua galerita	Sulphur-crested Cockatoo	1	o
Polytelis swainsonii	Superb Parrot	10	o
Malurus cyaneus	Superb-blue Fairy Wren	multiple	o
Podargus strigoides	Tawny Frogmouth		o
Hirundo nigricans	Tree Martin		o
Daphoenositta chrysoptera	Varied Sitella		o
Malurus lamberti	Variegated Fairywren		
Aquila audax	Wedge-tailed eagle	1	o
Smicrornis brevirostris	Weebill		o
Hirundo neoxena	Welcome Swallow		o
Epthianura albifrons	White-fronted Chat		
Sericornis frontalis	White-browed Scrubwren		o
Ardea novaehollandiae	White-faced Heron		
Lichenostomus penicillatus	White-plumed Honeyeater	multiple	o
Gerygone olivacea	White-throated Gerygone		h
Cormobates leucophaeus	White-throated Treecreeper		o
Corcorax melanorhamphos	White-winged Chough		o
Rhipidura leucophrys	Willie Wagtail		o
Acanthiza nana	Yellow Thornbill		h
Acanthiza chrysorrhoa	Yellow-rumped Thornbill		h
AMPHIBIANS			
Plains Froglet	Crinia parinsignifera	multiple	h
Brown Froglet	Crinia signifera	multiple	h
Banjo Frog	Limnodynastes dumerilii	multiple	h
Spotted Marsh Frog	Limnodynastes tasmaniensus	multiple	h
MAMMALS			
Bos taurus	Cow*		o
Trichosurus vulpecula	Common Brustail Possum	6	o
Pseudocheirus peregrinus	Common Ringtail Possum		o

SCIENTIFIC NAME	SPECIES	NUMBER	OBS. TYPE
Vombatus ursinus	Common Wombat		sc
Macropus giganteus	Eastern Grey Kangaroo	mob	o
Macropus robustus	Euro	mob with Eastern Greys	o
Oryctolagus cuniculus	European Rabbit		o
Chalinolobus gouldii	Gould's Wattled Bat		a
Mormopterus sp. 4	Freetail Bat spp.		a
Nyctophilus spp	*Nyctophilus spp*		a
Lepus europeaus	European Hare *		o
Vulpes vulpes	Red Fox*	1	h
Macropus rufogriseus	Red-necked Wallaby	2	o
Ovis aries	Sheep*		o
Wallabia bicolor	Swamp Wallaby		o
Scotorepens balstoni	Western Broad-nosed Bat		a
Tadarida australis	White-striped Freetail bat		
REPTILES			
Pogona barbata	Common Bearded Dragon		o
Ctenotus taeniolatus	Coppertail Skink		o
Egernia cunninghami	Cunningham's Skink	2	o
Pseudonaja textilis	Eastern Brown Snake		o
Delma inornata	Legless Lizard		o
Pseudechis porphyriacus	Red-bellied Black Snake		O
Chelodina longicollis	Snake-necked Turtle		o
Tiliqua rugosa	Shingleback lizard		o

Appendix C **EPBC ACT ERT REPORT**

Appendix D **THREATENED AND MIGRATORY SPECIES EVALUATION**

An evaluation of threatened species known from the area from both the Environmental Reporting Tool (EPBC Act) and DECC Wildlife Atlas database (TSC Act) determined that several species have potential to occur at the subject site based on the ecology of the species such as habitat requirements and their recorded distribution. The following definitions are used in this evaluation.

Assessment methodology

Presence of Habitat:	
Present:	Potential or known foraging, roosting, nesting, refuge, movement corridor (including movement of genetic material) or other habitat is present within the study area
Absent:	No potential foraging, roosting, nesting or other habitat is present within the study area
Likelihood of Occurrence	
None:	Species has a very low, or no, probability of occurrence
Vagrant:	Species could occur on occasion as a vagrant or passing over/across the study area (usually applies to more mobile species)
Possible:	Species could occur and utilise resources in the study area
Present:	Species was recorded during the field investigations
Possible Impact	
No:	The proposal would not impact this species or its habitats. No Seven-Part Test is necessary for this species.
Yes:	The proposal could impact this species or its habitats. A Seven-Part Test for NSW threatened species or an EPBC Assessment of Significance for Commonwealth Migratory of Threatened Species has been applied to these entities.

D.1 THREATENED FLORA HABITAT EVALUATIONS

An evaluation of the presence of habitat, nearest records, likelihood of occurrence and potential impact to threatened species recorded within and predicted to occur from the Murrumbateman, Upper Slopes and Bondo CMA subregions (from the Murrumbidgee region) on the NSW DECC threatened species website, and from the Commonwealth DEWHA Environmental Reporting Tool for within a 50km radius of the study area (centre point 34° 44' 42.51" S, 148° 33' 36.16" E, 24/09/2008). Marine and littoral species have been excluded from this analysis due to the absence of suitable habitat.

SPECIES	ECOLOGY	PRESENCE OF HABITAT	NEAREST RECORDS	LIKELIHOOD OF OCCURRENCE	POSSIBLE IMPACT?
FERNS					
Austral Pillwort *Pilularia novae-hollandiae* E TSC	In NSW, this species has been recorded from suburban Sydney, Khancoban and the Riverina between Albury and Urana in shallow swamps and waterways, often among grasses and sedges. It is most often recorded in drying mud as this is when it is most conspicuous. Most of the records in the Albury-Urana area were from table drains on the sides of roads. An ACT record is from a subalpine grassy plain.	Absent	Predicted Upper Slopes sub-catchment. Not recorded from the locality	None, no wetlands on the site	No
FORBS					
Yass Daisy *Ammobium craspedioides* V TSC V EPBC	This species is found on the Southern Tablelands and South West Slopes near Wagga Wagga and Yass, most often in dry sclerophyll forest, Box-Gum Woodland and grasslands derived from clearing of these communities (DECC 2008b).	Present	Recorded approximately 10km east of the site.	Recorded in two locations close to the site (on adjacent lower slopes below site 7a and saddle between sites 6 and 7a) and off-site north of site 10.	Yes. 7 part test completed.
Woolly Ragwort *Senecio garlandii* V TSC V EPBC	This species is found mostly on the south-west slopes, with the largest populations at The Rock and Mt Tabletop near Wagga Wagga. It occurs on sheltered slopes of rocky outcrops (DECC 2008b).	Present	This species has been recorded in the region, near Lake Burrinjuck.	Very low due to heavy grazing pressure on rocky areas. Could occur on some very steep and rocky sideslopes (for example, site 3) , which were not searched and would be outside the impact zones.	No

Austral Toadflax *Thesium australe* V TSC V EPBC	This species is found in small populations across eastern NSW, along the coast and from the Northern to Southern Tablelands. It occurs in grassland or grassy woodland (DECC 2008b), often in damp sites, and is closely associated with Kangaroo Grass (*Themeda australis*), on which it is a partial root-parasite.	Absent	No records from the region (all south from the ACT)	None, almost no kangaroo grass on the site, heavy grazing pressure in most areas.	No
Silky Swainson-pea *Swainsona sericea* V TSC	This species has been recorded from the Northern Tablelands to the Southern Tablelands and further inland on the slopes and plains, but its stronghold is on the Monaro. It is found in Natural Temperate Grassland and Snow Gum (*Eucalyptus pauciflora*) Woodland on the Monaro and in Box-Gum Woodland in the Southern Tablelands and South West Slopes.	Marginal within site	No records for the region. Closest from Tumut and Queanbeyan	Very low due to heavy grazing pressure over most of the site.	No
Small Scurf-pea *Cullen parvum* E-TSC E-EPBC	A perennial forb to 30cm high, recorded mainly from grassland or forest on the plains of the Murrumbidgee and Murray Rivers (Harden, 2002). This species was recently located in remnant box-gum woodland at Galong (FOG, 2006). In Victoria, where it is more common, it grows in grassland, woodland and grazing country in the 450-700mm rainfall belt (DECC, 2008b). Plants may die back in summer and resprout after rain. There had been good rainfall at the time of the survey.	Marginal within site	Not predicted, but possible, as nearest record is only c. 25km N of the site	Very low due to heavy grazing pressure over most of the site. Almost no native peas were recorded anywhere on the site	No
Hoary Sunray *Leucochrysum albicans* ssp *albicans var. tricolor* E EPBC	This species may be locally common on the Southern Tablelands, and is therefore not listed as threatened in NSW. It grows in natural and secondary grasslands and grassy woodlands, often colonising disturbed sites such as road verges. It does not appear to persist well in heavily grazed situations (J. Miles, pres. obs.) although bare ground is clearly important for recruitment (Gilfedder and Kirkpatrick, 1994).	Present	Road verges west of Goulburn (J. Miles, pers. obs.)	Very low due to heavy grazing pressure over most of the site.	No

ORCHIDS					
Pine Donkey Orchid *Diuris tricolor* (Syn. *D. sheaffiana*) V TSC V EPBC	Sporadically distributed from Narrandera across the western slopes to northern NSW, usually in grassy *Callitris* woodland on sandy soils in flat country or on top of small hills. There is a 1906 record from the Goulburn area. Flowering period is Sept-Nov (Bishop 1996).	Marginal within site	Not recorded in the Yass area, but there are records from further west in the Upper Slopes sub-catchment.	Very low due to heavy grazing pressure and lack of Cypress Pine communities and sandy soils. Soils at the site are clay-loam and the usual range of this species is well to the west. The survey was within the flowering period.	No
Tarengo Leek Orchid *Prasophyllum petilum* E TSC E EPBC	Known from three sites on the Southern Tablelands, at Boorowa and Captain's Flat in NSW and Hall in the ACT, growing in Natural Temperate Grassland, Box-Gum Woodland or moist grassy flats, with kangaroo grass or wallaby grasses (*Austrodanthonia spp*). The Captains Flat population occurs in an area with a high watertable. Flowering period is Oct-Nov(Bishop 1996)., with 22 October recorded as a time when this species was flowering profusely at Booroowa (FOG, 2006).	Marginal	Recorded in the region, at Boorowa.	This species is known only from ungrazed or lightly grazed remnants of high native species diversity, a habitat not occurring within the turbine clusters. The survey timing was too early to detect this species.	No
Burrinjuck Spider Orchid *Caladenia* aff. *concolor* (Burrinjuck) Not currently listed but would satisfy criteria for listing as Endangered.	The Crimson Spider Orchid, *Caladenia concolor* is confined to granite ridge country in the Nail Can Hill Crown Reserve near Albury, and two localities in Victoria (DECC 2008b). It is listed as Endangered under TSC and EPBC Acts. There is a similar undescribed species from near Cootamundra (*Caladenia* sp. Bethungra) and another undescribed species (Burrinjuck Spider Orchid) occurs in Burrinjuck Nature Reserve and Burrinjuck Waters State Park, and possibly in other locations on private property nearby. It grows in dry open forest or tall open forest dominated by *E. goniocalyx, E. dives, E. mannifera, E. macrorhyncha* or *E. rossii* (NSW NPWS 2002). Neither of the undescribed species are currently listed as threatened, but they appear to be similarly restricted in distribution to *C. concolor*, and may face some similar threats (e.g. collection by orchid enthusiasts). Flowering period is late August to October.	Marginal	Burrinjuck Dam area	Low due to heavy grazing pressure over most of the sites. Survey was conducted during the flowering period and the Burrinjuck Spider Orchid was not detected, though it is unlikely to flower reliably every year, or could flower later than the survey period (16-21 Sept).	Yes, if present. 7 part test completed.

SHRUBS					
Cotoneaster Pomaderris *Pomaderris cotoneaster* E TSC	This shrub grows in riparian and rocky areas, the latter often close to creeks. It is known from the Tumut area (Goobarragandra River), and Bungonia Gorge (J. Miles, pers. obs.), but not from near Yass.	Absent	Goobaragandra River	None, sites are remote from drainage lines.	No
Wee Jasper Grevillea *Grevillea iaspicula* E TSC E EPBC	This species is found only in the Wee Jasper area and on the shores of Lake Burrinjuck. It grows only on rocky outcrops, cave entrances and cliff bases in limestone country (DECC 2008b).	Absent	Near Lake Burrinjuck.	None, there is no limestone on the sites	No
Tumut Grevillea *Grevillea wilkinsonii* E TSC	The Tumut Grevillea is found in two areas: one is a 4.5 km stretch of the Goobarragandra River, approximately 18 km south-east of Tumut; the other at a small site near Gundagai. Habitat is in dense riparian shrubland on steep rocky slopes or on alluvial terraces with sparse tree cover. Typical associated tree species are *E. blakelyi, E. macrorhyncha, E. bridgesiana* and *E. melliodora*	Absent	Near Gundagai	None, sites are remote from drainage lines and heavy grazing pressure has removed virtually all shrubs.	No
ECOLOGICAL COMMUNITIES					
Aquatic ecological community in the natural drainage system of the lower Murray River catchment EC TSC	This community refers largely to fauna (fish and invertebrates) rather than flora. The Lower Murray aquatic ecological community includes all native fish and aquatic invertebrates, within all natural creeks, rivers, lagoons, billabongs and lakes of the regulated portions of the Murray, Murrumbidgee and Tumut Rivers, as well as all their tributaries and branches. The portion of the Murrumbidgee River below Burrinjuck Dam is included. The listing of this community as an EEC gives all aquatic fauna within it the status of endangered species (NSW DPI, 2007).	Absent except for one transmission route	Present in the Upper Slopes sub-catchment of Murrumbidgee CMA	The sites are remote from major drainage lines, except for a transmission easement crossing of Jugiong Creek, which drains into the Murrumbidgee River below Burrinjuck Dam.	No

Aquatic ecological community in the natural drainage system of the lowland catchment of the Lachlan River EC TSC	This community refers largely to fauna (fish and invertebrates) rather than flora. The Lowland Catchment of the Lachlan River is part of the Murray-Darling Basin. The area covered includes all natural rivers, creeks, streams and associated lagoons, billabongs, lakes, wetlands, paleochannels, floodrunners, effluent streams (those that flow away from the river) and the floodplains of the Lachlan River within the State of NSW, and including Lake Brewster, Lake Cargelligo and Lake Cowal. Excluded are man-made canals, off-stream reservoirs, water distribution and drainage works, and farm dams. The Coppabella Hills are part of the watershed between the Lachlan and Murrumbidgee catchments, and so are at the extreme upper end of the Lachlan catchment.	Absent	Present in the Upper Slopes sub-catchment of Lachlan CMA	The sites are remote from major drainage lines on this catchment.	No
Inland Grey Box Woodland in the Riverina; NSW South Western Slopes; Cobar Peneplain; Nandewar and Brigalow Belt South Bioregions **EC TSC**	A grassy woodland dominated by Grey Box (*Eucalyptus microcarpa*) which may intergrade with White Box-Yellow Box-Blakely's Red Gum Grassy Woodland, generally occurring further west on the NSW western slopes and plains and on alluvial soils and in flatter parts of the landscape.	Absent	Known from Upper Slopes sub-catchment	None. Sites are all on ridge crests, not alluvial flats. The characteristic dominant tree species is not present.	No
Natural Temperate Grassland of the Southern Tablelands of NSW and the ACT **EC EPBC**	Natural Temperate Grassland is a naturally treeless or sparsely treed community, characterised by the dominance of native grasses including kangaroo grass (*Themeda australis*), poa tussock (*Poa sieberiana*), river tussock (*P. labillardieri*), spear grasses (*Austrostipa spp*) and wallaby grasses (*Austrodanthonia spp*). A high diversity of forbs is typical of better quality remnants (DECC 2008b).	Absent	Unknown, but likely to be present in the region	Low. Treeless sites appear to be derived from clearing of woodlands	No
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland **EC TSC** **CEEC EPBC**	This is a grassy woodland community, with White Box (*Eucalyptus albens*), Yellow Box (*E. melliodora*), and Blakely's Red Gum (*E. blakelyi*). Some sites may contain additional tree species, shrubs are generally sparse, and the groundcover contains numerous grasses and forbs. (DECC 2008b).	Present	Remnants common in the Yass area	Present on the site, generally in poor condition within the impact zones, though better quality remnants occur nearby.	Yes, TSC and EPBC tests of significance

D.2 THREATENED FAUNA HABITAT EVALUATIONS

Due to the additional collision and impact risk posed on fauna, a preliminary impact assessment was conducted to help identify those species most at risk from the proposal. Fauna species with a preliminary impact factor (PIF) of more than 4 have been assessed for their potential to be significantly impacted by the proposal and have been assessed for significance of impact. Two additional species (White-bellied Sea-eagle and Little Whip Snake) have been included based on impact types and potential to occur.

Species and status*	Ecology	Presence of habitat	Nearest records	Likelihood of occurrence	Potential to be impacted?	PIF
AMPHIBIANS						
Green and Golden Bell Frog *Litoria aurea* *E TSC* V EPBC	Formerly, this species had a wide distribution across most of NSW, although since 1990 recorded populations have become largely restricted to small, coastal or near coastal populations. This species has been recorded in a wide variety of natural and man-made waterbodies such as coastal swamps, marshes, lagoons, permanent farm dams and other excavations capable of capturing water (DEC NSW, 2005c). Habitats are generally permanent, still or slow-flowing, unpolluted waterbodies with a complexity of vegetation structure and abundance of refuge sites, although without heavy shading (DEC NSW 2005)	Marginal. Farm dams are accessible to stock, with little or no aquatic or fringing vegetation, and generally eroded	Has not been recorded within 20km of the site	Unlikely	Yes, farm dams near the turbines would be filled to prevent attracting birds and bats to the site, this would have impacts on amphibian species present on the site	**4**
Booroolong Frog *Litoria booroolongensis* E TSC E EPBC (Likely)	This species occurs predominately along the western-flowing streams of Great Dividing Range. It occurs in permanent rocky streams with fringing vegetation cover such as ferns, sedges or grasses (DECC, 2008b). Adults shelter under rocks adjacent to streams and lay their eggs under small in-stream rocks and rocky margins (Regan 2002). The majority of records are from the Tumut area.	Absent	This species has been recorded in the region, near Burrinjuck Dam.	None	No	**2**
Yellow-spotted Bell Frog *Litoria castanea* E TSC E EPBC	This species has not been recorded in the wild since the 1970s (DECC, 2008b). It occurs in highland habitats and has only two known populations, in the New England Tableland and on the southern highland ranges from Lake George to Bombala. It occurs between 1000 and 1500 AHD in permanent ponds, wetlands and slowly moving streams with abundant emergent bulrushes and other vegetation (NPWS	Absent	Has not been recorded in the region	No	No	**0**

Species and status*	Ecology	Presence of habitat	Nearest records	Likelihood of occurrence	Potential to be impacted?	PIF
	2001).					
Southern Bell Frog *Litoria raniformis* *E TSC* V EPBC	Formally this species was distributed along the Murray and Murrumbidgee Rivers and their tributaries; however its current distribution is limited to isolated populations in the Coleambally Irrigations area, the Lowbidgee floodplain and around Lake Victoria (DECC 2008b). This species is found in permanent swamps or billabongs along floodplains and river valleys.	Absent	Has not been recorded in the region	None	No	**0**
AVES						
Speckled Warbler *Pyrrholaemus saggitatus* V TSC	This species occurs in a wide range of eucalypt woodland communities in the hills and tablelands of the Great Dividing range. Habitats typically are structurally diverse with a grassy understorey, a sparse shrub layer and an open canopy (DECC 2008b; Watson *et al.* 2001). Declines have been linked to habitat fragmentation as the species appears to be locally extinct in districts where no habitat fragments larger than 100ha remain (Watson *et al.* 2001). Further, larger remnants (about 300ha) may be required for populations to be viable (Gardner 2002a). The species is sedentary and nests and forages on the ground. Nests are built directly on the ground amongst leaf litter and understorey vegetation and are vulnerable to predation by large birds such as Currawongs (Gardner 2002b).	Present, however woodland remnants are fragmented – largest remnant is approximately 150 ha on flat north of the development envelope	Recorded at Marilba Hills This species has been recorded in the region, in the Mundoonen Nature Reserve.	Possible	Yes, grassy woodland habitat is present within the development envelope and has been recorded from the region	**6**
Square-tailed Kite *Lophoictinia isura* V TSC	This species has a large and sparsely populated range throughout mainland Australia (Griffioen and Clarke 2002) and is a breeding migrant to the south east from July to December. It occurs primarily in coastal and sub-coastal open forest, woodlands and mallee. It has been recorded inland along timbered watercourses and adjacent areas (NPWS 1999e). The species hunts small passerines, especially honeyeaters in the tree canopy. Resident pairs have large hunting ranges of greater than 100 km² (DECC 2008b). Nests are a platform of sticks up to 90cm in diameter in a fork of a tall tree in forest or woodland (DEC NSW 2004).	Present	This species has been recorded in the region, in the Mundoonen Nature Reserve.	Possible	Yes, this species may be impacted by removal of woodland habitat and blade-strike	**8**
Blue Billed Duck	This species is widespread in NSW although is most common	Not present,	This species has	Vagrant	Yes, habitat is not	**5**

Species and status*	Ecology	Presence of habitat	Nearest records	Likelihood of occurrence	Potential to be impacted?	PIF
Oxyura australis V TSC	in the southern Murray-Darling Basin area. During spring and summer birds travel up to 300km from non-breeding areas on the Murray River system and coastal lakes to breed in deep swamps of inland NSW (NPWS 1999b). They are often seen in coastal areas in summer and during drought (DECC 2008b). Feeding occurs in permanent freshwater wetlands and swamps with deep water and dense aquatic vegetation. Nesting occurs in Cumbungi over deep water or in dense wetland vegetation.	however species may fly between Burrunjuck lake inland to breed	been recorded in the region near the Murrumbidgee River, Bundarbo, approx. 20km south west of the site.		present, however the species has been recorded in the region and may be at risk of blade-strike	
Freckled Duck *Stictonetta naevosa* V TSC	This species occurs on wetlands of inland NSW. Large temporary swamps created by floods in the Bulloo and Lake Eyre basins and the Murray-Darling system, particularly along the Paroo and Lachlan Rivers, and other rivers within the Riverina are a breeding stronghold (DECC 2008b). The species is partially migratory and may move to coastal habitats during severe inland drought. The species inhabits a variety of plankton-rich wetland types, including swamps, lakes farm dams, sewerage ponds and floodwaters that are heavily vegetated with Cumbungi, Lignum, Canegrass or Tea-tree (DECC 2008b).	Absent, however may move across the site to Burrunjuck during drier periods	Has been recorded from Lake George (approx. 80km east of the site)	Vagrant	No, although there is potential for blade strike, the species has not been recorded in the region and is unlikely to pass over the site.	**3**
Australasian Bittern *Botaurus poiciloptilus V TSC*	This species is widespread although uncommon over south-eastern Australia (DECC, 2008). It favours permanent shallow freshwater or brackish wetlands and swamps with dense vegetation including rushes (particularly bulrushes Typha spp.), sedges and reeds (Garnett and Crowley 2000; NPWS 1999a). This species are mainly sedentary although sightings are occasionally irruptive (suddenly occurring in great numbers) after heavy rains.	Absent	Known from Lake George	Unlikely	No, habitat is not present and the species has not been recorded from the locality. Local movements would be more likely restricted to wet habitat corridors and wetlands which occur adjacent to the site.	**3**
Bush Stone-curlew *Burhinus grallarius* E TSC	This species has a broad distribution although has suffered severe declines throughout its range, particularly in disturbed and fragmented areas and where foxes are common (DEC NSW 2006a). In NSW, it is not found on the escarpments but on lower elevation grassy woodlands of the coast or west of	Present, however no records from region	Not recorded from the region. Records are from the coast or Wagga Wagga	Unlikely	No, this species is sedentary and has not been recorded from the locality. Therefore it is unlikely to be	**4**

Species and status*	Ecology	Presence of habitat	Nearest records	Likelihood of occurrence	Potential to be impacted?	PIF
	the divide. The area bounded roughly by Albury, Wagga Wagga, Hay and Wentworth is regarded as the stronghold for the species in NSW (DEC NSW 2006a). This species inhabits open forests and grassy woodlands where it builds nests directly on the ground (DECC 2008b). It requires logs, fallen trees and branches, course litter and some shrubs for shelter. Foraging may occur over a wide area within woodlands, paddocks, grasslands, residential gardens and saltmarsh (DEC NSW 2006a). Breeding pairs are generally sedentary within home ranges estimated to be 250-600ha for foraging year round, with a core of 10-25ha during breeding. It is very vulnerable to predation by exotic predators, the clearing of native woodlands, habitat degradation and even trampling by stock.				impacted by the proposal	
Gang-gang Cockatoo *Callocephalon fimbriatum* V TSC	In NSW, this species is distributed from the south-east coast to the Hunter region, and inland to the Central Tablelands and south-west slopes. It occurs regularly in the ACT. It feeds in pairs or small flocks on seeds of eucalypts and wattles, and occurs primarily in heavily timbered and mature wet forest, but occasionally in towns, farming areas (DECC 2008b). It is often a seasonal altitudinal migrant, moving to lower altitudes and more open forests and woodlands (particularly Box-Ironbark assemblages for winter. This species requires large hollows in which to breed (Gibbons and Lindenmayer 2000)	Present, however habitat is open	This species has been recorded in the region, south of Binalong, approximately 9km east of the site.	Unlikely/vagrant	Yes. Breeding (hollow-bearing trees) and foraging habitat is present within the development envelope (Cluster 10, 7 and 3). Potential for collision with turbine blades also apply.	**7**
Brown Treecreeper (eastern subspecies) *Climacteris picumnus Victoriae* V TSC	The species occurs in eucalypt woodlands, mallee and drier open forest on inland slopes and plains of the Great Dividing Range (DECC 2008b). Populations have declined over much of their range, particularly in fragments smaller than 300 hectares that have been isolated or fragmented for more than 50 years (Barrett *et al.* 1994; DECC 2008b). Declines in NSW have been attributed primarily to habitat fragmentation which limits dispersal and recruitment (Cooper and Walters 2002; Walters *et al.* 1999). The species occurs in eucalypt woodlands dominated by stringybarks or other rough-barked eucalypts with an open canopy and sparse understorey and shrub layer (DECC 2008b). It is sedentary and gregarious and	Present, however woodland habitats on the site are highly fragmented	This species has been recorded in the region near the Murrumbidgee River, Bundarbo; west of the Burrinjuck Dam.	Possible	Yes, Although continuous woodland habitat is not present within the development envelope, some collision impacts may apply	**5**

Species and status*	Ecology	Presence of habitat	Nearest records	Likelihood of occurrence	Potential to be impacted?	PIF
	nests in tree hollows. It forages for insects on tree trunks and on the ground amongst fallen timber and leaf litter.					
Diamond Firetail *Stagonopleura guttata* V TSC	This species is widely distributed in NSW, occurring predominantly west of the Great Dividing Range, although populations are known from drier coastal areas near Sydney, the Hunter Valley and the Bega Valley. Habitat is grassy eucalypt woodlands, including Box-Gum and Snow Gum assemblages (DECC 2008b). The species may also occur in open grassy forest, mallee, Natural Temperate Grassland, secondary grassland and lightly wooded farmland. The species is gregarious and primarily sedentary. It forages on the ground for grass seeds and other plant material and nests in shrubby understorey and will nest in mistletoe (Cooney and Watson 2005; DECC 2008b).	Present	This species was observed by **ngh**environmental at Marilba Hills, approximately 7km from the site in 2008. This species has been recorded in the region north of Yass.	Present	Yes, grassy woodland habitat is present within the development envelope and has been recorded from the region	**7**
Brolga *Grus rubicunda* *E TSC*	This species was formally found across Australia, except for the south-east corner. It inhibits large open wetlands, grassy plains, coastal mudflats and irrigated croplands. Breeding and foraging habitat includes shallow (< 50 cm) wetlands, mudflats and margins of deeper waterbodies with emergent vegetation (e.g. canegrass, lignum or sedges) (DECC 2008b).	Absent	Has not been recorded from the region, records are clustered inland from Wagga Wagga and Forbes	None	No	**3**
Painted Honeyeater *Grantiella picta* V TSC	This species primarily occurs on the inland slopes of the Great Dividing Range, although is nomadic and may occur in low densities in other parts of NSW in suitable habitat. It inhabits dry open forests and woodland including Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark open forests, also paperbark and casuarinas (DECC 2008b; Pizzey *et al.* 2003). It is a specialist feeder on mistletoe, particularly of genus *Amyema*, and generally requires 5 or more mistletoes per hectare (DECC 2008b). Seasonal migrant, movements are linked to the fruiting of mistletoe.	Marginal, Mistletoe is present however only in low densities	Closest records are from Cootamundra and north of Young, approximately 50km west of the site.	Vagrant	Yes, mistletoe feed resources are present within the development envelope, however in low densities. Migratory/nomadic. Potential for collision impacts.	**5**
Black-chinned Honeyeater (Eastern Subspecies) *Melithreptus gularis gularis*	This species is widespread west of the Great Dividing Range, although has declined throughout its range due to removal and fragmentation of habitat. It inhabits the upper levels of drier open forests or woodlands most often dominated by box and ironbark eucalypts, particularly Mugga Ironbark, White Box, Grey Box, Yellow Box and Forest Red Gum (DECC	Present, however marginal as woodland highly fragmented on the site	This species has been recorded in the region near Harden-Murrumburrah approximately	Vagrant	No, although woodland habitat is present, this habitat has been fragmented and disturbed, which reduces the likelihood	**4**

Species and status*	Ecology	Presence of habitat	Nearest records	Likelihood of occurrence	Potential to be impacted?	PIF
V TSC	2008b). A gregarious species usually seen in pairs and small groups of up to 12 birds and occupies large home ranges of at least 5 hectares. Local populations appear not to persist in remnants less than 200 ha in area (NSW Scientific Committee 2001).		30km west of the site (1992) Frogmore (60km north) and Goulburn.		of this species occurring on the site.	
Regent Honeyeater *Xanthomyza Phrygia* E TSC E EPBC M EPBC	This species was formally widely distributed across NSW, although has since greatly declined in numbers and range extension due to land clearing. There are now only a small number of known breeding sites in NSW, the most important of which are: Warrumbungles NP, Pilliga NR, Barraba district, central coast around Gosford, Hunter Valley, and Capertee Valley (NPWS 1999d). Most records are from box-ironbark eucalypt associations and it appears to prefer wetter fertile sites within these associations (Menkhorst *et al.* 1999). It is a generalist forager, which mainly feeds on the nectar from a wide range of eucalypts and mistletoes. Key eucalypt species include Mugga Ironbark, Yellow Box, Yellow Gum, Blakely's Red Gum and White Box (Menkhorst *et al.* 1999). It also occurs in riparian forests of River She-oak and wet lowland coastal forests dominated by Swamp Mahogony and Spotted Gum and (DECC 2008b; NPWS 1999d). The species can undertake large-scale nomadic movements in the order of hundreds of kilometres.	Foraging (feed trees) habitat present	This species has been recorded in the region, south of Binalong, approximately 9km east of the site.	Possible	Yes, species is nomadic; potential for collision impacts. Feed tree species are present within and adjacent to the site	**7**
Gilbert's Whistler *Pachycephala inornata* V TSC	This species is sparsely distributed over much of the arid and semi-arid zone of inland southern Australia, west of the western slopes of NSW (DECC 2008b). There are only three separate populations left in NSW. Most of the eastern population occurs in an area enclosed by a line joining Gilgandra to Cobar, then south to Narrandera, east to Wagga Wagga, north to Wellington and back to Gilgandra. In NSW the species occurs mostly in mallee shrubland in association with Spinifex and low shrubs. It also occurs in box-ironbark woodlands, Cypress Pine and Belah woodlands and River Red Gum forests. In woodland habitats, the species requires a dense shrubby understorey (DECC 2008b).	Absent	-	None	No	**1**
Hooded Robin	This species is sparsely distributed throughout much of NSW,	Present	This species has	Possible	Yes, habitat is present	**6**

Species and status*	Ecology	Presence of habitat	Nearest records	Likelihood of occurrence	Potential to be impacted?	PIF
(South eastern form) *Melanodryas cucullata cucullata* V TSC	and is rarely found on the coast. It is sedentary and occurs in open eucalypt woodland and scrub, often in or near cleared areas (DECC 2008b). The species generally occurs in woodland remnants with high habitat complexity (Watson *et al.* 2001) and uses stumps, posts or fallen timber for nesting and locating prey on the ground. Territories range from 10 to 30ha (DECC 2008b).		been recorded in the region, near Blakney Creek.		within the development envelope and has been recorded from the region	
Grey-crowned Babbler (Eastern Subspecies) *Pomatostomus temporalis temporalis* V TSC	This species. In NSW this species occurs west of the Great Dividing Range and on the coast near the Hunter Valley and several locations on the north coast of NSW. It prefers Box-Gum Woodlands although also inhabits open forests, scrub lands, even farmlands and suburbs (DECC 2008b; Pizzey *et al.* 2003). The species is gregarious and forage on the ground on invertebrates on tree trunks and branches and by foraging amongst litter and tussocks. Territories of family groups range from one to fifty hectares (DECC 2008b).	Present	This species has been recorded from Boorowa (2000; approx 45km north of the site). Most records are west of the line between Cowra and Albury.	Unlikely, given the lack of records from the region	No, species has not been recorded from the region, no potential for collision	**4**
Swift Parrot *Lathamus discolour* E TSC E EPBC (species or habitat may occur) Marine overfly (may)	This species breeds in Tasmania, migrating to south and eastern NSW in autumn/winter where it inhabits eucalypt forests and woodlands, particularly Box-Ironbark Forests of central Victoria and southern NSW (DECC 2008b; Smales 2005). Mostly occurs on the south-west slopes. It feeds on nectar flowers of eucalypts and lerp-insects, also soft fruits and berries sometimes foraging in grass (Pizzey and Knight 2003). Favoured feed trees include winter flowering species such as Swamp Mahogany, Spotted Gum, Red Bloodwood, Mugga Ironbark, and White Box (DECC 2008b).	Present, foraging only	This species has been recorded near McMahons Reef (1997, within 10km of the site)	Possible	Yes, foraging habitat is present within the development envelope, potential collision risks are also present refer to (Smales, 2005)	**7**
Turquoise Parrot *Neophema pulchella* V TSC	In NSW, this species is typically recorded west of the escarpment in the tablelands and on the western slopes, extending to the coastal districts through the Hunter Valley (NPWS 1999f). It occurs in grassy woodland and open forest carrying a mixed assemblage of White Box, Yellow Box, Blakely's Red Gum, Red Box and Red Stringybark (NPWS 1999f). The species will also utilise the edges of woodland, timbered ridges and creeks in farmland and nests in tree	Present	Records are west of the line between Cowra and Albury (40km west of the site).	Possible, although records are from west of the dividing range	Yes, although the species has not been recorded locally, woodland habitat is present within the development envelope, collisions risks may also apply	**6**

Species and status*	Ecology	Presence of habitat	Nearest records	Likelihood of occurrence	Potential to be impacted?	PIF
	hollows, logs or posts (DECC 2008b). The species lives in pairs or small groups and forages on the ground.					
Superb Parrot *Polytelis swainsonii* V TSC V EPBC (Breeding likely to occur)	This species is found throughout eastern inland NSW. On the South-western slopes the core breeding area is roughly bounded by Cowra and Yass in the east, and Grenfell, Cootamundra and Coolac in the west (DECC 2008b). It inhabits Box-Gum, Box-Cypress-pine and Boree Woodlands and River Red Gum Forest. The species nests in the hollows of large trees (dead or alive) in open Box-Gum Woodland or isolated paddock trees. Species known to be for used for nesting are Blakely's Red Gum, Yellow Box, Apple Box and Red Box (DECC 2008b). It forages on the ground in grassy woodland, also on fruit, seeds and blossoms of acacias, eucalypts and mistletoes (Pizzey and Knight, 2003).	Present	Observed onsite in remnant grassy woodland and road side trees. A flock of 10 Superb Parrots were observed onsite during the surveys.	Present	Yes. The species was recorded on the site within habitat that occurs within the development envelope, collision risks also apply	**8**
Barking Owl *Ninox connivens* V TSC	This species is found throughout Australia except for the central arid regions and Tasmania. It has declined across much of its range across NSW and is most frequently recorded on the western slopes and plains (DECC 2008b). It occurs in dry box-dominated forest and woodlands and roosts in dense foliage of *Acacia, Casuarina* or *Eucalyptus* species. It nests in large hollows (20-46 cm diameter) of large, old eucalypts including River Red Gum, White Box, Red Box and Blakely's Red Gum (DECC 2008b; NPWS 2003a). Nest and roost sites are usually near watercourses or wetlands (NPWS 2003a). The species have also been recorded in remnants of forest and woodland and in clumps of trees at farms, towns and golf courses (NPWS 2003a). Have large territories of 30 to more than 200 hectares (DECC 2008b; NPWS 2003a).	Present	This species has been recorded in the region near Jugiong Reservoir and the Burrinjuck Nature Reserve.	Possible	Yes, woodland habitat and hollow-bearing trees and present within the development envelope, collision risks may also apply, particularly for nocturnal fliers	**7**
Powerful Owl *Ninox strenua* V TSC	This species occurs primarily in tall, moist productive eucalypt forests of the eastern tableland edge and the mosaic of wet and dry sclerophyll forests occurring on undulating, gentle terrain nearer the coast (DEC NSW 2006b). Only scattered, mainly historical records are from the western slopes and plains (DECC 2008b). The species requires old hollow eucalypts in unlogged, unburnt forests for nesting, and roosts in dense mid-canopy trees or tall shrubs (She-oaks, wattles or	Absent	This species has been recorded in the region, near Burrinjuck Dam. And Burrinjuck Nature Reserve.	Unlikely	No	**3**

Species and status*	Ecology	Presence of habitat	Nearest records	Likelihood of occurrence	Potential to be impacted?	PIF
	rainforest species). Nesting and roosting habitat occurs in sheltered gullies, or within 100m of streams, creekflats or minor drainage lines (DEC NSW 2006b). Hollows greater than 45 cm diameter and greater than 100 cm deep are required. Breeding pairs of this species defend large (300-1500hectare), permanent territories. Optimal habitat includes a tall shrub layer with abundant hollows and supporting high densities of arboreal marsupials (DEC NSW 2006b).					
Painted Snipe or Australian Painted Snipe *Rostratula benghalensis* E TSC V EPBC M EPBC CAMBA Marine overfly (may)	In NSW, this species has been recorded at the Paroo wetlands, Lake Cowell, Macquarie Marshes and Hexham Swamp. It is most common in the Murray-Darling Basin (DECC 2008b). It inhabits inland and coastal ephemeral and permanent freshwater wetlands, especially where there is a cover of vegetation. It has been recorded on the margins of wetlands, dams and even sewage ponds, also found in wet pastures, marshy areas, irrigation systems, tea tree scrub and adjacent open woodlands (Pizzey and Knight 2003). The species is likely to be nomadic in response to suitable conditions, such as floods (NPWS 1999c).	Absent	This species has not been recorded in the region. Canberra (1964)	Unlikely/vagrant	No, habitat is not present and the species has not been recorded from the locality. Local movements would be more likely restricted to wet habitat corridors and wetlands which occur adjacent to the site.	**2**
White-bellied Sea-Eagle *Haliaeetus leucogaster* M EPBC CAMBA Listed (likely)	This species is resident from India through southeast Asia to Australia. It occurs around coastal areas, islands and estuaries, but is also found in inland areas where there are from large rivers, wetlands and reservoirs (Pizzey and Knight 2003). This species is known from the area and is thought to use terrestrial as well as riparian corridors to access inland areas (R. Falconer pers. comm. Dec 6 2005).	Absent	This species has been recorded along the Murrumbidgee River system near the site at Burrinjuck Dam and Yass.	Vagrant	Yes, although the risk assessment indicates that the risk to this species is low; it is considered that there is a high collision risk for this highly nomadic species, should it occur on the site	**4**
Fork-tailed Swift *Apus pacificus* Marine overfly area M EPBC	This species breeds from central Siberia eastwards through Asia and winters south to Australia. Uncommon in eastern Australia. It spends most of its time in the air feeding on insects, occasionally roosting on cliffs or in large trees (Pizzey *et al.* 2006). It spends most of its life in the air feeding on insects. It occurs throughout mainland Australia, mostly west	Present, although generally occur west of the divide	This species is uncommon in eastern Australia (Pizzey et al., 2006) Closest record is from Junee (100km	Vagrant	No, the site is outside this species migratory range and therefore it is highly unlikely to occur.	**4**

Species and status*	Ecology	Presence of habitat	Nearest records	Likelihood of occurrence	Potential to be impacted?	PIF
CAMBA JAMBA ROKAMBA	of the divide.		west of the site, in 1980)			
White-throated Needletail *Hirundapus caudacutus* M EPBC CAMBA JAMBA Marine overfly (may)	This species is noted as one of the world's fastest birds, this species has been recorded in the airspace above woodlands, forests and farmlands (Pizzey and Knight 2006). It is a regular summer migrant to eastern Australia and returns to the northern hemisphere in mid-April to breed. It is often seen 'patrolling' favoured feeding grounds above ridges and hilltops. It feeds on flying insects and has been recorded flying at c.1000-2000m ASL over the Australian Alps (Pizzey *et al.* 2006).	Present	This species has been recorded in the region in the Bungongo State Forest (approx. 30km south of the site).	Possible	Yes, the species has been recorded locally and is at risk of collision with turbine blades	**6**
Rainbow Bee-eater *Merops ornatus* M EPBC Marine overfly area (may)	This species inhabits open woodlands with sandy, loamy soil (Pizzey and Knight 2006); also occurs in riverbanks, sandspits, road cuttings, beaches and golf courses. It builds a burrow in sandy ground or bank cuttings. The species is a summer breeding migrant (Sept-Apr) to south-eastern Australia, but winters in northern Australia, Solomon Islands, PNG and Indonesia, moving in large flocks.	Present	This species was observed on the site and has been recorded near Jugiong Creek.	Present	Yes, Although habitat would not be impacted, the species is migratory and is therefore at risk of collision	**7**
Satin Flycatcher *Myiagra cyanoleuca* M EPBC Marine overfly	This species is normally found in heavily vegetated gullies in tall forests, woodlands wherever a shrub layer is present (Pizzey and Knight 2003). During migration it is often found in coastal forests, woodlands and trees in open country. It breeds mostly in south-east Australia, nesting on a dead branch 5-25m high under live foliage (Pizzey and Knight 2003), regularly returning to the same locality to breed. The species moves northwards in winter to northern Queensland and Papua New Guinea, returning south to breed in spring.	Optimal habitat is not present	This species has been recorded in the region north-east of Yass.	Possible (during migration only)	No. Breeding habitat and optimal habitat (dense gullies) is not present on the site	**4**
Great Egret *Ardea alba* V EPBC M EPBC	Great Egrets occur throughout most of the world. They are common throughout Australia, with the exception of the most arid areas. They prefer shallow water in rivers, estuaries, tidal mudflats, freshwater wetlands, sewerage ponds, irrigation areas and larger dams etc (Pizzey *et al.*	Absent	This species has not been recorded in the region.	Unlikely	No, habitat is not available onsite. Any long-distance movements would follow wetland	**3**

Species and status*	Ecology	Presence of habitat	Nearest records	Likelihood of occurrence	Potential to be impacted?	PIF
CAMBA, JAMBA Overfly Marine area	2006). They nest in treetop canopy over water in swamp woodland or mangroves (Pizzey *et al.* 2006).				corridors and thereby avoid the site.	
Cattle Egret *Ardea ibis/ Bubulcus ibis* M EPBC CAMBA, JAMBA Marine overfly area	The Cattle Egret is found in grasslands, woodlands and wetlands. It also utilises pasture lands, paddocks and croplands where drainage is poor, often in association with cattle and other stock; wetlands, tidal mudflats and drains (Pizzey *et al.* 2006). Nests in swamp woodlands in groups. Originally found in Africa, Europe and Asia, the Cattle Egret is now found on nearly every continent. Occurs on the north and east coast of Australia. Partially migratory.	Present	This species has been recorded near Murrumbidgee west of the site.	Possible, around the pasture and dams on the flats	Yes, minor impacts would occur on flats, however the removal of dams may impact this species. Collision risks also apply	**7**
Latham's Snipe *Gallinago hardwickii* M EPBC JAMBA Marine overfly area	This species breeds in northern Japan and migrate to eastern Australia in during the Australian summer. The species is generally coastal and sub-coastal, although also move inland through Murray-Darling regions (Pizzey *et al.* 2006). It usually inhabits open, freshwater wetlands with low, dense vegetation for shelter (e.g. swamps, flooded grasslands or heathlands, around bogs and other water bodies) although can also occur in habitats with saline or brackish water, and in modified or artificial habitats including pasture, ploughed paddocks, irrigation channels and drainage ditches (DEWHA 2008). It requires areas of mud and some form of vegetative cover for feeding (DEWHA 2008).	Absent	This species has not been recorded in the Murrumbidgee CMA catchment.	Vagrant	No, habitat is not available onsite. Any long-distance movements would follow wetland corridors and thereby avoid the site.	**3**
MARSUPIALS						
Eastern Pygmy-possum *Cercartetus nanus* V TSC	In NSW this species is found from the coast inland as far as the Pillaga, Dubbo, Parkes and Wagga Wagga on the western slopes. It prefers woodland and heath although has been recorded in a broad range of habitats including rainforest and sclerophyll (including Box-Ironbark) forest (DECC 2008b). This species feeds largely on nectar and pollen from banksias or other proteaceous or myrtaceous shrubs incl. Melaleucas, Tea-trees & Callistomens (DECC 2008b). This species requires hollows, cracks or fissures > 2.0 cm diameter in trees, stumps or logs,	Absent, woodland doesn't have shrubs	Closest record is from Mundoonen Nature Reserve near Gunning (1996).	None	No	**2**

Species and status*	Ecology	Presence of habitat	Nearest records	Likelihood of occurrence	Potential to be impacted?	PIF
	bark or disused bird's nests for breeding (DECC 2008b).					
Spotted-tailed Quoll *Dasyurus maculatus* V TSC E EPBC (species of habitat may occur)	This species is found in a variety of forest types such as rainforest, wet and dry sclerophyll forest, woodland, coastal heath and scrub, sometimes Red Gum forest along inland waterways (Menkhorst and Knight 2004). It utilises hollow-bearing trees, fallen logs, rock caves and crevices as denning and breeding sites (DECC 2008b). Mostly nocturnal it hunts mammals, birds and large arthropods. Females occupy home ranges up to about 750 hectares and males up to 3500 hectares; usually traverse their ranges along densely vegetated creeklines.	Absent	This species has been recorded in the region, near Burrinjuck Dam, and Burrinjuck Nature Reserve.	Unlikely, given absence of suitable habitat	No	**2**
Yellow-bellied Glider *Petaurus australis* V TSC	This species is found along the eastern coast to the western slopes of the Great Dividing Range (DECC 2008b). It occurs in tall mature wet and damp eucalypt forest with high rainfall and nutrient rich soils and feed primarily on plant and insect exudates, including nectar, sap, honeydew and manna with pollen and insects providing protein (DECC 2008b; Menkhorst and Knight 2004). A large number of eucalypt species are used as sap trees throughout the range (NPWS 2003c). Have large home ranges between 20 to 85 ha to encompass dispersed and seasonally variable food resources. Trees with hollows >10 cm diameter are required for nesting in eucalypt forests.	Absent	This species has been recorded in the region, near Burrinjuck Dam. Burrinjuck Nature Reserve.	None	No	**2**
Squirrel Glider *Petaurus norfolcensis* V TSC	This species inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas (DECC 2008b). It prefers mixed species stands with a shrub or Acacia understorey although will occur in areas where no understorey if there is more than one species of Eucalypt. Feeds on insects, nectar and exudates from leaves and trees (*Eucalyptus* and *Acacia*) and requires abundant tree hollows greater than 5cm diameter (DECC 2008b). It can use patches less than 1 ha & isolated trees if within 75 m of other patches (DECC 2008b). Has a mean home range of 1.4–2.8 ha (Quin 1995; Ree and Bennett 2003).	Present	This species has been recorded in the region, near Burrinjuck Dam. and Bungongo State Forest	Possible	Yes, potential woodland habitat is present within the development envelope	**6**

Species and status*	Ecology	Presence of habitat	Nearest records	Likelihood of occurrence	Potential to be impacted?	PIF
Brush-tailed Phascogale *Phascogale tapoatafa* V TSC	This species is found in a variety of forest types although prefers dry sclerophyll forest with a sparse groundcover (DECC 2008b). It generally occurs in areas where the annual rainfall exceeds 500mm. Have large overlapping territories between 20 – 100 hectares. It requires tree hollows with openings 25-40mm wide for nesting and utilises multiple trees throughout its lifetime. Prefer large trees and are most abundant where there are more than 2 trees per ha greater than 60cm DBH. It requires remnants greater than 25ha in dry forests and ridges.	Present, although marginal due to fragmentation	No records from the Murrumbidgee CMA	Unlikely	No	**4**
Koala *Phascolarctos cinereus* V TSC	This species was historically abundant in the south of NSW, although now occurs in sparse and possibly disjunct populations. It occurs in woodland communities, coastal forests, woodlands of the tablelands and western slopes and the riparian communities of the western plains (NPWS 2003b). May also utilise isolated paddock trees (NPWS 2003b). Primary feed tree species listed for the central and southern tablelands are Ribbon Gum and River Red Gum, secondary species include Candle Bark, Blakely's Red Gum, White Box, Yellow Box and Brittle Gum (DECC 2008a).	Present	This species has been recorded approximately 8km east of the site (2004)	Possible	Yes, feed tree species are located within the development envelope	**6**
BATS						
Little Pied Bat *Chalinolobus picatus* V TSC	This species occurs in dry open forest, open woodland, mulga woodlands, chenopod shrublands, cypress-pine forest, mallee, bimbil box (DECC 2008b). It roosts in caves, rock outcrops, mine shafts, tunnels, tree hollows and buildings. It often forages along watercourses (Menkhorst and Knight 2004) where it feeds on moths and possibly other flying invertebrates.	Present	This species has been recorded in the region north of Yass.	Possible	Yes, collision and barotrauma risk, Woodland habitat is located within the development envelope.	**7**
Eastern False Pipistrelle *Falsistrellus tasmaniensis* V TSC	This species occurs on the south-east coast and ranges of NSW. It tends to prefer moist forests with tall trees. It roosts in tree hollows, under bark, or in buildings. The species hibernates in winter (DECC, 2008b)	Present	Closest records are from Cuumbeun Nature Reserve, near Queanbeyan (90km south-east)	Unlikely, vagrant	Yes, collision and barotrauma risk.	**4**
Eastern Bent-wing	This species is a common although a vulnerable species that is likely to be widely distributed throughout the region. It	Foraging habitat is	This species was recorded on the	Possible	Yes, collision and barotrauma risk is	**8**

Species and status*	Ecology	Presence of habitat	Nearest records	Likelihood of occurrence	Potential to be impacted?	PIF
Bat *Miniopterus schreibersii oceanensis* V TSC	roosts and raises its young in caves and mine tunnels (Strahan 1995). The species appears to forage above the forest canopy in a diverse range of forest types (Strahan 1995).	present on the site	site. Wee Jasper Caves is a known breeding site for the species, approximately 35km south of the site.		present. Foraging habitat is located within the development envelope	
Greater Long-eared bat (south-eastern form)/ Eastern Long-eared Bat *Nyctophilus timoriensis* V TSC V EPBC	The distribution of the south eastern form coincides approximately within arid regions in the Murray Darling Basin with the Pilliga Scrub region being the distinct stronghold for this species (DECC, 2008b). This species inhabits a variety of vegetation types, including mallee, bulloke but more commonly box/ironbark/cypress-pine communities that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland (DECC 2008b). It is a slow flying agile species and forages in the lower parts of the canopy, even amongst the shrub layers and on the ground (Menkhorst and Knight 2004). The species roosts in tree hollows, and under loose bark.	Absent	No records of the species exist for the Murrumbidgee CMA area.	Unlikely	No, It is unlikely that the species occurs in the proposed Coppabella Wind Farm area due to the lack of suitable habitat types.	**1**
Large-footed Myotis *Myotis adversus* V TSC	This species is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. It is rarely found more than 100 km inland, except along major rivers (DECC, 2008b). It forages on the surface of water bodies such as rivers, lakes and swamps. It roosts in small groups in caves, mine, tunnels and old buildings (Hall & Richards 1979).	Foraging habitat (dams and Jugiong Creek) is present on the site	Most records of this species are from west of the dividing range although there is a single record from Wee Jasper approximately 35km south of the site.	Vagrant, given that the site is more than 100km from the coast	Yes, potential foraging habitat (dams) would be impacted. Collision and barotrauma risk also exists.	**6**
Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris* V TSC	This species is a wide-ranging species across northern and eastern Australia. It roosts alone or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows (DECC 2008b). Seasonal movements are unknown; is thought to be sedentary, however the species may migrate to southern Australia in late summer and autumn (DECC 2008b).	Foraging and breeding habitat is present	No records of the species have been recorded in the Murrumbidgee CMA area.	Vagrant	Yes, potential breeding and foraging habitat is present within the development envelope. Collision and barotrauma risk	**5**

Species and status*	Ecology	Presence of habitat	Nearest records	Likelihood of occurrence	Potential to be impacted?	PIF
					also exists.	
RODENTIA						
Smoky Mouse *Pseudomys fumeus* E TSC E EPBC (species or habitat may to occur)	In NSW, there are 3 records from Kosciuszko National Park and 2 records adjacent to the park in Bondo and Ingbyra State Forests; the remainder are centred around Mt Poole, Nullica State Forest and the adjoining S. E. Forests National Park (DECC 2008b). The species has been recorded on heathy ridge tops and slopes within sclerophyll forests, heathland and open forest from the coast to sub-alpine regions (DECC 2008b). It forages on seeds and fruits from leguminous shrubs, some invertebrates and fungi.	Absent	Not recorded in the region	None	No	**0**
REPTILIA						**0**
Little Whip Snake *Suta flagellum* V TSC	This species is found within an area bounded by Crookwell in the north, Bombala in the south, Tumbarumba to the west and Braidwood to the east (DECC 2008b). It occurs in Natural Temperate Grasslands and grassy woodlands, including those dominated by Snow Gum or Yellow Box as well as secondary grasslands derived from clearing of woodlands. It is commonly found on well-drained hillsides with loose scattered rocks.	Present	This species has not been recorded in the region. Records are from north and east of the ACT.	Unlikely, beyond the known distribution of the species	Yes, although the site is more than 30km from this species known distribution range, extensive areas of potential habitat are present within the development envelope	**4**
Pink-tailed Legless or Worm Lizard *Aprasia parapulchella* V TSC V EPBC	This species is only known from the Central and Southern Tablelands, and the South Western Slopes (Osborne and Jones 1995). This species inhabits sloping, open woodland areas with predominantly native grass groundlayers, particularly those dominated by Kangaroo Grass (*Themeda australis*). Typically these areas are well-drained, with rocky outcrops or scattered, partially-buried rocks. Commonly found beneath small, partially-embedded rocks in burrows below these rocks; the burrows usually have been constructed by and are often still inhabited by small black ants and termites (Osborne and Jones 1995). This species feeds on the larvae and eggs of these ants (DECC 2008b).	Present, however rocky habitat is severely grazed	The closest record is from Boorowa (2001), approximately 35km north of the site.	Possible	Yes, potential habitat (rock outcrops) is located within the turbine development envelope	**6**
Striped Legless Lizard	Populations of this species are known in the Goulburn, Yass, Queanbeyan, Cooma and Tumut areas. It inhabits temperate lowland grasslands, secondary grasslands and occasionally in	Present	This species has been recorded in the region near Yass	Possible	Yes, potential habitat (rock outcrops) is located within the	**6**

Species and status*	Ecology	Presence of habitat	Nearest records	Likelihood of occurrence	Potential to be impacted?	PIF
Delma impar V TSC V EPBC	open Box-Gum Woodland. It has been recorded at sites dominated by introduced species (such as *Phalaris aquatica, Nasella trichotoma* and *Hypocharis radicata*) and sites with a history of grazing and pasture improvement (Smith and Robertson 1999). Shelters in grass tussocks, thick groundcover, soil cracks, under rocks, spider burrows, and ground debris such as timber. The key to their survival in rural areas may be the availability of shelter during disturbance events (Smith and Robertson 1999).		(1997).		turbine development envelope	
Rosenberg's Goanna *Varanus rosenbergi* V TSC	This species occurs on the Sydney Sandstone in Wollemi National Park to the north-west of Sydney, in the Goulburn and ACT regions and near Cooma in the south. It is found in heath, open forest and woodland. It is known to nest in termite mounds and feeds on carrion, birds, eggs, reptiles and small mammals. Individuals require large areas of habitat.	Absent	This species has not been recorded in the region	Unlikely	No	**0**
FISH						
Macquarie Perch *Macquaria australasica* V TSC E EPBC (species or habitat may occur)	The Macquarie Perch is a riverine, schooling species. It prefers deep, rocky holes with considerable cover and a substrate of small boulders, pebbles and gravel. Occurs within rivers, dams and tributaries in Southern NSW (Ecology Lab, 2003), but mainly in the upper reaches of rivers and streams where siltation levels are low. The species appears to prefer pools with cover.	Absent	Recorded from Yass Known from all three	None	No	**0**
Murray Cod *Maccullochella peelii peelii* V EPBC (species or habitat may occur)		Absent	-	None	No	**0**

Species and status*	Ecology	Presence of habitat	Nearest records	Likelihood of occurrence	Potential to be impacted?	PIF
INVERTEBRATES						
Golden Sun Moth *Synemon plana* E TSC CE EPBC (species of habitat likely to occur)	This species is distributed in an area of NSW between Queanbeyan, Gunning, Young and Tumut (DECC 2008b). It occurs in grassy Box-Gum Woodlands and natural temperate grasslands, typically low, open and dominated by several wallaby grass species. Also may be associated with spear-grasses (*Austrostipa* spp.) or Kangaroo Grass (*Themeda australis*).	Present	Closest record is from Queanbeyan	Unlikely, site is beyond the known distribution of the species	No	**0**
ENDANGERED POPULATION						
Squirrel Glider population in the Wagga Wagga LGA *Petaurus norfolcensis*	The extent of the endangered population is legally defined by the boundaries of the Wagga Wagga LGA. The site does not occur within this LGA.	-	-	-	No	**0**

Appendix E **ASSESSMENTS OF SIGNIFICANCE**

E.1 TSC Act (NSW)

E.2 EPBC Act (COMMONWEALTH)

Species and communities that have been assessed for significance of impacts are outlined below:

SCIENTIFIC NAME	COMMON NAME	LISTING*	TEST APPLIED
FLORA			
Ammobium craspedioides	Yass Daisy	V, v	TSC Act, EPBC Threatened Species
Caladenia sp *Burrinjuck*	Burrinjuck Spider Orchid	E, e	TSC Act, EPBC Threatened Species
ECOLOGICAL COMMUNITIES			
White Box Yellow Box Blakely's Red Gum Woodland (TSC Act) / Yellow Box – White Box- Blakely's Red Gum Grassy Woodland and Derived Native Grasslands (EPBC Act)		EEC, ceec	TSC Act, EPBC Act Ecological Communities
FAUNA			
Pyrrholaemus saggitatus	Speckled Warbler	V	TSC Act
Lophoictinia isura	Square-tailed Kite	V	TSC Act
Oxyura australis	Blue-billed Duck	V	TSC Act
Callocephalon fimbriatum	Gang-gang Cockatoo	V	TSC Act
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	V	TSC Act
Stagonopleura guttata	Diamond Firetail	V	TSC Act
Grantiella picta	Painted Honeyeater	V	TSC Act
Xanthomyza phrygia	Regent Honeyeater	E, e, m	TSC Act, EPBC Act Threatened Species, EPBC Act Migratory Species
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V	TSC Act
Lathamus discolor	Swift Parrot	E, e, m	TSC Act
Neophema pulchella	Turquoise Parrot	V	TSC Act
Polytelis swainsonii	Superb Parrot	E, e	TSC Act
Ninox connivens	Barking Owl	V	TSC Act
Haliaeetus leucogaster	White-bellied Sea-Eagle	m	EPBC Act Migratory Species
Hirundapus caudacutus	White-throated Needletail	m	EPBC Act Migratory Species
Merops ornatus	Rainbow Bee-eater	m	EPBC Act Migratory Species
Ardea ibis	Cattle Egret	m	EPBC Act Migratory Species
Petaurus norfolcensis	Squirrel Glider	V	TSC Act
Phascolarctos cinereus	Koala	V	TSC Act
Chalinolobus picatus	Little Pied Bat	V	TSC Act
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	TSC Act
Miniopterus schreibersii oceanensis	Eastern Bent-wing Bat	V	TSC Act
Myotis adversus	Large-footed Myotis	V	TSC Act
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	TSC Act
Suta flagellum	Little Whip Snake	V	TSC Act
Aprasia parapulchella	Pink-tailed Worm-lizard	V, v	TSC Act, EPBC Act Threatened Species
Delma impar	Striped Legless Lizard	V, v	TSC Act, EPBC Act Threatened Species

*V: Vulnerable TSC Act, E: Endangered TSC Act, EEC: Endangered Ecological Community TSC Act, v: Vulnerable EPBC Act, e: Endangered EPBC Act, ceec: Critically Endangered Ecological Community EPBC Act

E.1 TSC ACT ASSESSMENT OF SIGNIFICANCE

The following Assessments of Significance (7-part tests) assess the significance of likely impacts associated with the Coppabella Hills Precinct wind farm proposal on NSW listed threatened species and Endangered Ecological Communities considered at risk from the proposal.

Guild	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
FLORA	
	Yass Daisy, *Ammobium craspedioides*
Ecology	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 flower heads are hemispherical buttons, to 20 mm wide, and surrounded at the base by papery leaf-like structures (bracts). The solitary flower heads are borne on unbranched stems to 60 cm tall; the stems are sparsely leafed, and edged with narrow "wings". Rosettes die off after fruiting. The species is found from near Crookwell on the Southern Tablelands to near Wagga Wagga on the South Western Slopes. Most populations are in the Yass region. It occurs in dry forest, Box-Gum Woodland and secondary grassland derived from clearing of these communities. It grows in association with a large range of eucalypts (*Eucalyptus blakelyi, E. bridgesiana, E. dives, E. goniocalyx, E. macrorhyncha, E. mannifera, E. melliodora, E. polyanthemos, E. rubida*). It is apparently unaffected by light grazing, as populations persist in some grazed sites though the intensification of grazing regimes and invasion of weeds are listed as potential threats to this species. Other threats include agricultural developments, road works (particularly widening or re-routing), inappropriate mowing or slashing in the cemetery sites where species occurs.
Assessment	Occurrences of this species were found on slopes within the potential transmission corridor on the saddle between Clusters 6 and 7a. Another two occurrences were recorded on slopes below sites 7a and north of Cluster 10 were found, however these were outside the proposed development envelope. It is possible that more occur nearby and in similar moderate to good condition woodland, given that not all of the woodland on adjacent slopes was included in the flora survey. The probability that this species occurs on the heavily grazed ridges and upper slopes within the turbine impact zone is very low, as it was not recorded in any of the areas surveyed in this type of habitat. The species was observed within a heavily grazed paddock on the nearby property 'Marilba', though only within 10 metres of where it was abundant in woodland in an adjacent lightly grazed paddock. Given that all turbine clusters are heavily grazed, it is not likely that a seed source of the species would persist in these areas, even if seeds were continually transported from nearby woodland habitats. The occurrences found on the slopes between Clusters 6 and 7a were within a potential transmission corridor in the initial infrastructure layout. However, the layout has since been modified to avoid impacts to high constraint woodland in this area. Potential habitat for this species occurs in moderate, moderate-good and good condition woodland patches (high constraint woodland) in areas that aren't heavily grazed or cleared, such as on steep slopes. Approximately 11.45 hectares of Box-Gum Woodland and Dry Grass Forest has the potential to be removed as a result of the proposal, of this total approximately 0.59 hectares of high constraint woodland would be impacted. It is possible that offsets such as fencing of more lightly grazed remnants where it occurs (such as in the woodland remnant north of Cluster 10) to manage the timing of grazing may produce a positive

Guild	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
	outcome for Yass Daisy populations at the Coppabella site. Provided that works avoid impacts on good and moderate to good quality woodland habitats, it is considered highly unlikely that the proposed activity would have an adverse effect life cycle of the Yass Daisy such that a viable local population of the species is likely to be placed at risk of extinction. **Burrinjuck Spider Orchid, *Caladenia* sp. Burrinjuck** The Burrinjuck Spider Orchid is only known from the Burrinjuck Nature Reserve, about 20km south of the site and Burrinjuck Waters State Park. The habitat in which it occurs within the reserve include dry open forest dominated by *E. goniocalyx, E. dives, E. mannifera,* and *E. rossii* or tall open forest dominated by *E. dives, E. goniocalyx* and *E. macrorhyncha* (NSW NPWS 2002). This habitat type is not very similar to the grassy woodland on fertile soils found on the subject site, and this dissimilarity, along with the heavy grazing regime on most of the site, means that it is very unlikely to occur there. The survey was undertaken within the flowering period of this orchid, which may occur between late August and October. However, if the local flowering time was October, then the surveys in mid-September and early November would not have detected it. Given that remnant populations of rare orchid species can be small and isolated, if one does occur on the site, the development could eliminate it. However, the probability of this occurring is extremely low. It is considered unlikely that the proposed activity would have an adverse effect life cycle of the Burrinjuck Spider Orchid such that a viable local population of the species is likely to be placed at risk of extinction.
FAUNA	
Waterbirds	
Ecology and life cycle	**Blue-billed Duck** The Blue-billed Duck has been recorded in the region approximately 20km south west of the study area. During spring and summer birds travel up to 300km from non-breeding areas on the Murray River system and coastal lakes to breed in deep swamps of inland NSW (NPWS 1999b). They are often seen in coastal areas in summer and during drought (DECC 2008b). Feeding occurs in permanent freshwater wetlands and swamps with deep water and dense aquatic vegetation.
Assessment	This species has been recorded near the Murrumbidgee River, Bundarbo, approximately 20km south west of the site. The site does not provide potential feeding or breeding habitat, however, the species disperses long distances for breeding and during drought. There are several large water bodies within a 300km radius, and birds travelling between them may pass over ridges within the study area and be at risk from collision with turbine blades. Potential long-distance movement paths may occur between Lake Burrinjuck and Lake Cowal, Lake Wyangala or the Murrumbidgee River (see Figure 4-1). Their large body and awkward flight characteristics, as well as their flocking habits, increase the potential impact to any local population. It is possible that this species may pass over the turbine sites during movement between foraging and breeding areas, however this movement is unlikely to be regular given that no large water bodies or wetlands are located near the site to act as attractants for this species. DECC Atlas of NSW Wildlife records indicate the species are more likely to follow river systems than ridges between water bodies. Therefore, the risk to local populations as a result of collision is likely to be **low**. Monitoring during wind farm operation would target this species to document collision impacts and ensure that adaptive measures would be adopted if mortalities are

Guild	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
	found to occur. The proposed development is not likely to result in adverse impacts on the Blue-billed Duck such that a local population is likely to be placed at risk of extinction.
Raptors	
Ecology and life cycle	**Square-tail Kite and Barking Owl** The Square-tailed Kite and Barking Owl occur sparsely throughout mainland NSW. Square-tailed Kite occurs primarily in coastal and sub-coastal open forest, woodlands and mallee, although has been recorded inland along timbered watercourses and adjacent areas (NPWS 1999e). Barking Owl is most frequently recorded on the western slopes and plains (DECC 2008b) in dry box-dominated forest and woodlands and has been recorded in farmland forest and woodland remnants and in clumps of trees at farms, towns and golf courses (NPWS 2003a). The two species tend to prefer structurally diverse habitats (G. Czechura, in Garnett, 1992; Garnett & Crowley 2000). Square-tail Kites appear to prefer open environments, while Barking Owl prefers dense foliage of *Acacia, Casuarina* or *Eucalyptus* species along water courses and in gullies for roosting (Schodde and Tidemann 2007); DNRE 1999; NPWS, 2003a). Square-tailed Kites hunt small passerines, especially honeyeaters, in the tree canopy. Barking Owl feeds primarily invertebrates, but also takes birds and small to medium size mammals. Raptors are long-lived with low fecundity. The two species occur in pairs in low densities (DNRE 1999; NSW Scientific Committee 1998; Olsen 1998) and occupy very large territories for hunting, from 1000 ha (Barking Owl) to 10,000ha (Square-tailed Kite) (Hollands 2008; Pizzey & Knight 1999). The Square-tailed Kite is considered partially nomadic, whilst the Barking Owl is nomadic (DNRE 1999; Pizzey & Knight 1999). Breeding requirements are limiting for the species. The Square-tailed Kite requires species rich patches of woodland with structural diversity (G. Czechura, in Garnett, 1992; Olsen 1998). Nests are a platform of sticks up to 90cm in diameter in a fork of a tall tree in forest or woodland (DEC NSW 2004). The Barking Owl requires large tree hollows (20-46 cm diameter) in large, old eucalypts for nesting including River Red Gum, White Box, Red Box and Blakely's Red Gum (DECC 2008b; NPWS 2003a). Nest and roost sites are usually near watercourses or wetlands (NPWS 2003a).
Assessment	Square-tailed Kite and Barking Owl were not detected in the study area; however they have been recorded within potential home range distance from the study area and foraging habitat is within the woodland habitat on the site. The potential impacts of the proposal relate to loss and degradation of woodland habitat, decline in prey species due to habitat degradation and fragmentation, loss of hollow-bearing trees and collision with turbine blades. The risk to local populations as a result of woodland habitat removal and degradation, decline of prey species and impacts to hollow-bearing trees is likely to be **low** for the following reasons: - • Riparian and gully habitat will not be affected by the proposal • Woodland that would be cleared or modified is primarily degraded due to fragmentation, grazing and weed invasion • The impact area on woodland habitats would be small (11.45 hectares in total, and only 0.38 hectares of higher quality woodland habitat) relative to large territories of the raptors. • The works would not further fragment continuous areas of forest; works would only occur in

Guild	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
	marginal habitat on the edges of woodland and in small isolated patches on steep slopes and ridges. • A small number of hollow-bearing trees occur within the development envelope, however these trees are unlikely to provide hollows large enough for Barking Owl and are not located near watercourses or wetlands. To further minimise impacts on these woodland species, works should avoid impacts on high constraint woodland patches, particularly mature areas with hollow-bearing trees (along Whitefields Road, on Cluster 10 and in the transmission easement between 6 and 7a). **Collision impacts:** The foraging height and use of thermals by the Square-tailed Kite places it at risk from collision and changes in habitat utilisation due to potential avoidance of turbine areas. Northern hemisphere studies suggest that raptors are among the most vulnerable to bladestrike (Smales and Muir, 2005, Barclay et al., 2007). The study area carries cleared lands and woodland patches provide habitat for this species, however the degree of fragmentation from clearing across the site, particularly on the ridges, reduces the potential for the species to occur on the site. Therefore the risk of collision impacts on a local population of this species arising from the Coppabella wind farm is considered to be **moderate.** The Barking Owl forages within the canopy and in open areas at night. Therefore, turbines positioned above the canopy or within open areas nearby to woodland/forest pose the greatest risk from blade-strike or changes in habitat utilisation. Higher risk turbine sites to Barking Owl occur along Cluster 7a and 7b, north end of Cluster 3 and Cluster 10. Owls are more likely to be found foraging in gully areas than exposed ridges, and tend to use a perch and pounce method of foraging rather than gliding, risk to local populations from **collision** or changes in **habitat utilisation** is likely to be **moderate**. The collision risk of both raptor species has been assessed as being moderate, although are unlikely to result in a significant impact on the species such that a local population of the species is likely to be placed at risk of extinction. However the **cumulative impact** of the other wind farms proposed for nearby ridges (at Marilba and Carrols Ridge) **increases the risk** to local populations of these species given that they occur at low densities over a very large area. Monitoring of raptor collisions during wind farm operation would be undertaken at all proposed wind farm sites to ensure impacts to populations are monitored and appropriately managed.
Woodland Birds	
Ecology and life cycle	**Speckled Warbler, Brown Treecreeper, Diamond Firetail, Hooded Robin** The Speckled Warbler, Brown Treecreeper, Diamond Firetail and Hooded Robin forage for seeds and insects on the ground in *Eucalyptus* dominated communities with a grassy understorey and sparse shrub layer (Garnett & Crowley 2000; Hogendyk 2008; NSW Scientific Committee 2008). The Hooded Robin also utilises dead stumps and woody debris for perch and pounce on prey, while the Brown Treecreeper forages for invertebrates on tree trunks and on the ground amongst fallen timber and leaf litter (DECC, 2008b; Hogendyk 2008). The Diamond Firetail and Hooded Robin often utilise open grassy areas adjacent to woodland habitats, with the Diamond Firetail often occurring in grassland and lightly wooded farmland foraging for grass seed and other plant material. The species tend to persist only in large woodland areas (100-300 ha) containing structurally diverse habitat, particularly the Speckled Warbler and Brown Treecreeper (Barrett *et al.* 1994); Hogendyk 2008; NSW Scientific Committee 2008; TAMS 2005). Warblers appear to be adverse to open canopy areas, thus limiting dispersal between fragments (Garnett & Crowley 2000). The species generally

Guild	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
	occur in low densities, although the Diamond Firetail and Brown Treecreeper are gregarious (Cooney & Watson 2005; DECC 2008b). The territory ranges in size from 2-20 ha depending on habitat richness (NSW Scientific Committee 2008; Olsen et al. 2005). The Speckled Warbler nests in leaf litter on the ground and are therefore highly vulnerable to predation by large birds and mammalian and reptilian carnivores. The Brown Treecreeper nest in tree hollows.
Assessment	Potential threats to this suite of species arising as a result of the proposal are clearance and fragmentation of habitat including removal of dead timber, over-grazing, invasion of exotic grasses and increases in edge predators (Cooper and Walters, 2002; Garnett & Crowley 2000; James 2003; NSW Scientific Committee 2008; Walters et al., 1999; Watson et al. 2001). Poor dispersal abilities increase the vulnerability of the Speckled Warbler to these threats (Garnett & Crowley 2000). Diamond Firetail was detected within the study area. Speckled Warbler was recorded from Marilba Hills by **ngh**environmental 2008 and Hooded Robin have been recorded within the locality. The species may occur in higher quality woodland patches, particularly north of Cluster 10 and on the south-east facing slope of 7, however these predominately occur outside the envelope. Lower constraint woodland (poor and poor-moderate condition) is considered to be only marginal for these species as they are not structurally complex and are fragmented from other woodland areas. The proposal would remove approximately 11.5 ha of woodland habitat. Impacts would primarily occur within disturbed and fragmented areas, or along the edges of larger remnants. Excepting Diamond Firetail and Hooded Robin, these species tend to be adverse to open canopy areas and edge habitats, suggesting that habitat removal would not be likely to impact these species. Diamond Firetail and Hooded Robin may occur on the edges of woodland or in pasture areas and may therefore utilise the impact zone. However, given the disturbed condition of these areas, and the large extent of similar and high quality habitat nearby, the removal of habitat is not likely to be significant for these species. A small risk of collision with turbine blades is also present for these species; however as they are sedentary, forage primarily on the ground or on tree trunks and generally prefer continuous woodland habitats, the risk of collision is **very low.** The Diamond Firetail forages in groups in open areas and have been recorded to travel 5km during dispersal (Olsen et al. 2005) and may be at higher risk of collision than the other species, however their small size and ground-foraging habit suggests that they are unlikely to fly at the height of the turbine blades.
Honeyeaters	
Ecology and life cycle	**Regent Honeyeater, Painted Honeyeater (Honeyeaters Meliphagidae)** The Regent Honeyeater and Painted Honeyeaters are arboreal honeyeaters and are found at low densities in eucalypt open forests or woodlands, particularly box-ironbark and box-gum assemblages. Regent Honeyeaters appear to prefer wetter, more fertile sites along creek flats, broad river valleys and lower slopes. The Painted Honeyeater prefers dry woodlands and open forests and also paperbark and casuarina forests. The Painted Honeyeater is a specialist forager on mistletoe, particular from the genus *Amyema*. Pairs or small groups generally require 5 or more mistletoes per hectare to persist in an area. In contrast, Regent Honeyeaters are generalist foragers, which feed mainly on nectar from a wide range of eucalypts and mistletoes. Key eucalypt species include Mugga Ironbark, Yellow Box, Yellow Gum, Blakely's Red Gum and White Box (Menkhorst *et al.* 1999). Stands suitable species growing on high quality sites where nectar production is copious and relatively predictable appear to be critical to the

Guild	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
	survival of the Regent Honeyeater (Menkhorst et al., 1999). These species are nomadic, with movements linked to flowering events of favoured feed species (Garnett & Crowley 2000; NSW Scientific Committee, 2008). Regent Honeyeaters are known to undertake irruptive nomadic movements hundreds of kilometres between coastal and inland resources (DECC, 2008b). While their relative mobility should make the species better able than some to cope with fragmentation, local populations appear not to persist in small remnants (less than 200 ha in area) (Garnett & Crowley 2000; NSW Scientific Committee, 2008).
Assessment	Potential threats to these species arising from the proposal include habitat loss and degradation and collision risks. **Habitat loss and degradation:** Neither of these species was detected in the study area. Painted Honeyeater has not been recorded within 50km of the site, and predominately occurs west of the dividing range. The site does provide habitat for the species, including mistletoe species *Amyema pendulum* and *Muellerina eucalyptoides.* Mistletoe was identified at low densities on the midslopes below Cluster 7a (outside the development envelope) and on parts of Cluster 10 within the development envelope. Although these mistletoe species are a potential feed resource for the Painted Honeyeater, it occurs in low densities and may not provide sufficient resources to support a local population. The fragmentation and low availability of resources suggests that there is a low probability of Painted Honeyeater occurring on the site, therefore removal and degradation of habitat associated with the proposal is unlikely to significantly impact the species at the population level. Regent Honeyeater has been recorded in the region, south of Binalong, approximately 9km east of the site. Suitable foraging habitat was found for the Regent Honeyeater including Yellow Box, Blakely's Red Gum, White Box and mistletoe. Based on an indicative layout, the proposal would impact approximately 11.5 hectares of woodland primarily along the edges of larger patches of woodland and in isolated stands on ridge tops and slopes, only 3.6 hectares of which is considered to be in moderate to good condition. The works would not impact habitat connectivity Given the disturbed and fragmented condition of much of the woodland present within the development envelope, and the extent of woodland elsewhere within the study area, it is not considered that the removal or degradation of these resources would significantly impact the species at the population level. **Collision risks:** The Regent Honeyeater and Painted Honeyeater undertake large-scale nomadic movements across the landscape, both moving in flocks. Records from the DECC Atlas of NSW Wildlife suggests that the species may pass over the site when travelling between the western slopes and the coast. White Box Yellow Box Blakely's Red Gum Woodland north of Cluster 10 and the on western slope of Cluster 7b may act as sinks, attracting the Regent Honeyeater to the site. However, 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 2002). This suggests that if present, the honeyeater species are more likely to use valleys, roadside remnant corridors and low hills than the disturbed high ridges of the proposed turbine sites to reach foraging habitat. Consequently, blade-strike and habitat removal are assessed to be **low** risk to these species and are unlikely to adversely affect the lifecycle of these species such that a viable local population is likely to be placed at risk of extinction.
Ecology and life cycle	**Gang-gang Cockatoo, Swift Parrot, Superb Parrot, Turquoise Parrot (Parrots Psittaciformes)** The Turquoise Parrot and Superb Parrot occur in Box-Gum grassy woodland and open forest (NPWS, 1999f), and also on the edges of these habitats. Swift Parrot and Gang-gang Cockatoo also occur in eucalypt forests and woodlands, particularly Box-Ironbark assemblages (Higgins, 1999). All four species

Guild	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
	are long lived with low fecundity and require tree hollows for nesting (Gibbons and Lindenmayer 2002). The Gang-gang Cockatoo are known to favour old growth attributes for nesting and roosting and rely on large hollows (NSW Scientific Committee, 2008). Turquoise Parrots are generally sedentary and occur in pairs or small groups (Pizzey *et al.* 2006). Nesting sites are located within a few kilometres of foraging grounds usually in tree hollows, in forests within 100 m from cleared land and 250 m from surface water (Higgins 1999). The other three parrots undertake nomadic or seasonal migratory movements (Swift Parrot and Gang-gang Cockatoo) for breeding and foraging (Garnett & Crowley, 2000). The Gang-gang Cockatoo moves between tall mature wet sclerophyll forest for breeding (summer) and dry open eucalypt forests (winter). The Swift Parrot is an annual migrant to the southern mainland from Tasmania (where it breeds). On the mainland, Swift Parrots inhabit eucalypt forests and woodlands, particularly box-ironbark forests, with a preference for sites along drainage lines (Higgins 1999). Superb Parrots utilise Box-Gum Woodland for foraging and breeding (summer), mostly nesting in dead trees (Manning et al., 2006; Webster, 1988). Where suitable nesting trees are widely dispersed, they forage up to 15 km from the nest. In winter they move into box, box-pine *Callitris*, and Boree *Acacia pendula* woodlands to feed on lerp, mistletoe berries, eucalypt flowers and grass seed (Higgins, 1999). All four parrots occupy different niches within forest and woodland environments. The Gang-gang Cockatoo feed mostly in the canopy on seeds of eucalypt trees and shrubs (e.g. banksia, hakea, casuarina), and may also eat invertebrates (Cameron 2007). The Swift Parrot is a specialised nectar- and pollen-feeder, particularly favouring *E. globulus*, and also eats psyllids and exotic fruits (Hingston et al 2004; Blakers et al. 1984, Emison et al. 1987). The Turquoise Parrot forages mostly on the ground for seeds of grasses and herbaceous plants, or browses on vegetable matter (Garnett & Crowley 2000). The Superb Parrot forages on the ground or in trees, feeding on lerp, mistletoe berries, eucalypt flowers and grass seed (Higgins, 1999).
Assessment	Potential impacts arising from the proposal are similar for the four parrots: habitat loss and degradation; the loss of hollow bearing trees as breeding (Superb Parrot and Turquoise Parrot) and roosting habitat, and blade-strike impacts. **Records:** Superb Parrot was detected in flying in a flock of approximately 12 over the woodland patch north of Cluster 10, outside the development envelope. This species was also detected by the authors in disturbed mature woodland alongside Illalong Road, approximately 5 km from the study area. None were observed in the vicinity of the proposed turbine sites. The Gang-gang Cockatoo and Swift Parrot have been recorded from within 10km of the site (south of Binalong and near McMahons Reef respectively). Turquoise Parrot records are from west of dividing range, with the closest record occurring approximately 40km west of the site. **Habitat loss and degradation:** Suitable foraging, roosting and breeding habitat (excluding Swift Parrot) is present on the site for these parrot species. Removal or degradation of breeding habitat has the potential to place local populations at risk. However, Turquoise Parrots are generally found west of the Great Dividing Range and Gang-gang Cockatoo move to tall mature wet sclerophyll forest to breed and therefore the likelihood of impacting important breeding areas is **very low**. Superb Parrots breed locally and have low fecundity, therefore loss or degradation of habitat suitable for breeding, particularly along Whitefields Road, is considered to be a **high risk** to a local population. The proposal would remove approximately 11.5 hectares of woodland, however only 3.5 hectares of this is within high condition remnants. Potential Superb Parrot habitat occurs in: • **road-side remnants adjacent to Whitefield's Road**

Guild	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
	• **in the saddle and north west crest on Cluster 10** • **in the transmission easement on the south-facing slope and saddle between Clusters 6 and 7a** • **in hollow-bearing paddock trees and woodland that occur within the valley between Clusters 5 and 7a** **Impacts on these areas, in particular on hollow-bearing trees, should be avoided to ensure that the proposed action does not result in a significantly impact on the lifecycle of Superb Parrot such that a local population is likely to be placed at risk of extinction.** **Collision risk:** Gang-gang Cockatoo, Swift Parrot and Superb Parrot populations may be at risk from collision when travelling above canopy during migration and dispersal. If present, the Turquoise Parrot may also be at risk of collision when travelling between foraging sites; however the lack of local records suggests that the probability of collision risk is **low** and would be unlikely to result in population-scale impacts. Superb Parrots and Swift Parrots may fly in large flocks (>50 birds) and Gang-gang Cockatoos in family groups increasing the risk factor to **moderate** (S.Sass pers. comm.2008). No flight height data is available for these species; however 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 use woodland remnants to forage and move across the landscape and are less likely to cross extensive open areas (Garnett & Crowley, 2000). Feeding areas and flying routes are therefore more likely to correspond with valleys and low hills with tree cover and remnant woodland along roadsides, rather than with the ridge top turbine sites. Swift Parrots and Gang-gang Cockatoo may fly at turbine blade height as they migrate to other woodland and forest sites, however the lack of mature woodland habitats at the turbine sites suggest that the frequency of visits is likely to be low. Swift Parrots and Gang-gang Cockatoos are manoeuvrable fliers and do not breed locally. 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). These three species would be among the bird species targeted for the bird and bat monitoring during the wind farm operation. Adaptive measures would be adopted if mortalities are found to occur. Impacts arising from the proposed development associated with collision and habitat removal are not considered likely to result in an adverse effect on the life cycle of these four parrot species such that a viable local population of the species is likely to be placed at risk of extinction.
Marsupials	
Ecology and life cycle	**Koala, Squirrel Glider** Both these species occupy woodland and forest and appear able to occupy moderately disturbed environments although it is questionable whether these species can persist in fragmented habitats over time (Ahern & van der Ree 2003; DECC 2008b; Gordon et al. 1988; McAlpine et al 2006; Wintle 2004). Squirrel Gliders have been found to travel over a large area for forage (up to 2.6km), while Koalas are less able to travel between fragments due to their low energy diet (Ahern & van der Ree 2003; Menkhorst 2004). Important habitat parameters for Squirrel Gliders are the presence of Yellow Box, Long-leaved Box, and Red Stringybark species, abundant tree hollows greater than 5cm diameter, and

Guild	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
	vegetated corridors if in fragmented landscape (showing a preference for lowlands and gullies) (Ahern & van der Ree 2003; DECC 2008b). Koalas are specialised foragers and regionally utilise Ribbon Gum and River Red Gum as primary habitat and Blakely's Red Gum, White Box, Yellow Box and Brittle Gum as secondary habitat (DECC 2008a). Connectivity is important for Koala persistence in an area. Secondary habitat has been found to be highly important, as it is more common and aids dispersal (McAlpine et al 2006). These species were not detected within the study area. Koala has been recorded within 8km in 2004, and Squirrel Glider from Burrinjuck Dam (approximately 25km of the site). Preferred eucalypt species for both animals are found on site.
Assessment	Potential impacts on these species associated with the proposal include habitat removal and degradation. **Habitat removal and degradation:** Squirrel Glider feed trees are present in all woodland areas, however hollow-bearing trees are not found in high numbers in any of these areas. Consequently the site is considered to provide only marginal habitat for this species. Hollow-bearing trees in mature (although disturbed) woodland within the development envelope are found on Cluster 10, along the edges of woodland within the transmission envelope between Clusters 6 and 7a and along Whitefields Road. Impacts on woodland within these areas should be avoided to minimise impacts on Squirrel Glider. The primary Koala feed tree River Red Gum occurs along Jugiong Creek, a small portion of which may be impacted by a proposed electricity easement. Secondary feed trees Blakely's Red Gum, White Box and Yellow Box occur in all examples of Box-Gum Woodland on the site. Approximately 29.57 hectares of Box-Gum Woodland and Dry Grass Forest has the potential to be removed as a result of the proposal, based on the indicative development layout. Additional mature disturbed woodland occurs along Whitefields Road which may contribute to east-west connectivity across the site. Given that the site is already highly fragmented and disturbed, impacts to these habitat is not considered likely to place a viable local population at risk of extinction should one occur on the site. Avoiding impacts on good to moderate condition and mature Box-Gum Woodland would reduce potential impacts on this species.
Insectivorous microbats	
Ecology	**Eastern Bent-wing Bat- *Miniopterus schreibersii oceanensis*** The Eastern Bent-wing Bat is a cave dependant species. Females migrate to specific cave sites in **October-November each year to give birth in December** and raise one young. Post weaning, **females leave maternity sites in late February-March** (Dwyer in Strahan 1983), with young dispersing from the sites approximately two weeks later (late March) (G. Richards pers.comm). Eastern Bent-wing Bats will utilise other structures for roosting such as mines, and occasionally buildings, when caves are in short supply. The species moves roosts based on climatic conditions and life cycle stage (Dwyer in Strahan 1983). Specific conditions are required in caves or mines used for winter torpor, mating events in Autumn, and raising of young. Eastern Bent-wing Bats require forested areas to forage in, flying above the canopy and to some height over the canopy to capture insects on the wing. The species will utilise "flyways"- tracks or roads- to forage also. There is no evidence that they have a strong affiliation with gradient, being recorded on ridges, midslopes and gullies.

Guild	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
	The species would forage in the same areas over the breeding season, and each year. Wilkinson (1992) showed that for a North American cave dwelling species, *Nycticeius humeralis,* that also congregates into maternity caves, bats exchanged information at roosts (and by 'eavesdropping' on echolocation of other bats) and followed successful bats to rich sources of insects. The maternity cave at Wee Jasper is in an open paddock area and demonstrates that the species will utilise open areas, though this may be an artefact of their requirement for specific cave conditions to raise young. Caves such as Wee Jasper's Church Cave and Drum Cave at Bungonia are not common in the Eastern Australian landscape and they seem to have strong affiliation with the sites that provide climatic conditions suitable for raising young
Distribution and movements	The Eastern Bent-wing Bat was not recorded by Anabat surveys at the site conducted in September 2008, although was recorded at nearby proposed Precincts, Carrolls Ridge and Marilba. Females migrate to specific cave sites in October-November each year to give birth in December and raise one young. Post weaning, females leave maternity sites in late February-March (Dwyer in Strahan 1983), with young dispersing from the sites approximately two weeks later (late March) (G. Richards pers.comm). The species distribution covers a wide area along the east coast of Australia, with populations dispersed within 300 kilometres of each of the known maternity roosts (DEC 2005). Eastern Bent-wing Bat are long-lived species. Churchill (1998) records an adult banded female being recaptured 18 years post banding. Four maternity caves are known in NSW: Willi Willi and Riverton in the north and Church (near Yass) and Drum in southern NSW. Each maternity cave often has an associated "staging" cave close by (Wee Jasper's is Mt Fairy Cave situated in the triangle between Bungendore, Tarago and Doughboy). Church Cave at Wee Jasper is c.42kilometres in a straight line from the site of the proposed Coppabella Wind Farm. The maternity colony size at Church Cave has been estimated at 60,000 when juveniles are flying with mothers (ie 30,000 pregnant females+ 30,000 babies). Dwyer (1968) suggested that the nursery colony at Church Cave, Wee Jasper was the maternity centre for the population of Eastern Bent-wing Bat from the Murrumbidgee, Lachlan and Moruya drainages, plus some of those from the Shoalhaven drainage (Mt fairy & Major's Creek). The exact nature of the migration route taken by females to reach or disperse from Church or other maternity caves is unknown, though supposed by Dwyer (1968) to be strongly related to topography-both waterways and divides, with the species flying along ridges or waterways, using them as navigation aides, rather than over. Dwyer went on to say that Eastern Bent-wing Bat may alter navigational cues from area to area. Home ranges are not confined to river basin areas (Wilson 2003). Flight speed has been recorded at 5.8metres/second or c.20kms/hour (Bullen & McKenzie 2008). Eastern Bent-wing Bats will not fly in wind speeds higher the c. 50kms/hour (Richards pers comm. 2008). Wind farms generally operate between 0.24 and 90km/hour. Dwyer (1964) recorded emergence and re-entry times of Eastern Bent-wing Bat's at mines and caves on the NSW north coast. He found that Eastern Bent-wing Bat's emergence correlated strongly with astronomical sunset, though slight differences in caves was based on the light intensity it received (ie facing West or North etc). Re-entry was however not so precise. Dwyer proposed re-entry was based more on food availability. Other factors affecting re-entry would be stage of development of the individual (juveniles only emerge for short periods when first flying at c.12 weeks old) (Dwyer 1963), females would forage longer with return flights to nursery caves when lactating, there is lower activity all round in winter. These factors could assist in helping to model peak activities of Eastern Bent-wing

Guild	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
	Bat's in the area for turbine operation.
Assessment	Potential impacts on this species include collision and barotrauma and foraging habitat removal (woodland). In light of the fact that the Eastern Bent-wing Bat would migrate to and from coastal areas, **migration impacts on the species by the proposed Coppabella wind farm are unlikely as the site is located to the north-west of the maternity cave at Wee Jasper**. However, large numbers of females are present at the maternity cave during the maternity season and a **high mortality of foraging females may result in population-scale impacts.** The cumulative impact risk arising from all three proposed Yass wind farms exacerbates the risks to this the local population of this species. Dwyer (1968) stated that nightly male movements did not often exceed 100 miles (120 kilometres). This is verified by Wilson (2003) assessing recaptured bat records from the Australian Bird and Bat Banding Scheme, as giving a population range of no more than 200 km from any roost, including maternity caves. Females would travel further to reach maternity caves, and may travel further afield than males in order to meet nutritional requirements of lactation. When not breeding however, most movements are local for foraging for both males and females. The 42km distance of **Coppabella Hills from Wee Jasper would be perhaps too far for regular nightly foraging activity**, given 120km is considered a maximum total night's flying. The turbine development envelope at the Coppabella site is predominately cleared and highly fragmented, however it continues to carry woodland and disturbed woodland habitats which are foraging habitats for this species. The removal of foraging habitat for the proposed wind farm is unlikely to result in population scale impacts given that the area of impact is small compared with the extent of similar habitats within the locality. However, the presence of foraging habitat within and adjacent to the proposed turbine locations may attract foraging individuals to the site, increasing the risk of collision and barotrauma. Eastern Bent-wing Bat occurrences within the forest patches in the study area are likely to be less frequent that in the larger, more continuous areas of forest that occur within the nightly foraging distance of 120km such as Burrinjuck Nature Reserve and nearby State Forest and National Park estate. **Further monitoring in November to March** during the maternity period, and follow-up assessment is considered necessary to determine the frequency that the species may forage on the site, and therefore the potential frequency of collision and barotrauma mortality during this time. This monitoring would help to determine the potential risk to the survival of the local population that is associated with the proposed wind farms. Potential mitigation measures which may reduce the risk to this species acceptable levels include the operating the wind farm only during low activity periods, such as during winter and only in high wind (between 50km/h and 90km/h), or during the day.
Ecology and Life cycle	**Little Pied Bat- *Chalinolobus picatus*** The Little Pied Bat roosts in caves, mines, buildings, and tree hollows in small groups, though one colony of 40 individuals has been recorded (Churchill, 1998). It prefers open, dry forests such as Mulga woodlands, chenopod shrublands or mallee with access to water sources (Churchill 1998, DECC 2008b). Little Pied Bat forage within the canopy (or subcanopy), as with most of the Vespertilinidae in Australia. It often forages along watercourses (Menkhorst and Knight 2004) where it feeds on moths and possibly other flying invertebrates. It gives birth usually to two young in November. Little Pied Bat is a sedentary species, little is known of home ranges for foraging but the species has been known to travel up to 34 km to gain access to water in more arid environments (Queensland

Guild	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
	Murray Darling Basin Commission, 2008). One record is present from the region: near Bowning is present for the Yass area, approximately 20 km from the site.
Assessment	Though the species is recorded in a wide variety of habitats, they are mainly found in arid inland areas. The site is unlikely to provide suitable habitat for the species, as it contains dry grass/herb forests and woodlands in mostly poor condition. The dams on the site are highly degraded and are unlikely to attract species to the site. It is considered highly unlikely that the species occurs in the area and therefore the proposal is not likely to result in impacts on the species such that a viable local population is likely to be placed at risk of extinction.
Ecology and Life cycle	**Eastern False Pipistrelle- *Falsistrellus tasmaniensis*** The Eastern False Pipistrelle utilises tree hollows for roosting, and has also been found under loose bark and in buildings (DECC 2008b). Colonies are small, from 3 to 36 individuals having been recorded, often segregated by sex (Churchill 1996). The Eastern False Pipistrelle relies on forested areas and forages within or just above the forest canopy. It is a relatively fast, manouverable flyer that hunts prey by pursuit. The species prefers tall wet sclerophyll forest with trees approximately 20 metres in height, though has been found in drier forests foraging. It can move medium distances to forage (c. 12km) (Churchill 1996). It is a winter hibernating species and it has been suggested that some highland populations migrate to the coast for winter (Parnaby in Strahan 1983), though by what route is unknown. Eastern False Pipistrelle give birth to one young in late Spring/Summer (December usually) and young are weaned by late February (Churchill 1998).
Assessment	All records for this species in the greater area are in forested areas south-west and south-east of Burrinjuck Dam. The closest records are from Cuumbeun Nature Reserve, near Queanbeyan (90km south-east). The site does contain small, fragmented patches of suitable foraging habitat for the species; however the distance from the closest known recordings of the species, it's preference for wet sclerophyll forest and its limited foraging range suggest that impacts on the species by the proposal are highly unlikely to result in population-scale impacts such that it could be placed at risk of extinction.
Ecology and Life cycle	**Large-footed Myotis *Myotis adversus*** The Large-footed Myotis is known to use tree hollows, caves, mines, under bridges, storm water drains, and vegetation such as Pandanus for roosting. Foraging is dependent on the presence of water bodies, both riparian and artificial such as dams. The species gleans insects from the waters surface and just below, as well as aerial prey. In NSW one young born per year in November / December (Churchill 1998). Only one record exists in the area for the Large-footed Myotis, at Wee Jasper near Burrinjuck Dam. The next closest record is south of the ACT border.
Assessment	Potential impacts on this species include collision and barotrauma risks and habitat removal. This species is rarely found away from water, often not further in than 100km from coast or along substantial rivers such as the Murray or Fitzroy. There are no major water bodies or large dams on the site. Given that the site is more than 100km from the coast, the species is unlikely to frequently occur on the site. The species may occur along Jugiong Creek north of the site; however moments are likely to be restricted along this riparian line and not on ridge top sites, reducing the risk of collision or

Guild	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
	barotrauma impacts. Given that the species is unlikely to occur on the site and that wetland habitats would not be impacted, it is not considered likely that the proposal would result in adverse impacts on the species such that a viable local population is likely to be placed at risk of extinction. Hollow-bearing trees are present on the site and provide breeding habitat for this species. Impacts to hollow-bearing trees in mature woodland remnants should be avoided. **Yellow-bellied Sheathtailed Bat *Saccolaimus flaviventris*** Listed as vulnerable under the NSW TSC Act, this cryptic species is known to use a variety of habitats. Yellow-bellied Sheathtailed Bats roost solitarily or in small groups in hollows, old buildings or occasionally abandoned nests of other species such as Sugar Gliders (Churchill 1996). The species is sedentary and possibly territorial, though has been found in Southern Australia only between January and June (Churchill 1998), which may suggest some movement for hibernation. A fast flying species with low manoeuvrability, it favours a range of insect species, mainly beetles (Churchill 1998; Richards 2001). One young are born December to mid-March, though peak is likely to be December (Churchill 1998)
Assessment	Potential impacts on this species include habitat removal and collision and barotrauma risks. No records of the species have been recorded in the Murrumbidgee CMA area; however it is a wide ranging species in northern and eastern Australia. Richards (2005) claims that the species may favour habitat in large tracts that has extensive understory flora (shrubs). This habitat is not provided on the site, being dissected by grazing paddocks and with low understorey richness from grazing activities. It is considered **unlikely that the species occurs** in the proposal area and therefore the proposal is not likely to have an adverse effect on the life cycle of the species such that a local population is likely to be placed at risk of extinction.
Conclusion: all microbats	Habitat loss, collision and barotrauma impacts on microbats may occur as a result of the proposed activity. **Habitat loss** is assessed as a **low risk for all species** given the small area of impact compared with the extent of similar vegetation in the locality and the mobility of the species. Mitigation measures should include protection of good and moderate-good condition woodland, and retention of mature hollow-bearing trees. **Collision and barotrauma** is assessed as being a **high risk for Eastern Bentwing Bat** as: - The species is known from the locality. - Although the site is not along a migration route between maternity and staging caves and the coast, the site is located within the foraging range of a known maternity cave. - Cumulative impacts arising from the development of the other two Yass wind farm sites have the potential to result in population-scale impacts Large areas of suitable forested foraging habitat occur within the foraging range of the maternity cave (120km), particularly to the south. The site is within fragmented rural farmland, suggesting that the species may not frequently visit the site when compared with other areas, however further monitoring needs to be undertaken in order to determine the significance of potential impacts on this species. **Collision and barotrauma** is assessed as a **low risk** for the other microbat species, Yellow-bellied Sheathtailed Bat, Little Pied Bat, Eastern False Pipistrelle, Large-footed Myotis due to the absence of

Guild	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
	preferred habitat on the site and the lack of local records. *It is considered unlikely that the proposal would result in adverse impacts on these species such that a local population would be placed at risk of extinction.* ***Additional microbat surveying has been conducted in January 2009 to coincide with foraging periods during the maternity season. The results of this survey will be reported in a separate report.***
Reptiles	
Ecology and life cycle	**Pink-tailed Legless Lizard (*Aprasia parapulchella*), Little Whip Snake (*Suta flagellum*) and Striped Legless Lizard (*Delma impar)*** Pink-tailed Legless Lizard occur in areas where a moderate to extensive cover of native grass occurs (Jones 1998). The presence of**Grass** (*Themeda australis*) is likely an indicator of less disturbed areas where pasture improvement has not occured. Little Whip Snake has been found in grasslands, grassy woodlands, and secondary grasslands. Both species require well-drained slopes with loose scattered rocks or rocky outcrops as these provide basking, shelter and foraging habitat. Pink-tailed Legless Lizards feed on the larvae and eggs of ants and termites and have frequently been found in arthropod burrows beneath small, partially embedded rocks (DECC 2008b; Osborne and Jones 1995). Striped Legless Lizards tend to prefer **native grassland** dominated by dominated by perennial, tussock-forming grasses such as Kangaroo Grass (*Themeda australis*), spear-grasses (*Austrostipa* sp.) and poa tussocks (*Poa* sp.), but have also been recorded in **grassy woodland, secondary grassland and grasslands that have a high exotic component** (DECC 2008b; Smith and Robertson 1999). The Striped Legless Lizard recovery plan suggests that their key to survival in disturbed habitat may be linked with grassland with a dense and continuous structure and to the presence of refuge sites such as dense grass tussocks,rock outcrops, road easements, less disturbed neighbouring land or even soil cracks and arthropod burrows in the short-term; however it is not known whether the species can survive in disturbed sites in the long-term (Smith and Robertson 1999). **Distribution/records** These species were not recorded during the field surveys and have not been recorded within 20km of the site. Pink-tailed Legless Lizard and Striped Legless Lizard are known from the region (DECC 2008b; Osborne and Jones 1995); however, Little Whip Snake has been found within an area bounded by Crookwell in the north, Bombala in the south, Tumbarumba to the west and Braidwood to the east which the Coppabella site would sit within (DECC 2008b). Despite the lack of records from the locality, the site provides suitable habitat for these species. Pink-tailed Legless Lizard have been found to occupy small home sites of up to 500 cm^2, with multiple individuals sharing the same home site; however home range and movements of this species is unknown (Jones 1998). Little Whip Snake is likely to have a home range of around 2000-5000 m^2 (S. Sass Pers com 2008). Striped Legless Lizard species is relatively long lived (around 10 years) and is wide ranging for a small reptile (Smith and Robertson 1999). Movements of between 5-20m per day, or utilisation of an area of up to 0.25ha over a week (Kutt 1993). **Assessment** Potential impacts on these reptile species arising as a result of the proposed development include rocky outcrop, woodland and secondary grassland habitat removal, degradation and fragmentation. Rocky outcrops on well-drained slopes provide habitat for the Pink-tailed Legless Lizard and Little Whip Snake. This habitat occurs on all ridge tops across the site and forms a large proportion of the development envelope. The low mobility of the species, particularly the Pink-tailed Legless Lizard

Guild	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
	suggests that even a small area of impact within their home site may result in population-scale impacts. The highest quality rocky habitat for these threatened reptiles is present within native pasture habitats (Little Whip Snake) and in grassy woodland (both species). Approximately 197.56 hectares of rocky outcrops occurs within the development envelope, and 5.15 hectares would be removed, based on the indicative layout. Groundcover composition varies considerably between and within clusters; however, with the exception of Cluster 10, all ridge top rocky outcrops surveyed were heavily degraded by grazing, clearing and extensive weed invasion. All had an exotic forb component, and many were dominated by exotic grasses and forbs (surveys on Clusters 1, 2 and 4, parts of 5 and 6 upper slope, parts of 7a and 7b ridge and upper slope; 3a upper slope; and parts of 10). Observations from adjacent view-points revealed that non-surveyed cleared ridge tops were also heavily degraded, with little top soil. Grazing, clearing and weed invasion has been shown to reduce the suitability of rocky sites for reptile species (Dorrough and Ash 1999; Fischer *et al.* 2004) and these processes are listed as threats for both species (DECC 2008b). Therefore the cleared rocky outcrops that occur on the ridge top sites are only considered to be marginal habitat for these species. Rocky outcrops predominately occur in cleared pasture habitats, although occasionally within woodland on lower slopes, predominately outside the development envelope. Cluster 10 is the only area within the development envelope that features rocky outcrops in woodland. Given the discrete nature of the development, the extent of similar nearby habitat, present condition of habitat at Coppabella, habitat removal is considered to be a **low risk** for these species. It is unlikely that the proposal would result in an impact on Pink-tailed Legless Lizard and Little Whip Snake such that a viable local population of the species is likely to be placed at risk of extinction. Striped Legless Lizard is predominately restricted to grassland habitats, although has also been recorded within grassy woodland and grassland with a predominately exotic component (Smith and Robertson 1999). Cleared grassy habitats occur within the development envelope, however all areas are heavily degraded by grazing and do not provide suitable refuge sites for the species such as a dense and continuous groundcover structure or dense grass tussocks. Moderate to good condition woodland habitats may also provide habitat for this species, provided that there is suitable grassy groundcover and refuge sites available. All woodland remnants that occur within the development envelope have been grazed and there is few refuge sites present. Less disturbed areas are present on Cluster 10 (particularly on the saddle and slope), the edge of 7b and along proposed power-line route between Clusters 6 and 7a. Moderate to good condition woodland habitats are also listed as an Endangered Ecological Community (Box-Gum Woodland) and are considered to be high constraint areas for the proposal. Impacts to these areas should be avoided. Provided that works avoid impacts on good quality woodland habitats, it is considered highly unlikely that the proposed activity would have an adverse effect life cycle of the Striped Legless Lizard such that a viable local population of the species is likely to be placed at risk of extinction.

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	
	N/A

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 the 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

Approximately 983.1 hectares of the Endangered Ecological Community **White Box- Yellow Box - Blakely's Red Gum Grassy Woodland** occurs within the development envelope, 265.2 hectares of this total is considered to be in moderate to good condition (high constraint). Areas of pasture dominated by native grasses and a moderate diversity of forbs also come under the EEC definition. Areas of native pasture are irregularly interspersed between extensive areas of exotic dominated pasture throughout the development envelope. While small remnants or isolated trees in native pasture on other parts of the site must be regarded as belonging to the EEC under NSW legislation, they are considered to be of relatively low conservation significance due to the highly degraded nature of the groundcover and very limited recovery potential and therefore their removal is not considered likely to result in significant impacts on the extent or composition of the community such that its occurrence is likely to be placed at risk of extinction.

High conservation value EEC patches are considered to be high constraints for the proposal. The location and potential impacts on high constraint woodland EEC are outlined in the table below.

Location of high constraint woodland within development envelope	Aspect of works which may potentially impact the patch
On the central saddle on Cluster 10	Access track and turbine envelope
On the most south easterly crest on 10	track and 1 turbine
In the far north west corner on 10	track
Patches on the south facing slopes on 8	no impact
Patches on the south facing slopes on 7a and 7b	1 turbine
Within saddles and east of the northern part of Cluster 3	2 turbines, tracks and transmission easement
Within the transmission envelopes in the valley between 6 and 7a	Transmission easement

Based on the indicative layout, the proposal would remove approximately 3.5 hectares of Box-Gum Woodland in moderate to good condition, primarily along the edges of larger patches of woodland and in isolated stands on ridge tops and slopes. Of this total, only 0.59 hectares is woodland of high constraint (good, moderate to good and moderate condition).

The central saddle on Cluster 10 is the only area within the impact zones where the groundcover is in

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 the 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**
moderate-good condition (few weeds and a fair level of native species diversity); however this habitat is continuous with an extensive area of good condition woodland EEC (about 100ha) immediately north of Cluster 10 which provides habitat to a number of threatened species. Tracks and turbines on Cluster 10 should be micro-sited to avoid impacts to high constraint woodland. Woodland on the slopes and valley between Clusters 6 and 7a is primarily on steep slopes, which is likely to be less suitable for transmission siting. This area is connected to a large woodland remnant along the south west facing slope of Cluster 7. The transmission routes should be micro-sited further south west to avoid impacting this woodland patch. Impacts on these two areas should be avoided in order to ensure that the proposal does not result in a significant impact on the extent or composition of the community. Woodland remnants on Cluster 3 and in other areas are of less concern as these areas are more fragmented and disturbed by clearing than the patches around 10 and 7. Despite being of lower relative value, transmission, track and turbine siting should be micro-sited to minimise impacts to the existing woodland to maintain habitat stepping stones and avoid impacts to native understorey areas. This is particularly important when considering the cumulative impacts of the three Yass wind farms, all of which contain Box-Gum Woodland within the proposed development envelope. Vegetation clearing in lower conservation significant areas (poor, poor-moderate condition and cleared native pasture) is likely to be required, however given the current fragmented and disturbed condition of these areas, and the small extent of works given the large extent of similar habitats onsite, this is not considered to be significant. All vegetation clearing should be offset to achieve an 'improve or maintain biodiversity values' outcome. Further survey work should be undertaken once the final turbine layout has been determined in order to calculate likely offset targets for derived Box-Gum Woodland native pasture. Provided that impacts to high constraint woodland EEC are minimised, and any vegetation clearing is offset within nearby Box-Gum Woodland remnants, the proposal would not place the EEC at this location at risk of extinction, or modify the composition of remaining stands such that they are 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**
Flora
Moderate to good condition woodland that occurs on the steep slopes of Cluster 7a are habitat for Yass Daisy. A proposed transmission envelope was within this area; however, the proposal has been modified to avoid

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**

impacts on high constraint woodland. Given that this species also occurs within woodland on other areas outside the development envelope, the proposed action is not considered likely to impact the long-term survival of the species within the locality.

It is very unlikely that either Yass Daisy or Burrinjuck Spider Orchid occurs undetected in other parts of the turbine sites due to the heavy grazing pressure to which all the higher parts of the site appear to have been subjected.

Ecological Communities

i) Extent of EEC removal and modification: Approximately 11.5 hectares of Box-Gum Woodland and Dry Grass Forest EEC has the potential to be removed as a result of the proposal, based on the indicative development layout; of this only 0.59 hectares is considered to be in good, moderate to good and moderate condition.

Removal of lower constraint woodland and derived native pasture is likely to be removed as a result of the proposal; however this is not likely to be significant given the disturbed and fragmented condition of these remnants. Vegetation offsetting would help to reduce the overall loss of woodland within the locality, and may also increase the habitat value of existing remnants offsets through fencing and weed control.

ii) Fragmentation: The works will not significantly exacerbate the existing fragmentation of the habitat and EEC. Fragmentation is already such that only more mobile fauna species and long-distance dispersing are likely to be able to utilise the habitat patches, and genetic exchange between remnants is likely to be limited.

iii) Examples of good and moderate condition Box-Gum Woodland are relatively rare within the region. Areas of this highly constrained woodland EEC occurs within the development envelope and is likely to be contribute to the long-term survival of the community within the locality. Derived native pasture and lower condition remnants are of lower conservation significance. The removal and modification of lower constraint EEC as a result of the proposal would contribute to the ongoing loss and degradation of the woodland community across the region, however given the extent of Box-Gum Woodland within the broad development envelope (983.12 ha) and elsewhere within the locality, this is not likely to impact the long-term survival of the species within the locality.

Fauna

i) Extent of removal and modification: five distinct habitat types are present on the site: modified wetland habitats, woodland and disturbed woodland, pasture and rocky outcrops.

These are summarised below:

Habitat type	Total extent within DE(hectares)	Threatened species potentially occurring in this habitat type

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**

Woodland	241.37	Square-tailed Kite, Barking Owl, Hooded Robin, Diamond Firetail, Brown Treecreeper, Speckled Warbler, Painted Honeyeater, Regent Honeyeater, Superb Parrot, Turquoise Parrot, Swift Parrot, Gang-gang Cockatoo, Squirrel Glider, Koala, Eastern Bent-wing Bat, Little Pied Bat, Eastern False Pipistrelle, Yellow-bellied Sheathtailed Bat, Striped Legless Lizard, Little Whip Snake and Pink-tailed Legless Lizard
Disturbed woodland	780.75	Square-tailed Kite, Barking Owl, Hooded Robin, Diamond Firetail, Painted Honeyeater, Superb Parrot, Turquoise Parrot, Swift Parrot, Squirrel Glider, Koala, Eastern Bent-wing Bat, Little Pied Bat, Eastern False Pipistrelle and Yellow-bellied Sheathtailed Bat
Pasture with scattered trees	1,834.7	Square-tailed Kite, Diamond Firetail, Hooded Robin, Eastern Bent-wing Bat, Little Pied Bat, Eastern False Pipistrelle and Yellow-bellied Sheathtailed Bat, Striped Legless Lizard
Rocky outcrops	197.56	Little Whip Snake and Pink-tailed Legless Lizard
Modified wetland habitats	11.27	Large-footed Myotis; potentially all species for watering

The total direct footprint of the proposed turbine sites and associated infrastructure is approximately 70 hectares (refer to Tables 8-1 and 8-2). Impacts to higher quality woodland areas and wetland habitats would be avoided.

A number of threatened species utilise hollow-bearing trees for roosting and nesting. Only a small number of hollow-bearing trees occur within the development envelope on Clusters 10, on the edges of woodland on 7a and 6, and also adjacent to Whitefields Road. Impacts to hollow-bearing trees would be avoided where possible to minimise impacts to threatened fauna.

ii) Fragmentation: the site is already highly fragmented by clearing and grazing pressure. The proposed development would not further fragment woodland habitats as works would impact only isolated patches and copses of trees or the edges of larger woodland remnants.

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**
iii) The importance of the habitat to be removed as a result of the proposal has been assessed as a low and very low risk to the long-term survival of most of the relevant threatened fauna within the locality (part a. above). This is because the site is already highly fragmented and disturbed by clearing, grazing and weeds, wetland habitat would not be affected and works would aim to avoid impacts to high quality woodland habitat and hollow-bearing trees. Furthermore, the area to be impacted is small in relation to the availability of similar habitats on the site and within the locality and works would not result in fragmentation of habitats. Only Superb Parrot was assessed as being at high risk of habitat removal. Superb Parrot is known to breed locally and have low fecundity. Suitable breeding habitat of Superb Parrot occurs within the site. This habitat is likely to be important to the long-term survival of Superb Parrot within the locality. Impacts to Superb Parrot habitat (identified in a.) should be avoided to ensure that the proposed action does not impact the long-term survival of the Superb Parrot within the locality.

Species	**○ 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 within the district.

Species	**○ whether the action proposed is consistent with the objectives or action of a recovery plan or threat abatement plan**
Flora and Ecological Communities	There is no national or NSW Recovery Plan for White Box – Yellow Box –Blakely's Red Gum Woodland or for Yass Daisy. A Draft Recovery Plan exists for the closely related *Caladenia concolor*, *Caladenia* sp. *Bethungra* and *Caladenia* sp. *Burrinjuck*. Objectives or actions relevant to the latter species include survey for new populations in the vicinity of known populations, monitoring of known populations and improving public awareness of the three spider orchids in order to enlist support for the recovery program. The proposed action is consistent with these objectives, in that areas of (marginally) potential habitat have been surveyed for the relevant taxon as part of the preparations for the proposal.

Species	○ whether the action proposed is consistent with the objectives or action of a recovery plan or threat abatement plan
Fauna	Recovery Plans are have been made or adopted for the following species: • Barking Owl • Regent Honeyeater • Swift Parrot • Koala • Striped Legless Lizard
Barking Owl	The broad objective of the Draft Recovery plan for the Barking Owl is to ensure the long-term persistence of the Barking Owl in NSW through education, threat abatement and mitigation and through organisational support (NPWS 2003a). The recovery plan identifies the following relevant key threatening processes: Clearing of native vegetation; Continued net loss of native hollow bearing trees and coarse woody debris Removal of dead wood, dead trees and logs; Broad threat mitigation recommendations are as follows:- • Avoid clearing good and moderate-good condition woodland. Preserve hollow-bearing and mature trees where possible, particularly in better quality remnants (such as on the edges of 7a, Cluster 10 and along Whitefields Road). • Offset vegetation clearing by protecting high quality areas outside the development envelope and within the locality (north of Cluster 10 and on the slope below 7). Ensure offset areas contribute to maintaining connectivity across the region.
Regent Honeyeater	The broad objective of the National Recovery Plan for the Regent Honeyeater 1999-2003 is to ensure that the species persists and increases in the wild through maintaining and enhancing the value of habitat throughout their former range (Menkhorst *et al.* 1999). Relevant mitigation measures include: • Avoid impacts to feed tree species (including Yellow Box, Blakely's Red Gum, White Box) within woodland remnants. • Avoid impacting habitat connectivity by restricting impacts to the edges of continuous woodland or isolated stands
Swift Parrot	The broad objective of the Swift Parrot Recovery Plan is to change the conservation status of the Swift Parrot from endangered to vulnerable and to achieve sustained improvement in the quality of swift parrot habitat (Tasmanian Department of Primary Industries, Water and Environment) (Swift Parrot Recovery Team 2001). Relevant threats include habitat loss and adult mortality. Relevant mitigation measures to minimise impacts on Swift Parrot arising from the proposal include: • Minimise impacts to woodland habitats, particularly along drainage lines to

Species	○ whether the action proposed is consistent with the objectives or action of a recovery plan or threat abatement plan
	protect foraging habitat • Ensure collision impacts are monitored and implement adaptive measures are adopted if mortalities are found to occur.
Koala	The broad objective of the Approved Recovery Plan for the Koala is to reverse the decline of Koala and to protect, manage and restore Koala habitat. The Plan identifies the following relevant threats: • Clearing of native vegetation resulting in the loss, fragmentation and degradation of habitat • Broad threat mitigation recommendations are as follows:- • Avoid clearing good and moderate-good condition woodland, mature woodland, and potential movement corridors. Specific areas include Cluster 10, between Cluster 6 and 7, and within the mature woodland along Whitefields Road. • Offset vegetation clearing by protecting high quality areas within the locality
Striped Legless Lizard (EPBC)	The broad objective of the National recovery plan for the Striped Legless Lizard (*Delma impar*) 1999-2003 is to ensure the long-term survival of *D. impar* throughout its distribution. Its main threat throughout its entire range is listed as habitat degradation and destruction (Smith and Robertson 1999). Relevant mitigation measures to minimise impacts on Striped Legless Lizard arising from the proposal include the protection of high-quality grassy woodland habitats from impacts on the site.
Conclusion	This proposal is considered to be consistent with the objectives of these recovery plans.

Species	○ 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
	Five Key Threatening Processes (NSW Scientific Committee 2008) are relevant to this proposal: **Bush Rock Removal**. Includes removal of rocky outcrops or rock within areas of native vegetation. Impacts of bush rock removal includes loss or disturbance of native flora and fauna species habitat, including those described (e.g. *Delma impar).* Rocky outcrops occur on all ridge sites within the development envelope. Disturbed rocks should be relocated in situ to ensure suitable micro-habitat resources are maintained. **Invasion of perennial grasses:** The invasion of native vegetation by exotic perennial grass has the potential to occur following the construction phase. The Box-Gum Woodland EEC in particular is vulnerable to the introduction and spread of perennial grasses such as African Love Grass, Serrated Tussock, Phalaris, Cocksfoot, Yorkshire Fog and Paspalum. Weed controls should be implemented through an Environmental Control Plan prior to commencement of works.

	Clearing of native vegetation. Impacts of clearing include fragmentation, destruction of habitat, riparian zone degradation, loss of leaf litter layer and increased habitat for invasive species. Clearing is defined as "*...the destruction of a sufficient proportion of one or more strata within a stand or stands of native vegetation ...*" (NSW Scientific Committee 2008). **Loss and/or degradation of sites used for hill-topping by butterflies**. Hill-topping in butterflies is a very complex behaviour that often facilitates meeting of the sexes. Factors which determine whether an area is suitable can be subtle so that even small changes may cause butterflies to abandon the area. Disturbance of plants on, or topography of, the hill-top, or to its slopes and immediate surroundings, may render it unsuitable to butterflies as a hill-topping site. In the absence of other hill-topping sites, butterflies may disappear entirely from a district. Loss of hill-top habitats throughout NSW would affect butterfly species which rely on such sites and some local extinctions have undoubtedly occurred due to hill-top alteration. Loss of hill-topping sites due to habitat alteration (e.g. loss of vegetation for communication towers or power transmission lines), may lead to loss of perching or patrolling sites for male butterflies, loss of focal points for mating and thus local extinctions. Considered cumulatively, the impacts of the proposed Coppabella wind farm and the other 3 sites planned for the District may exacerbate this threatening process. **Loss of hollow-bearing trees**. Around 174 NSW vertebrate species are known to use tree hollows for shelter and nesting, including those discussed. Generally hollow-nearing trees are in decline due to reasons including lack of recruitment and clearing. In particular, trees bearing large hollows are rare, and required by species discussed including Powerful Owl. Generally hollow-bearing trees near riparian habitat are most valuable. Only a small number of hollow-bearing trees occur within the development envelope on Clusters 10, 3 north, along the edges of woodland below 7a and 6, and also adjacent to Whitefields Road. These do not occur near riparian habitat. Removal of these trees in higher quality woodland habitat and in mature remnants would be avoided. **Removal of dead wood and dead trees.** Removal of standing or fallen dead wood removes potential hollows in stags as well as ground refuge sites. All the sites provide this habitat resource. The proposed works may exacerbate this process during clearing for tracks or turbines, however all litter and timber disturbed would be relocated in situ to ensure suitable micro-habitat resources are maintained.

E.2 EPBC ASSESSMENTS OF SIGNIFICANCE

The *Environmental Protection and Biodiversity Conservation Act (C'th) 1999* specifies factors to be taken into account in deciding whether a development is likely to significantly affect Endangered Ecological Communities, threatened species and migratory species, listed at the Commonwealth level.

The assessment should be read in conjunction with the Assessment of Significance under the NSW EP&A Act and TSC Act (Appendix E), and the *Windfarm Risks to Birds and Bats* Addendum (Appendix G) which contain background information in relation to species ecology, species and community distribution and scale, specific development impacts, and impact risks. The assessments have been made assuming no mitigation measures. Some high risk category impacts may potentially be mitigated. Mitigation measures are detailed in Section 8.

Endangered Ecological Communities

White Box - Yellow Box - Blakely's Red Gum Woodlands Critically Endangered Ecological Community (CEEC)

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,
Approximately 15ha of grassy woodland occurs within the development envelope that is of sufficient integrity to be classified as Box, Yellow Box, Blakely's Red Gum Grassy Woodland CEEC, under the EPBC Act occurs within the proposed development envelope: between Clusters 5, 6, and 7a (Area 4, shown in Appendix I, map zone 2). Woodland in this area is primarily on steep slopes, which is likely to be less suitable for transmission siting. Works in this area would reduce the extent of CEEC woodland on the site and should be avoided or micro-sited further south west to avoid impacting standing live and dead trees within this woodland patch. The modifications outlined in Section 9 demonstrate that the proposal has been modified to avoid impacts on this area.
b) fragment or increase fragmentation of the community, for example by clearing vegetation for roads or transmission lines;
The proposal would not act to fragment this community provided that the proposed transmission in the valley between 5 and 7a proceeds further south west to avoid standing live and dead trees within the CEEC area.
c) adversely affect habitat critical to the survival of an ecological community which consists of, or includes, fauna species;
The development would not have this effect, provided that the transmission between 5 and 7a is micro-sited to avoid impacting trees within this woodland patch and weed controls implemented.
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;

Soils and nutrient balance are already highly disturbed due to grazing impacts over most of the site. It is apparent from differences in soil levels across some fences on ridge crests within the site that there has been substantial soil loss from some areas due to baring of the soil from overgrazing and sheep trampling, and wind erosion. Elevated nutrient levels are clearly present in areas favoured as sheep camps, with vegetation dominated by thistles and nettles. Some modification of surface water drainage patterns has undoubtedly also occurred due to soil compaction and loss of vegetation cover. Salinisation is reported by some landowners in the district, though no definite evidence of this was detected on the site.

This aspect of the landscape (soils and the water cycle) is already quite heavily disturbed. The proposal could lead to further damage if roading to provide access to the ridge crests, or other infrastructure development associated with the development interferes further with overland runoff.

Sediment controls should be implemented through a Construction Environmental Plan to prevent onsite habitat degradation during and following the proposed works. This Plan would ensure that the CEEC patches are not substantially impacted by the modification of essential abiotic factors.

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 proposal would not have this effect, provided that works in this area are micro-sited to avoid trees within the community and weed controls are implemented.

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 proposal would not have this effect, since the area of vegetation likely to be cleared or modified is small in comparison to the extent of the community that occurs within the locality; and works in this area would be discrete and could be micro-sited to avoid trees within the community. Hazardous spill and sediment erosion controls would be implemented as part of the proposed works.

The invasion of native vegetation by exotic species may impact this community. The Box-gum Woodland CEEC in particular is vulnerable to the introduction and spread of perennial grasses such as African Love Grass, Serrated Tussock, Phalaris, Cocksfoot, Yorkshire Fog and Paspalum. It appeared at the time of the survey that perennial exotic grasses were uncommon on the site, so the proposal is unlikely to exacerbate their spread, unless new grass weeds are introduced. Weed control measures should be implemented through an Environmental Control Plan prior to commencement of works. Machinery and vehicles should be washed down before being brought onto the site and unnecessary soil disturbance should be avoided, to minimise the risk of exacerbating weed invasion in the EEC remnants.

g) interfere with the recovery of an ecological community.

The proposal would not interfere with the recovery of the EEC, since the area of vegetation likely to be cleared or modified is small in comparison to the extent of the community that occurs within the locality; and works in this area would be discrete and could be micro-sited to avoid trees within the community. No recovery plan has yet been prepared for this EEC.

Threatened flora and fauna species

Species	*a) Will the action lead to a long-term decrease in the size of a population of a species?*
FLORA	
Yass Daisy	Yass Daisy was recorded on the slopes below 7a, part of which falls within a proposed transmission corridor between Clusters 6 and 7a; and also in the woodland patch north of Cluster 10. Burrinjuck Spider Orchid has not been recorded on the site and is not likely to, given the absence of suitable habitat and the grazing history. Yass Daisy may occur within moderate to good condition woodland patches on steep slopes in other areas on the site. The probability that this species occurs on the heavily grazed ridges and upper slopes within the turbine impact zone is very low, as it was not recorded in any of the areas surveyed in this type of habitat. Works within the proposed transmission easement between Clusters 6 and 7a should be micro-sited so that moderate to good condition woodland is not impacted. A pre-clearance survey should be conducted prior to works along the edges of moderate to good condition woodland to ensure that no individual Yass Daisies are impacted. This would ensure that works are not likely to lead to a long-term decrease in the population size.
FAUNA	
Regent Honeyeater	Local feed species including Yellow Box and Red Stringybark are present on the site, however given the disturbed and fragmented nature of the site, the removal of 11.5 hectares of woodland vegetation is not considered likely to impact this species given their high mobility and the extent of similar vegetation present within the vicinity. 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). This suggests that if present, Regent Honeyeaters are more likely to use valleys, roadside remnant corridors and low hills than the disturbed high ridges of the proposed turbine sites to reach foraging habitat. Consequently, blade-strike and habitat removal are assessed to be **low** risks to this species and are unlikely to lead to a long-term decrease in the size of a local population.
Superb Parrot	West of Yass forms part of the core breeding population of the Superb Parrot. This species have low fecundity and are known to nest locally in September-January in small colonies, using tree hollows in open Box-gum Woodland or isolated paddock trees (Manning et al. 2004). Habitat removal, particularly the removal of hollow-bearing trees in mature woodland remnants, is considered to be a high risk for this species, and has the potential to result in significant impacts on a local population of this species. The proposal would remove approximately 11.5 hectares of woodland, however only 0.59 hectares of this is within woodland of good, moderate to good and moderate condition. Potential Superb Parrot habitat occurs in: • **road-side remnants adjacent to Whitefield's Road**

	• **in the saddle and north west crest on Cluster 10** • **in the transmission easement on the south-facing slope and saddle between Clusters 6 and 7a** • **in hollow-bearing paddock trees and good condition woodland that occur within the valley between Clusters 5 and 7a** **Impacts on these areas, in particular on hollow-bearing trees, should be avoided to ensure that the proposed action does not lead to a long-term decrease in the size of a population of the Superb Parrot.** Superb Parrots fly in large flocks and have low fecundity and are at risk of population-scale impacts as a result of blade-strike. The species tend to use woodland remnants to forage and move across the landscape and are less likely to cross extensive open areas (Garnett & Crowley, 2000). Consequently, feeding areas and flying routes are more likely to correspond with valleys and low hills with tree cover and remnant woodland along roadsides, rather than with the ridge top turbine sites, reducing the risk of collision impacts. This species would be targeted for monitoring during the operation of the wind farm. Adaptive measures would be adopted if mortalities are found to occur in order to ensure that the action does not lead to a long-term decrease in the size of a local population.
Swift Parrot	The Swift Parrot is a migratory species travel in large flocks, however, they are maneuverable fliers and do not breed locally. 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). The species may forage within the woodland on the site; however given that the species does not breed in the region, the removal of 11.5 hectares of box gum woodland vegetation is not likely to result in significant impacts on the species such that the action leads to a long-term decrease in the size of a local population.
Pink-tailed Legless Lizard Striped Legless Lizard	There is likely to be a low risk to Striped Legless Lizard populations due to habitat loss given the absence of suitable native grassland habitats. The species may also occur within marginal grassland habitats with exotic species or grassy woodland; however the extent of grazing and weed invasion greatly reduces the likelihood that the species would persist on the site. Pink-tailed Legless Lizard occurs within rocky outcrops in native grassy woodland. Clusters 10 is the only area within the development envelope that features rocky outcrops in woodland. Rocky outcrops also occur within grazed native and exotic pasture habitats. Given the discrete nature of the development, the extent of similar nearby habitat and the grazing regime within these areas, habitat removal is considered to be a low risk for these species. The action is not likely to result in significant impacts on the species such that the action leads to a long-term decrease in the size of a local population.
b) Will the action reduce the area of occupancy of the species?	
FLORA	
Development within moderate to **good** condition woodland on slopes for transmission construction would reduce the area of potential habitat for Yass Daisy. Works on the saddle and slopes between Clusters 6 and 7a have been moved south so that moderate to good condition woodland is not impacted to ensure that the	

development does not reduce the area of occupancy of the species.

It is not likely that suitable habitat for the Burrinjuck Spider Orchid is present within the development envelope.

FAUNA

Works within moderate to good condition woodland, particularly mature woodland, may reduce the breeding area for Superb Parrot. Specific areas of concern for this species include impacts to road-side remnants along Whitefields Road, in the saddle and north west crest on Cluster 10, in the transmission easement on the saddle between Clusters 6 and 7a, and in hollow-bearing paddock trees in the valley between Clusters 5 and 7a. Impacts to these areas (in particular the removal of mature trees) should be avoided.

Regent Honeyeater and Swift Parrot are migratory and do not breed within the region. Works within woodland habitats would result in a reduction in potential foraging habitat for these species; however, impacts would primarily occur within disturbed and fragmented areas on ridge tops and in cleared habitats, with only 0.59 hectares of moderate to good condition woodland expected to be impacted. This is not considered to be a significant loss of habitat for these species.

The risk of blade-strike reduces aerial habitat for bird species. On-going monitoring to study the long-term effects of the operational wind farm on birds and bats in the locality is recommended.

The proposal would remove approximately 54 hectares of native and exotic pasture and 5.15 hectares of rocky outcrops. These habitats occur on all turbine Cluster ridges and are predominately disturbed by intensive grazing and weed invasion and could only be considered marginal habitat for the Striped Legless Lizard and the Pink-tailed Legless Lizard. Impacts to rocky outcrops within higher quality woodland habitat on Cluster 10 may reduce the area of occupancy for the Pink-tailed Legless Lizard, should it occur on the site; however this represents only a small habitat loss in relation to the availability of similar habitat outside the development envelope and is unlikely to significantly impact the species.

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

The proposed works are unlikely to result in fragmentation of woodland habitats given that the site is already highly fragmented and disturbed from grazing and clearing. Permanent habitat removal for wind turbines would occur primarily within marginal ridge-top woodland. Access to the turbine Clusters is via existing tracks and roads, along the edges of woodland habitats or within cleared and disturbed areas. Works be micro-sited to avoid removal of mature and hollow-bearing trees and continuous woodland habitat. Track and road widening would not dissect continuous patches; however this may result in the reduction of habitat 'stepping stones' for use by mobile fauna. This is not considered likely to result in significant impacts on fauna and flora in the locality given the limited extent of woodland habitat removal in relation to the extent of woodland that occurs within the broad development envelope (983.12 ha).

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

Yass Daisy was found within moderate to good condition continuous woodland on the steep slopes below 7a and north of Cluster 10. Similar condition woodland patches on steep and lower parts of the site could be considered critical habitat for this species, provided that grazing is not severe.

The Superb Parrot is known to breed within the region. The loss of large hollow-bearing trees and mature forest remnants from land clearing is an ongoing threat for the species within the region. Suitable breeding and habitat is present within the study area and could be considered critical habitat for this species.

The site is not considered to be critical to the survival of any of the other flora or fauna species assessed.

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

The proposal may disrupt the breeding cycle of **Yass Daisy** by reducing potential habitat in moderate to good condition forest remnants on steep slopes and lower parts. Specifically, works within the proposed transmission easement between Clusters 6 and 7a have been moved south so that moderate to good condition woodland is not impacted. All construction works should be conducted outside the flowering and seeding season for this species (late spring – early summer).

The proposal may disrupt the breeding cycle of **Superb Parrot** by reducing breeding habitat in mature forest remnants. The following potential works are high risk:

- Road widening within mature woodland remnants on Whitefields Road, resulting in removal of hollow-bearing trees
- Removal of mature woodland and hollow-bearing trees on the north west peak on Cluster 10
- Removal of moderate and moderate-good quality Box-gum Woodland in the saddle on Cluster 10
- Removal of hollow-bearing trees and good quality Box-gum Woodland between Clusters 6 and 7a for the electricity transmission

The visual and noise impact of the wind turbines has the potential to disrupt foraging behaviour. This is most likely to be an issue at Clusters 10 given the proximity to good condition woodland.

Works would not disrupt the breeding cycle of the Pink-tailed Legless Lizard or the Striped Legless Lizard given that the site could only be considered marginal habitat for these species.

Swift Parrot and Regent Honeyeater do not breed within the region.

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

Generally, the proposal is unlikely to cause a decline of the assessed species. However, the works in locations already highlighted in a) pertaining to the Superb Parrot and Yass Daisy, may cause a decline in the local populations.

Works in these areas should be micro-sited so that moderate to good condition woodland, and hollow-bearing paddock trees are not impacted in order ensure that the proposal does not cause a decline in the local population of either species.

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?

Flora

The proposal could result in the introduction or spread of any exotic species if seed of invasive plants are introduced on machinery or vehicles, or enabled to spread from nearby pasture as a result of disturbance of the groundcover or soil on the site. A dense infestation of weeds could reduce the amount of bare ground available for orchids or other native forbs, and lead to the local extinction of a population of the Yass Daisy or Burrinjuck Spider Orchid should one occur on this site. However, given that the locations where the Yass Daisy currently occurs adjacent to the site are not particularly weedy, despite intense disturbance from grazing and weeds nearby, it seems unlikely that the additional disturbance caused by this proposal will make much

change to its habitat in this respect. Weed controls should be implemented through a Construction Environmental Plan to prevent onsite habitat degradation during and following the proposed works.

Fauna

The development is unlikely to result in the introduction or spread of any exotic species harmful to assessed species.

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

Flora

Impacts on woodland that occurs on the steep slopes of Cluster 7a would be likely to impact the local population of Yass Daisy that occurs within this area. However, given that this species also occurs within woodland on other areas outside the development envelope, and that the transmission development could be micro-sited to avoid impacts on continuous woodland, the proposed action is not considered likely to interfere with the recovery of the Yass Daisy.

Fauna

Potential impacts disruption to breeding, or removal of breeding habitat may interfere with species recovery. As already discussed, this may be an issue for Superb Parrot. Impacts on hollow-bearing and mature trees within the areas listed in d) should be avoided in order ensure that the proposal does not interfere with the recovery of this species.

The proposal is not likely to interfere with the recovery of the other species assessed (see part f. of the TSC Act seven-part test, Appendix E).

Migratory species

Of the ten migratory terrestrial species indicated as having potential to be present within 50 kilometres of the proposal site by the Search Tool report, the following six *have at least moderate potential* to use aerial habitat at the proposal site:

- Regent Honeyeater (Xanthomyza phrygia)
- Swift Parrot (*Lathamus discolour*)
- White-bellied Sea-Eagle (*Haliaeetus leucogaster*)
- White-throated Needle-tail (*Hirundapus caudacutus*)
- Rainbow Bee-eater *(Merops ornatus)*
- Cattle Egret (*Ardea ibis/ Bubulcus ibis)*

The significance of potential impacts to the Regent Honeyeater and Swift Parrot has been addressed above. A monitoring and adaptive management program would be developed and implemented to respond to any unforeseen impacts on any significant species (refer Section 8.2.2).

The risk of blade-strike is the most likely potential impact to migratory species from the proposal.

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*

No, the development is not likely to 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 assessed migratory species.

The **White-bellied Sea-Eagle** and **Cattle Egret** are mostly associated with lowland areas including riparian corridors, wetlands, rivers and lakes (Schodde and Tidemann 2007). Cattle Egrets also forage within moist paddocks, creeks and farm dams. These latter habitats occur within the study area, although are highly disturbed from grazing, weed invasion, erosion and sedimentation and are not considered to provide important habitat for these species. The species are migratory and may cross the ridges within the study area while migrating from larger wetland systems in the west to wetlands on the coast, or between Lake Burrinjuck and wetlands in the north, and therefore be at risk of blade-strike. However given that wetland habitats do not occur locally, bird movements across the site are likely to be diffuse and irregular, rather than concentrated and seasonal. Long-distance migratory birds are likely to have attained a travelling altitude greater than the turbine height. Further, water birds are probably likely to follow riparian corridors, rather than travel over ridge systems in agricultural land. The ridges do not directly bisect large water bodies therefore do not fragment or isolate areas of habitat. Habitat removal and collision impacts are considered to pose **very low** and **low risks** respectively to migratory water-birds.

The **Rainbow Bee-eater** utilises a variety of habitats, including woodland, cleared areas, open forest usually near water. This species was observed during the surveys. The species forages for insects from open perches, pursuing prey on the wing. Approximately 11 hectares of disturbed riparian forest occurs within the development envelope, at the point where the transmission envelope crosses Jugiong Creek. Impacts to this area are likely to be minimal (0.14 hectares) and are unlikely to impact this species. There are few threats recorded for the species, although collision with lighthouses during migration may cause mortality. Mortality from such causes appears to be rare (DEWHA 2008). Migration and movement patterns are poorly understood. The species is highly manoeuvrable, and therefore it is considered unlikely that the proposal would result in impact habitat such that there would be a population scale effect on the Rainbow Bee-eater. Monitoring during wind farm operation would target this species to document collision impacts and ensure that adaptive measures would be adopted if mortalities are found to occur.

The **White-throated Needle-tail** travel in large numbers between the northern (breeding) and southern hemisphere. They forage on insects, captured in flight, often feeding in rising thermal currents and travelling nomadically following storm updraughts (DEWHA 2008; Schodde and Tidemann 2007). The species flies at great heights above the Earth's surface and has been recorded flying c.1000-2000m ASL over the Australian Alps (Pizzey et al., 2006), making it unlikely that the species would regularly encounter wind turbines blades, or be impacted by the minor loss in aerial foraging habitat. The development would not substantially modify, destroy or isolate an area 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.

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

It is likely that the proposal poses a **low risk** to the lifecycle of **Cattle Egret** and **White-bellied Sea-Eagle**, as suitable habitat does not occur on the site and these species would be likely to follow rivers and wetlands, rather than travel over ridges to reach suitable breeding and foraging grounds.

It is likely that the proposal poses a **low risk** to the lifecycle of **Rainbow Bee-eater** and **White-throated Needle-tail** over the population**.** Although the proposed development may reduce the total amount of aerial habitat available for foraging, may cause changes in habitat utilisation during foraging and has potential to cause blade-strike mortality due to foraging habits (such as foraging in groups, utilising thermals (Needle-tail only)), these impacts are unlikely to seriously disrupt the lifecycle of the species resulting in population scale impacts.

Appendix F **NON-LISTED FAUNA RISK ASSESSMENT**

The framework provided in the Australian standard for risk management and related guidelines, AS/NZS 4360 (Anon 2004a, 2004b), and the associated guide for environmental risk management HB203:2000 (Anon 2000), assesses risk using a combination of consequence (or potential impact) and the likelihood of occurrence of the impact (See below Auswind 2006)

Likelihood	**Consequence**			
	Insignificant	Minor	Moderate	High
Very rare	L	L	M	H
Rare	L	L	M	H
possible	L	M	H	H
probable	M	H	H	H

Where: L: Low risk, M: Moderate risk, H: High risk

Species	Description	Relevant behavioural ecology	Potential effects	Likeli-hood	Conse-quence	Risk (pop)
Wedge-tailed Eagle *Aquila audax*	Common and widely distributed in forest and plain habitats across Australia. Breeding pairs are monogamous and sedentary within a large well defined and defended home range of up to 100km (DECC 2002; Sharp *et al.* 2001).	Usually forages at or above blade height over open country but nests in forests. Foraging is by soaring on air currents and swooping onto prey (Schodde and Tidemann 2007). Feeds on birds, rabbits, small mammals. Rabbits and lambs are local food sources. Can soar continuously for up to 90 minutes, reaching heights of 2000m ASL (DECC 2002). Soar and skirmish in	This species has been observed successfully avoiding turbines at several different wind farms and are considered to have at least a 95% avoidance rate (Brett Lane & Associates 2003); Wonthaggi EES Panel 2003). However, Wedge-tailed Eagles are known to have died as a result of blade-strike in Tasmania and Victoria (URS Australia 2004). Mortalities for the related Golden Eagle in US were attributed to the presence of prey around turbines. Turbines with lower blade reaches were most deadly to Golden Eagles,	Possible	Moderate	H

Species	Description	Relevant behavioural ecology	Potential effects	Likeli-hood	Conse-quence	Risk (pop)
		wind over steep hills and peaks. Territorial displays include steep dives (Pizzey *et al.* 2006). Observed five times above 40m: ridge of 7a, 5, 9 and flying over the gully between Clusters 5 and 7a (2 individuals).	with summer and winter having the highest mortality rates (Thelander *et al.* 2003). Transient juvenile Wedge-tailed Eagles rapidly fill empty territories (Sharp *et al.* 2001). If ongoing fatalities occur at the proposed wind farm, there is a risk of becoming a population sink.			
Nankeen Kestrel *Falco cenchroides*	Sedentary or nomadic. Nests in tree hollows; nests of other raptor, babbler or chough; ledge or cavity in cliffs (Pizzey *et al.* 2003). Hollows are found in isolated paddock trees and in woodland fragments and more extensive areas of woodland at all sites.	Singles, pairs, or family parties hover over grasslands at about 10-20m height and soar in air currents on cliffs and buildings (Pizzey *et al.* 2003). Feeds on ground-dwelling prey including invertebrates and small reptiles and mammals. Tend to forage by perch-pounce when still and by hovering during windy conditions (Genelly 1978). Observed five times above 40m: ridge of 6, 7a (twice), 7b and 10	Studies indicate that kestrels do not display avoidance behaviour around turbines, yet report low mortality. Foraging may occur at blade height, although generally during windy conditions appears to remain closer to the ground (10-20m). Relatively large number of individuals within populations. The species is relatively common at the Woolnorth and Codrington wind farm sites and no collisions have been recorded at those sites (Meredith *et al.* 2002). Likely to habituate to turbines over time.	Possible	Insignificant	L
Brown Falcon *Falco berigora*	Sedentary or nomadic. Inhabits broad range of habitats including open woodland, forest clearings, farmlands and roadsides, among other habitat types. Local populations can be	Relatively high populations density (McDonald *et al.* 2003b). Forages from perches and also quarters and hovers high through open country at 10-30m, also soars to great heights (Pizzey *et al.* 2006; Schodde and Tidemann 2007). The main prey	A Brown Falcon mortality has been reported from the Codrington wind farm. Using this case, the avoidance rate for this species was calculated to be 95% (Meredith *et al.* 2002).	Possible	Insignificant	L

Species	Description	Relevant behavioural ecology	Potential effects	Likeli-hood	Conse-quence	Risk (pop)
	irruptive (McDonald *et al.* 2003b; Pizzey *et al.* 2003). Prey includes lagomorphs, small ground prey, small birds, large birds or reptiles (McDonald *et al.* 2003a).	attack technique is hover and drop (Baker-Gabb 1984). Courtships displays involve rotating and gliding descents and mutual soaring (McDonald *et al.* 2003b). Observed flying above 40m at two locations: from the ridge on Cluster 6 and over a valley north of 6				
Australian Hobby *Falco longipennis*	Inhabits a range of open habitats, typically woodland with large trees and timbered watercourses. Often seen over cities (Pizzey *et al.* 2006). Builds stick nest in top of tall trees. Nomadic and migratory (Schodde and Tidemann 2007).	Pursues in flight small and medium sized birds (including ducks and herons) at tree-top level and soars for flying insects (Pizzey *et al.* 2006). Also often hunts at dusk (Schodde and Tidemann 2007). Appears able to adapt and habituate to developed environments. Uncommon (Pizzey *et al.* 2006). Observed flying above 40m from Cluster 5	There is little available information on the behaviour and movement patterns of this species in and around wind farms. The assessment is made considering that the species probably occurs at low densities, is migratory and appears to fly and forage within range of turbine blades at dusk.	Possible	Minor	M
Black-shouldered Kite *Elanus axillaris*	Distributed throughout mainland in woodlands. Feeds on rodents, reptiles, amphibians and insects. Builds nest in tall trees (Schodde and Tidemann 2007).	Foraging activity peaks at dusk. Usually hunt at 10-30m above ground by quartering and hover and drop attacks (Baker-Gabb 1984). Also uses perches. Soaring and fluttering forms part of courtship (Schodde and	There is little available information on the behaviour and movement patterns of this species in and around wind farms. Given that this bird is highly manoeuvrability it is assumed that it would be likely to have similar avoidance rate to Brown Falcon (95%).	Possible	Insignificant	L

Species	Description	Relevant behavioural ecology	Potential effects	Likeli-hood	Conse-quence	Risk (pop)
		Tidemann 2007). May raise 2-4 successive broods in a good spring (Pizzey *et al.* 2003)				
Black Kite *Milvus migrans*	Sedentary, dispersive and irruptive (Pizzey *et al.* 2006). Occurs in woodland and savannah across most of Australia. Feeds on carrion and live rodents, reptiles and insects (Schodde and Tidemann 2007).	Usually congregates in flocks of several hundred and forage communally (Schodde and Tidemann 2007). Quarters low and soars high during foraging (Pizzey *et al.* 2006).	As above.	Possible	Insignificant	L
Whilstling Kite *Haliastur sphenurus*	Inhabits open forests and foothills, usually near water. Builds a bulky nest of sticks high in eucalypt. Occasionally nomadic (Schodde and Tidemann 2007).	Usually forage by transects low (15m) or by soaring at height and appears to dive attack (Baker-Gabb 1984). May forage alone or in large loose flocks (>100) although this is rare (Schodde and Tidemann 2007).	There is little available information on the behaviour and movement patterns of this species in and around wind farms. Given that the Kite may travel in flocks and is likely to forage within the height of turbine blades, it probably has a similar avoidance rate as Brown Falcon or Wedge-tailed Eagle (95%).	Possible	Insignificant	L
Swamp Harrier *Circus approximans*	Migratory, breeding mostly in Tasmania, Victoria and South Australia. Inhabits swamps and wetlands, tall grasslands and grain crops (Pizzey and Knight	Foraging tactics most commonly used are low quartering and transect hunting and flushing by stooping. Swamp Harriers soar occasionally. They appear to confine foraging to over lagoons, foreshores and long	It appears that specific investigations have not been undertaken into the behaviour and movement patterns of this species in and around wind farms, however, it is considered unlikely that the flight paths of Swamp Harriers would cause blade-strike risk.	Very rare	Insignificant	L

Species	Description	Relevant behavioural ecology	Potential effects	Likeli-hood	Conse-quence	Risk (pop)
	2003).	grass (Baker-Gabb 1984). More likely to be associated with flats than ridges and is unlikely to occur in study area, although may be found along Lake Burrinjuck.				
Brown Goshawk *Accipiter fasciatus*	Occurs in woodlands, open forests and scrublands. Builds nests in living trees 6-20m. Preys on small birds as well as small mammals (Pizzey *et al.* 2003). Sedentary; young birds may disperse up to 900km. Fairly abundant (Schodde and Tidemann 2007).	Mostly forages by perching with gliding or direct flying attacks within canopy. May also soar (Baker-Gabb 1984). Rarely leave the cover of forest or woodland (Schodde and Tidemann 2007).	Avoidance rate likely to be as for Brown Falcon, however, the species is unlikely to forage on cleared ridges.	Rare	Insignificant	L
Barn Owl *Tyto alba*	This species inhabits open forests, woodlands and grasslands with stands of timber, including farmlands. It nests in tree hollows. Diet includes small mammals, birds, lizards. Nomadic (Schodde and Tidemann 2007).	Usually nocturnal, although occasionally crepuscular foragers. Most often use perch and glide attacks, and also low quartering with hover and drop attack (Baker-Gabb 1984). Observed at Jugiong Creek, approximately 5km north of the site (near a proposed transmission easement).	Likely to fly at blade-height. Avoidance rate may be lower than for other birds discussed as is nocturnal hunter. However, specific investigations do not appear to have been undertaken.	Possible	Minor	M

Species	Description	Relevant behavioural ecology	Potential effects	Likeli-hood	Conse-quence	Risk (pop)
Tawny Frogmouth *Podargus strigoides*	Observed at Bannister and Pomeroy. Inhabits heavy forests to open woodlands, timber along watercourses in inland areas. Nests in flimsy stick platforms on branches 5-10m high. Sedentary (Pizzey 1985).	Active at dusk, takes prey from sitting position from ground surfaces such as roads. Feeding activities are more likely in timbered lowlands, and would generally occur below blade height.	Unlikely to forage a blade-height on ridges	Very rare	Insignificant	L
Peregrine Falcon *Falco peregrinus*	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). Sedentary with a home range of about 20-50km (Schodde and Tidemann 2007). Many local records.	This species appears able to adapt and habituate to human developments. Swoops on prey from above, at speeds of more than 300km/hours. Courtship involves circling flights, diving, swooping and tumbling from height (Schodde and Tidemann 2007).	No studies. Avoidance assumed to be as for Brown Falcon (95%). However, the speed at which may swoop on prey may affect negatively manoeuvrability while hunting.	Possible	Minor	M
White Ibis *Threskiornis molucca*	Can occur in large flocks, typically in pastures and swamps. Nests over water in dense trees or swamp growth. Highly nomadic, migratory or dispersive (Pizzey 1985).	Flocks in lines or 'v' formations with quick wing beats and glides. Australian White Ibises and other waterbird species demonstrate crepuscular peaks of abundance (Hamilton *et al.* 2004). Ibis and other waterbirds	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	Rare	Minor	Low

Species	Description	Relevant behavioural ecology	Potential effects	Likeli-hood	Conse-quence	Risk (pop)
		may travel large distances between local water bodies and those in Canberra. They probably use riparian corridors.	observed. This study found that 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). Given that there are no suitable habitats for Ibis on the site or within close proximity, visitation to the site is not likely to be frequent.			
White-winged Triller *Lalage tricolor*	Occur in woodland and dry open forest throughout the mainland. It prefers lightly timbered country with an open shrub layer and grassy groundcover. Breed in colonies. Migratory and partially nomadic (Schodde and Tidemann 2007).	Migrates in large flocks, moving south to breed in spring, travelling in small flocks of 3-50 birds. May forage for insects during flight (Schodde and Tidemann 2007). Displaying includes circling, climbing and gliding flight. Local records.	Migrating songbirds were shown to be the most affected group in wind farms studies in the northern hemisphere (AusWEA 2002). The ridges on the site are predominately cleared and heavily grazed, with no shrub understorey, which reduces the collision risk	Rare	Minor	L
Australian Magpie *Gymnorhina tibicen*	Occur in eucalypt woodland thoughout most of Australia. Sedentary, living in groups of 3-24 birds.	Forage on the ground in open fields. Glide to foraging sites. May fly to great heights in aggressive pursuit of potential predators. Flocks may become very large with food flushes (Schodde and Tidemann 2007).	Regularly use air-space at blade height although readily adapts to human developments. The species is also abundant and common; therefore the population scale impact would be low.	Possible	Insignificant	Low

Species	Description	Relevant behavioural ecology	Potential effects	Likeli-hood	Conse-quence	Risk (pop)
		Observed in all habitats on the site				
Silvereye *Zosterops lateralis*	Most vegetation types, preferring dense coastal shrubs, commercial orchards and urban parks and gardens. Partially migratory (Schodde and Tidemann 2007).	Forage in low shrubs. Migrate to northern Australia in large groups flying high during the night with activity appearing to peak pre-dawn (Chan 1995).	Night migrating song birds were the greatest impacted type of bird in North American and European wind farm studies. This suggests the likelihood of blade-strike for Silvereye would be probable. However, Atlas of NSW Wildlife records indicate that there may be a migration route to the coast following the more densely vegetated areas south of the study area. The majority of migration occurs along the coast (Schodde and Tidemann 2007). Flocking is a risk behaviour however given the small size of the bird, mass mortalities may not occur during a blade-strike event.	Possible	Minor	M
Galah *Cacatua roseicapilla* **Sulphur-crested Cockatoo** *Cacatua galerita*	Occur in a variety of habitat types including open country with scattered suitable trees or woodland areas	Both may travel some distance between roosting and feeding places, and feed on the ground, often in large flocks. When travelling between roosting and feeding sites both fly at height. Galahs are fast and agile fliers (Schodde and Tidemann 2007). Observed on the site in all habitats.	Galahs are considered high risk in the aeronautical industry as they fly unpredictably in large flocks; groups are often struck by planes (ATSB 2002). Both cockatoos are agile fliers, galahs perhaps more so, and therefore are likely to have a high avoidance rate. Both species are also abundant and common, therefore the population scale impact would be low.	Possible	Insignificant	L

Species	Description	Relevant behavioural ecology	Potential effects	Likeli-hood	Conse-quence	Risk (pop)
Crimson Rosella *Platycercus elegans*	Sclerophyll forests, woodlands and timbered farmlands. Sedentary living in small groups of bonded pairs; juveniles may form large flocks (Pizzey *et al.* 2006).	Feeds on the ground in shade or on the outer branches of eucalypts, foraging on fruits and seeds. Fast, undulating flight between feeding, watering and roosting places (Schodde and Tidemann 2007).	Rosellas are seen flying high above canopy and over open areas (pers.ob), although prefer cover. They may encounter turbines during daily dispersal, but are likely to have a high avoidance rate, as for other parrot and cockatoo species. There is no information about parrots being in a high risk group amongst Australian wind farm literature.	Rare	Insignificant	L
BATS						
Recorded bats *Chalinolobus gouldii* *Mormopterus* sp 4 *Nyctophilus* spp *Scotorepens balstoni* *Vespadelus* spp	The non-listed bats recorded on site are mostly forest dwelling bats (Strahan 1983) and roost in tree hollows.	The bats recorded (see Appendix B) mostly forage for insects close to the ground or within the forest canopy (Strahan 1983).	The bats considered roost and forage within forest and woodland blocks. They may encounter turbine areas travelling between blocks, but are generally unlikely to be travelling at blade height	Rare	Minor	L

Appendix G **WINDFARM RISKS TO BIRDS AND BATS**

Please see Attachment 3.3 of the Yass Valley Wind Farm Environmental Assessment

Appendix H **PHOTOGRAPHS OF THE SITE**

Photo 1. Extensive rocky outcrops along ridges in Cluster 4

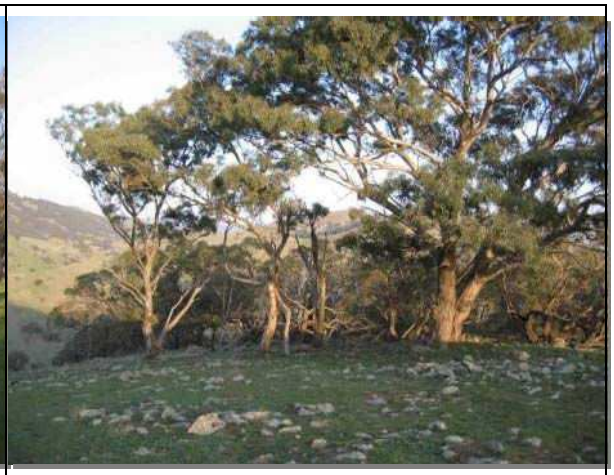
Photo 2. Areas heavily grazed by sheep in Cluster 1

Photo 3. Extensive rocky outcrops in Cluster 2

Photo 4. Creek crossing near proposed transmission route to the north of Cluster 2

Photo 5. Looking west from Cluster 6 toward Cluster 3, showing steepness of hillsides

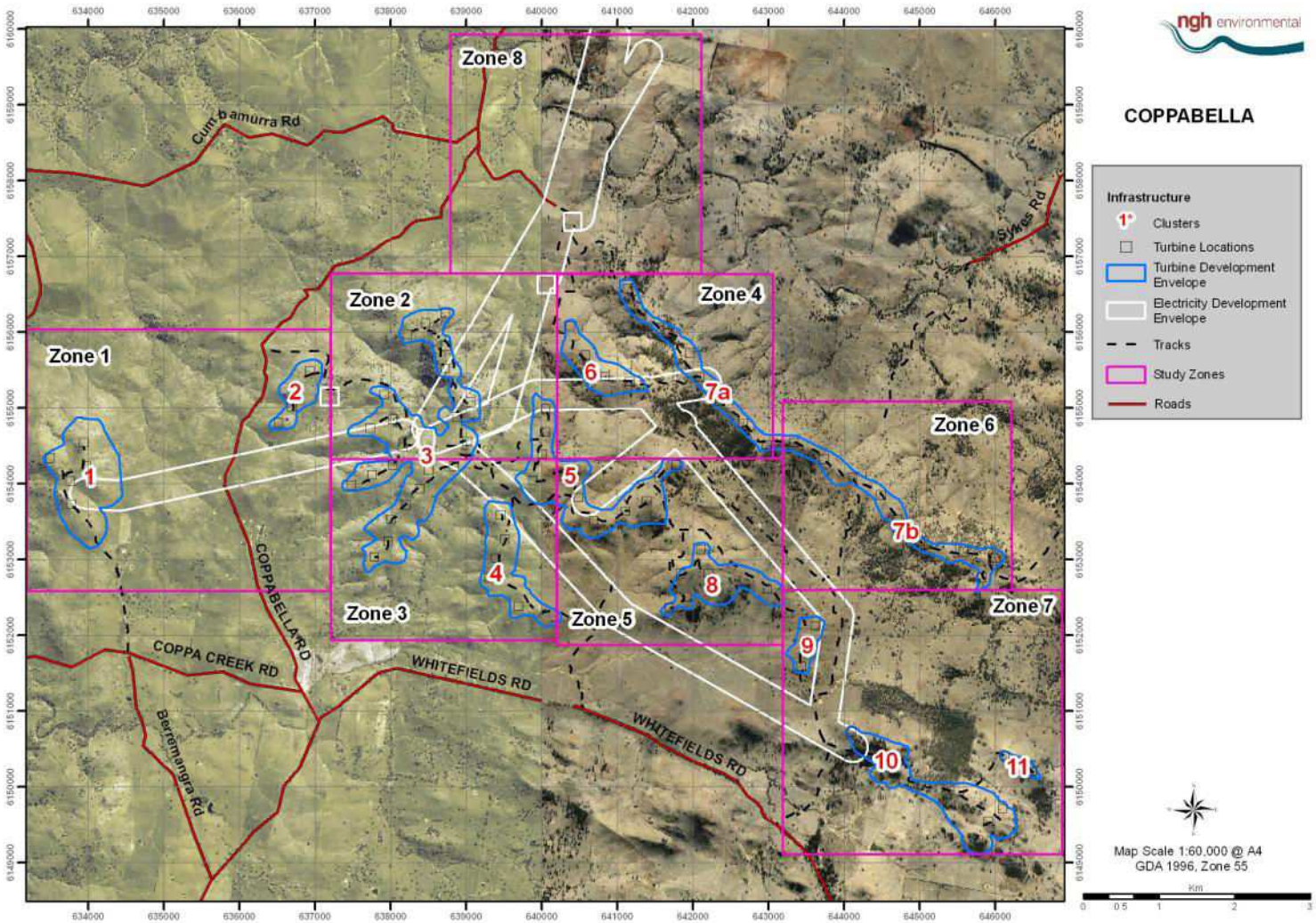
Photo 6. Potential reptile habitat and refuge at Cluster 7a

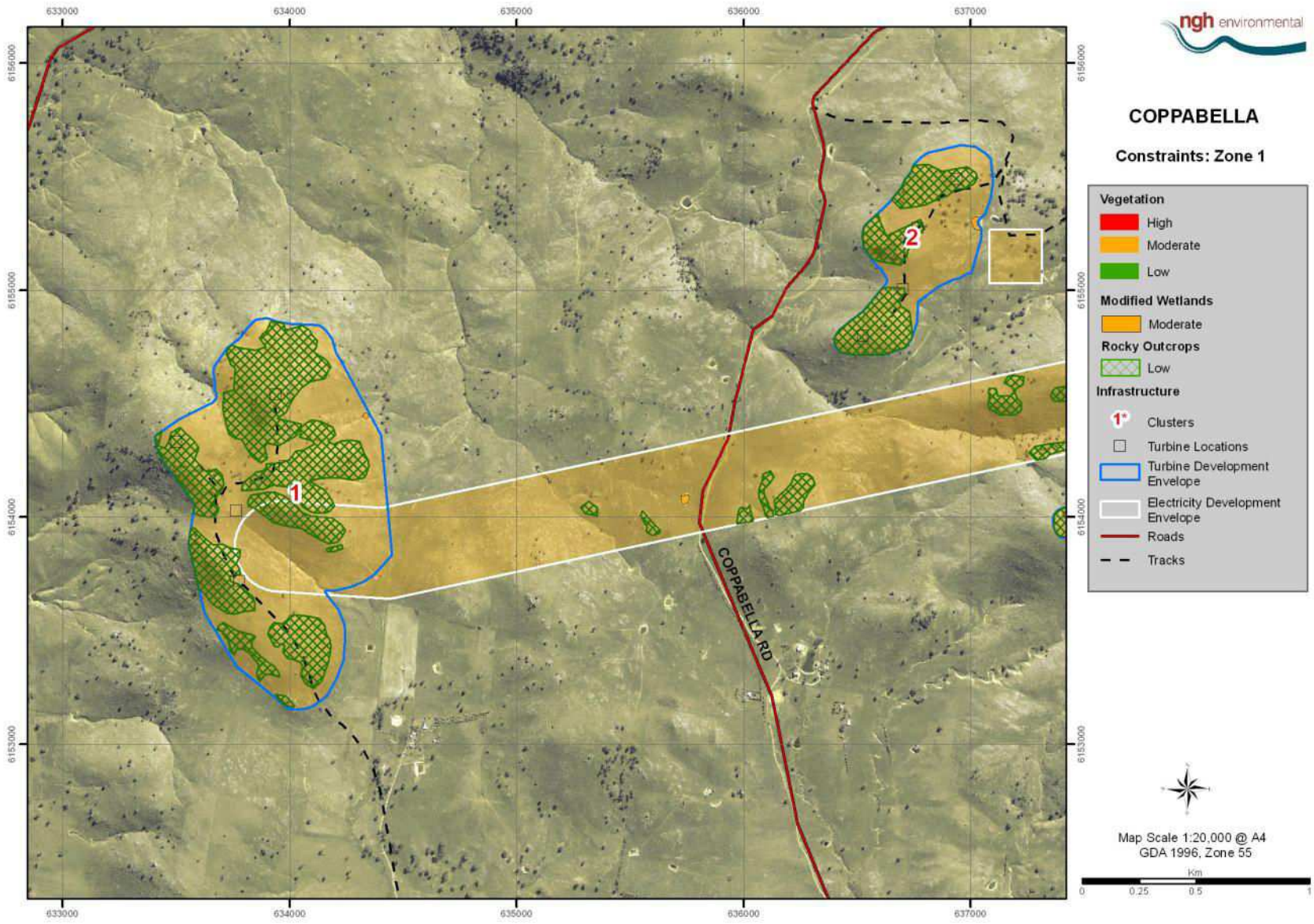
	
Photo 7. Edge of Box-gum Woodland CEEC (*E.albens* pictured) at the north end of Cluster 3	Photo 8. Edge of Box-gum Woodland CEEC (*E.melliodora* pictured) at the north end of Cluster 3

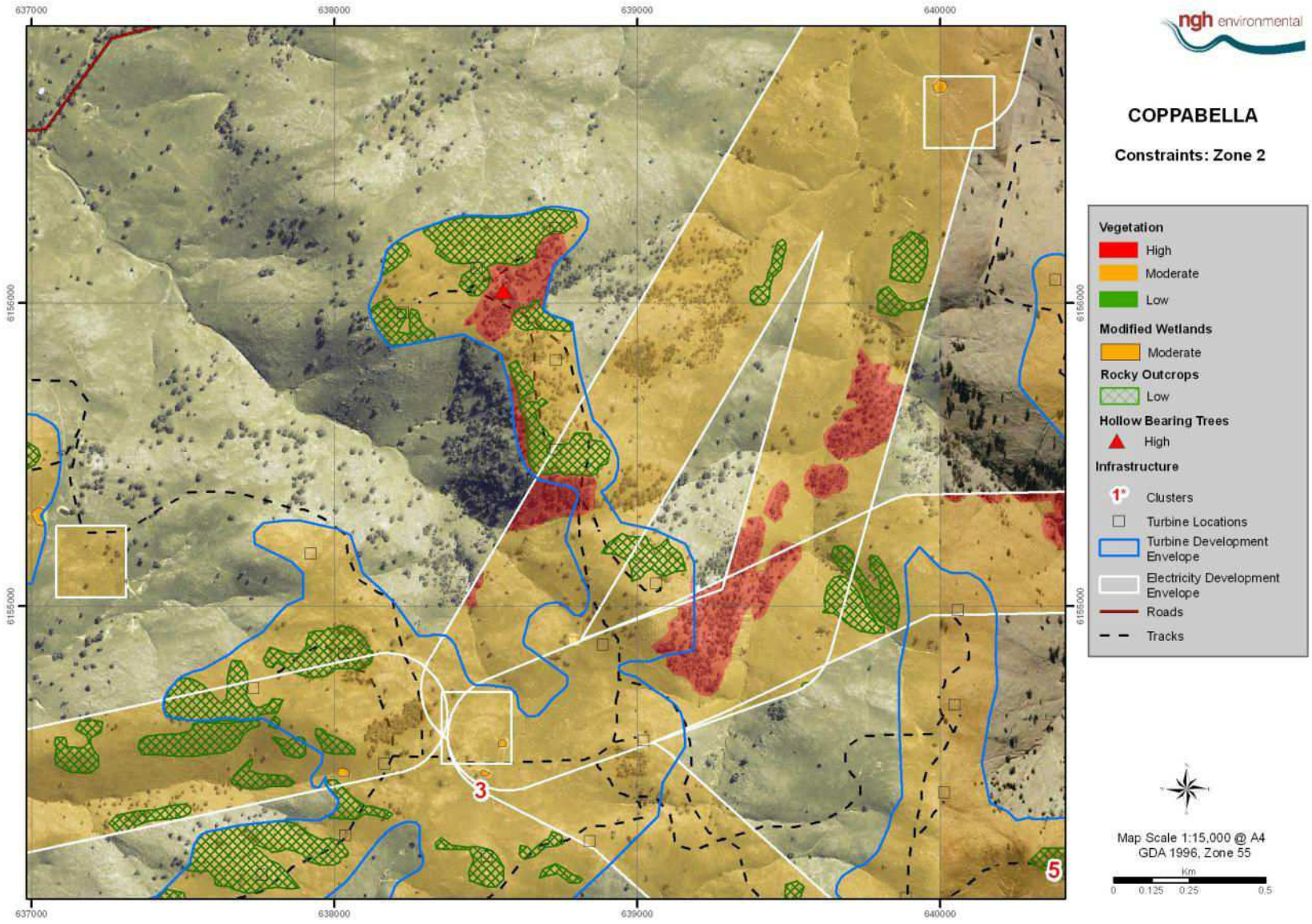
Appendix I **ORIGINAL INFRASTRUCTURE LAYOUT**

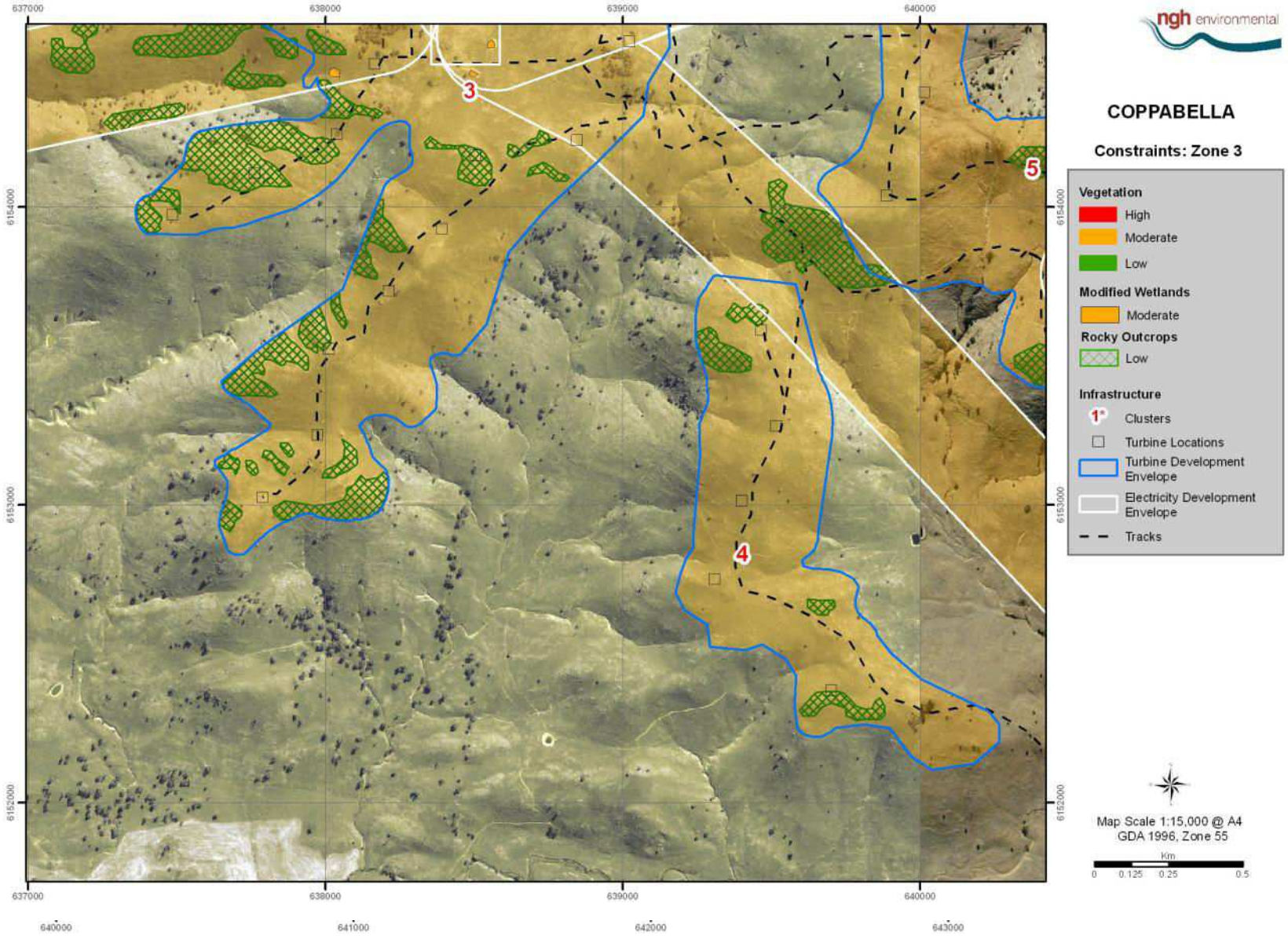
The infrastructure layout has been revised to reflect biodiversity constraints.

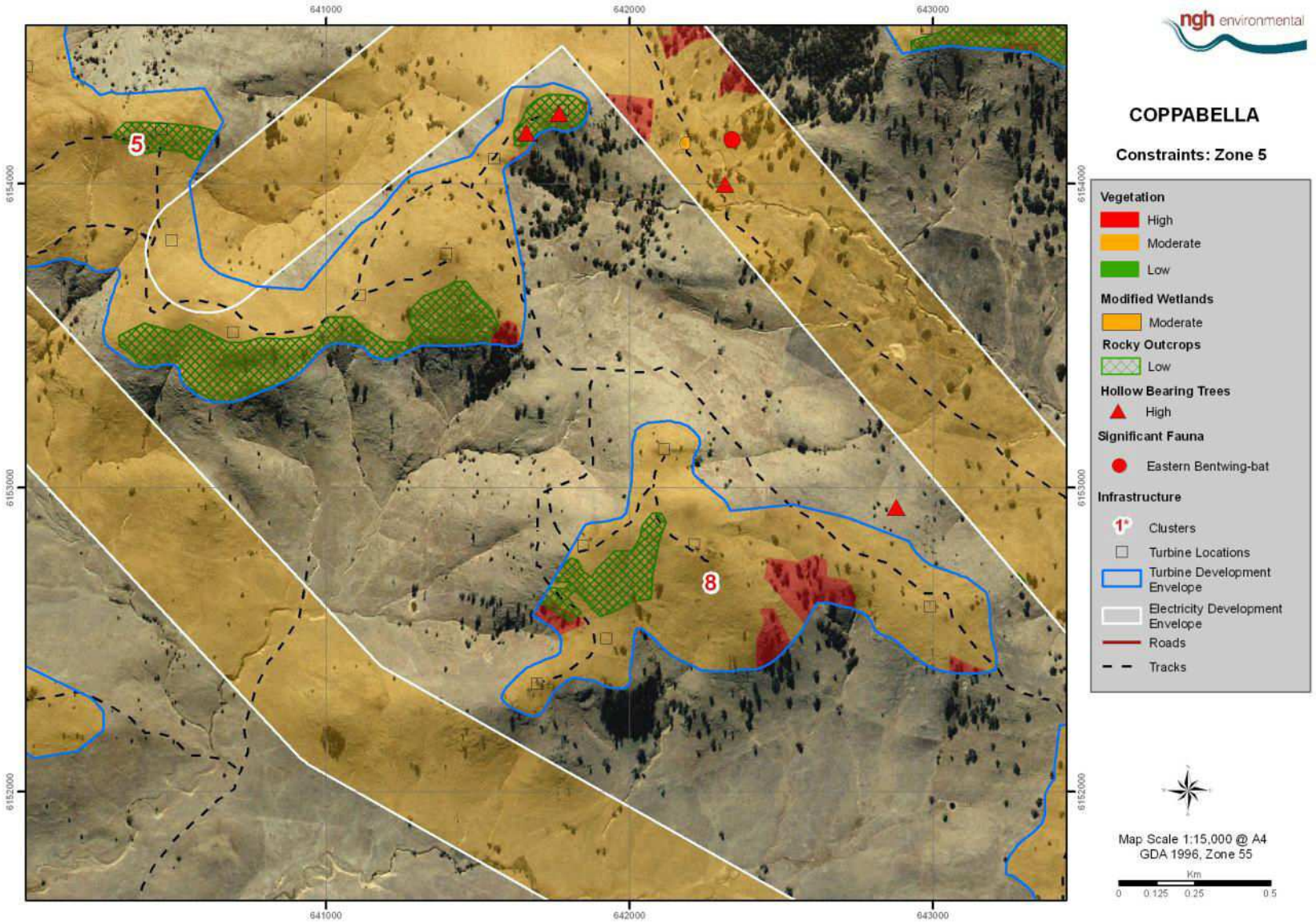
The original infrastructure layout is shown in the following map set (9 maps, including site overview).

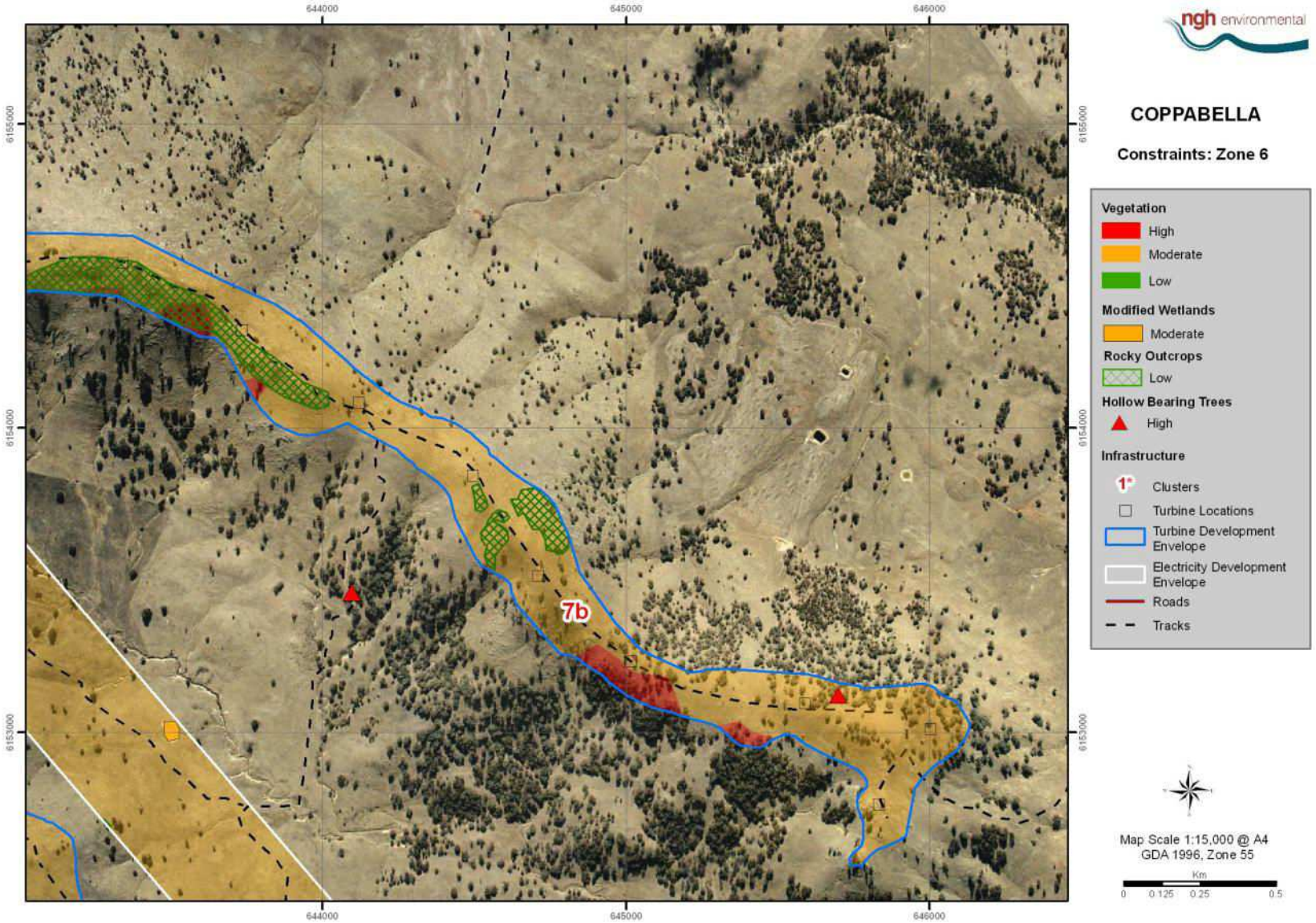

ngh environmental
COPPABELLA
Infrastructure
Clusters
Turbine Locations
Turbine Development Envelope
Electricity Development Envelope
Tracks
Study Zones
Roads
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
Zone 8
1
2
3
4
5
6
7a
7b
8
9
10
11
Cumbamurra Rd
Sykes Rd
COPPABELLA RD
COPPA CREEK RD
WHITEFIELDS RD
WHITEFIELDS RD
Berremangra Rd
Map Scale 1:60,000 @ A4
GDA 1996, Zone 55
Km
0
0.5
1
2
3

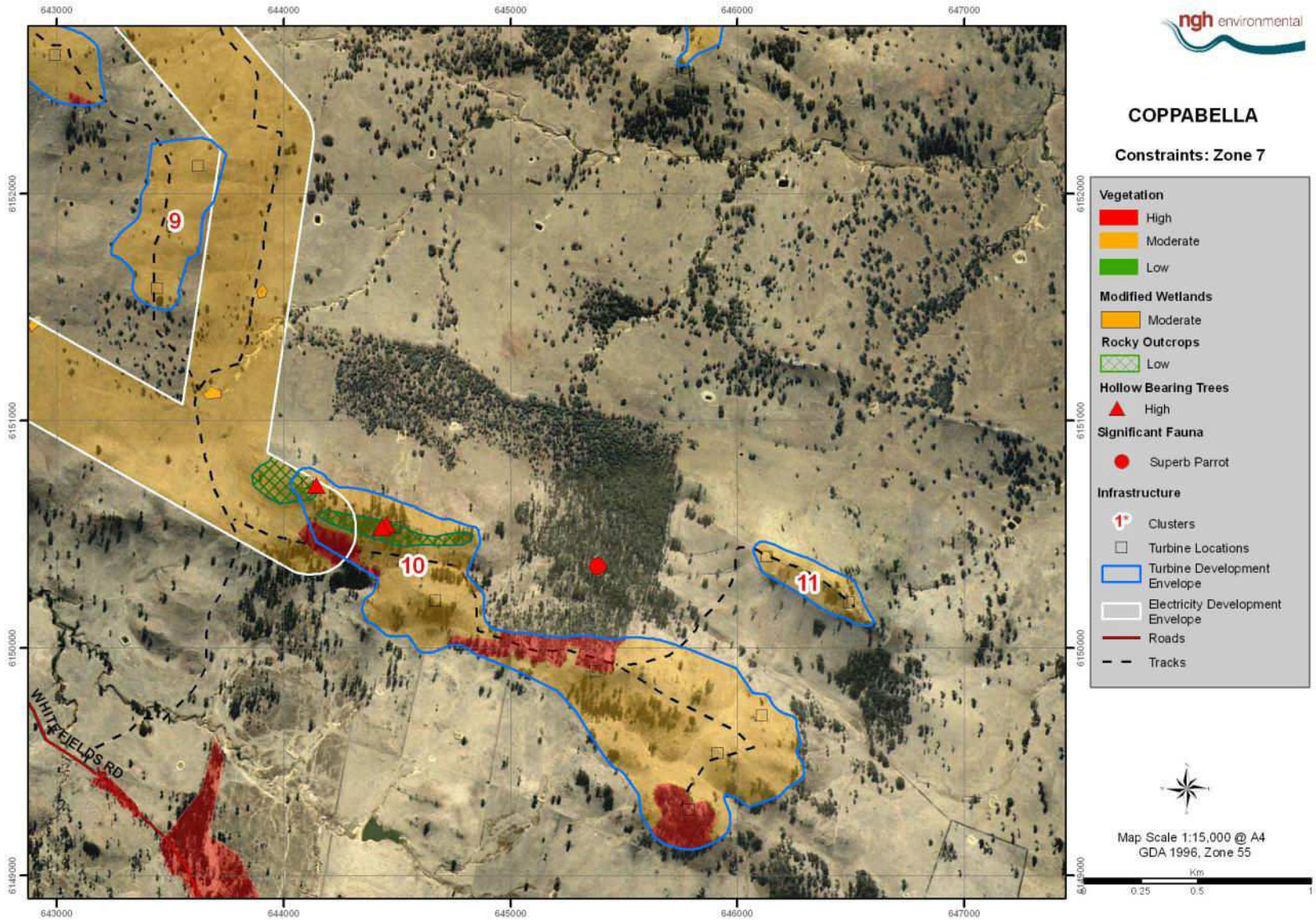

ngh environmental
COPPABELLA
Constraints: Zone 1
Vegetation
High
Moderate
Low
Modified Wetlands
Moderate
Rocky Outcrops
Low
Infrastructure
Clusters
Turbine Locations
Turbine Development Envelope
Electricity Development Envelope
Roads
Tracks
1
2
COPPABELLA RD
633000
634000
635000
636000
637000
6156000
6155000
6154000
6153000
Map Scale 1:20,000 @ A4
GDA 1996, Zone 55
Km
0
0.25
0.5
1

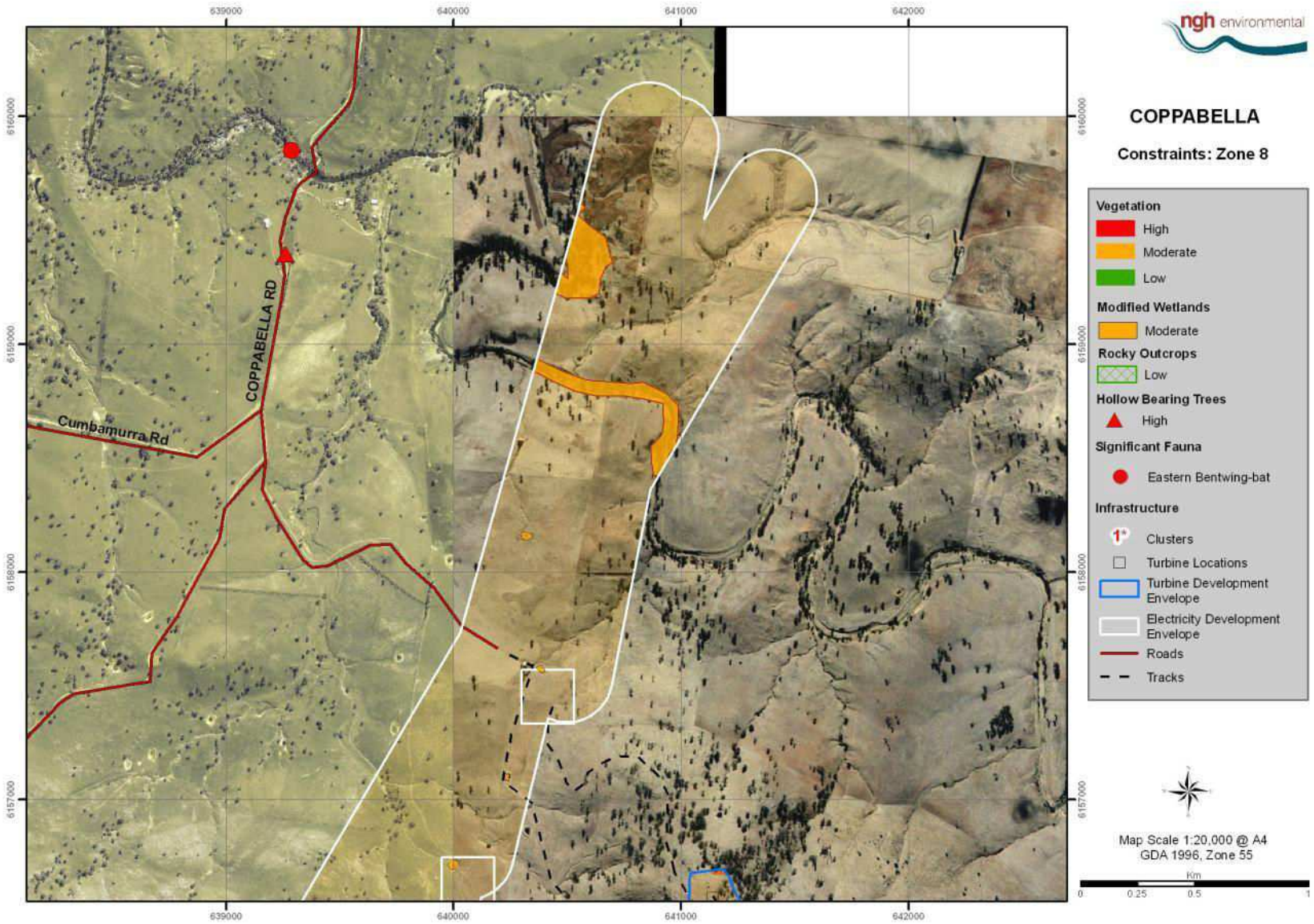

637000
638000
639000
640000
6156000
6155000
ngh environmental
COPPABELLA
Constraints: Zone 2
Vegetation
High
Moderate
Low
Modified Wetlands
Moderate
Rocky Outcrops
Low
Hollow Bearing Trees
High
Infrastructure
Clusters
Turbine Locations
Turbine Development Envelope
Electricity Development Envelope
Roads
Tracks
3
5
Map Scale 1:15,000 @ A4
GDA 1996, Zone 55
Km
0
0.125
0.25
0.5


ngh environmental
COPPABELLA
Constraints: Zone 3
Vegetation
High
Moderate
Low
Modified Wetlands
Moderate
Rocky Outcrops
Low
Infrastructure
Clusters
Turbine Locations
Turbine Development Envelope
Electricity Development Envelope
Tracks
3
4
5
637000
638000
639000
640000
6154000
6153000
6152000
640000
641000
642000
643000
Map Scale 1:15,000 @ A4
GDA 1996, Zone 55
km
0
0.125
0.25
0.5


641000
642000
643000
6154000
6153000
6152000
5
8
ngh environmental
COPPABELLA
Constraints: Zone 5
Vegetation
High
Moderate
Low
Modified Wetlands
Moderate
Rocky Outcrops
Low
Hollow Bearing Trees
High
Significant Fauna
Eastern Bentwing-bat
Infrastructure
Clusters
Turbine Locations
Turbine Development Envelope
Electricity Development Envelope
Roads
Tracks
Map Scale 1:15,000 @ A4
GDA 1996, Zone 55
Km
0
0.125
0.25
0.5


644000
645000
646000
6155000
6154000
6153000
7b
ngh environmental
COPPABELLA
Constraints: Zone 6
Vegetation
High
Moderate
Low
Modified Wetlands
Moderate
Rocky Outcrops
Low
Hollow Bearing Trees
High
Infrastructure
Clusters
Turbine Locations
Turbine Development Envelope
Electricity Development Envelope
Roads
Tracks
Map Scale 1:15,000 @ A4
GDA 1996, Zone 55
Km
0
0.125
0.25
0.5


643000
644000
645000
646000
647000
6152000
6151000
6150000
6149000
9
10
11
WHITEFIELDS RD
ngh environmental
COPPABELLA
Constraints: Zone 7
Vegetation
High
Moderate
Low
Modified Wetlands
Moderate
Rocky Outcrops
Low
Hollow Bearing Trees
High
Significant Fauna
Superb Parrot
Infrastructure
Clusters
Turbine Locations
Turbine Development Envelope
Electricity Development Envelope
Roads
Tracks
Map Scale 1:15,000 @ A4
GDA 1996, Zone 55
Km
0.25
0.5
1


ngh environmental
COPPABELLA
Constraints: Zone 8
Vegetation
High
Moderate
Low
Modified Wetlands
Moderate
Rocky Outcrops
Low
Hollow Bearing Trees
High
Significant Fauna
Eastern Bentwing-bat
Infrastructure
Clusters
Turbine Locations
Turbine Development Envelope
Electricity Development Envelope
Roads
Tracks
COPPABELLA RD
Cumbamurra Rd
639000
640000
641000
642000
6160000
6159000
6158000
6157000
Map Scale 1:20,000 @ A4
GDA 1996, Zone 55
Km
0
0.25
0.5
1

Environmental Reporting Tool

You are here: Environment Home > ERIN > ERT

19 November 2008 10:56

Database Report

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

Search Type:	Point
Buffer:	50 km
Coordinates:	-34.73805,148.5241

Report Contents: Summary >> Details >> Caveat >> Acknowledgment

---

Biodiversity

Threatened Species:	20
Migratory Species:	12
Listed Marine Species:	10
Invasive Species:	14
Whales and Other Cetaceans:	None
Threatened Ecological Communities:	2

Heritage

World Heritage Properties:	None
Australian Heritage Sites:	49

Wetlands

Ramsar sites: **(Internationally important)**	1
Nationally Important Wetlands:	None

National Pollutant Inventory

Reporting Facilities:	None
Airsheds:	None
Catchments:	None

Protected Areas

Reserves and Conservation Areas:	5
Regional Forest Agreements:	1

Biodiversity

Threatened Species [Dataset Information]	Status	Comments
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
Frogs		
Litoria booroolongensis Booroolong Frog	Endangered	Species or species habitat likely to occur within area
Insects		
Synemon plana Golden Sun Moth	Critically Endangered	Species or species habitat likely to occur within area
Mammals		
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population)	Endangered	Species or species habitat may occur within area
Nyctophilus timoriensis (South-eastern form) Eastern Long-eared Bat	Vulnerable	Species or species habitat may occur within area
Pseudomys fumeus Konoom, Smoky Mouse	Endangered	Species or species habitat may occur within area
Ray-finned 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
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
Grevillea iaspicula Wee Jasper Grevillea	Endangered	Species or species habitat likely to occur within area
Leucochrysum albicans var. *tricolor* Hoary Sunray	Endangered	Species or species habitat likely to occur within area
Prasophyllum petilum	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 [Dataset Information]	Status	Comments
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
Merops ornatus Rainbow Bee-eater	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		
Ardea alba Great Egret, White Egret	Migratory	Species or species habitat may occur within area

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

Migratory Marine Birds

Apus pacificus Fork-tailed Swift	Migratory	Species or species habitat may occur within area
Ardea alba Great Egret, White Egret	Migratory	Species or species habitat may occur within area
Ardea ibis Cattle Egret	Migratory	Species or species habitat may occur within area

Listed Marine Species [Dataset Information]	Status	Comments

Birds

Apus pacificus Fork-tailed Swift	Listed - overfly marine area	Species or species habitat may occur within area
Ardea alba Great Egret, White Egret	Listed - overfly marine area	Species or species habitat may occur within area
Ardea ibis Cattle Egret	Listed - overfly marine area	Species or species habitat may occur within area
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
Invasive Species [Dataset Information]	Status	Comments
Selected Invasive Species: Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.		
Mammals		
Capra hircus Goat	Feral	Species or species habitat may occur within area
Felis catus Cat, House Cat, Domestic Cat	Feral	Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit	Feral	Species or species habitat likely to occur within area
Sus scrofa Pig	Feral	Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox	Feral	Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus	WoNS	Species or species habitat may occur within area

Genista sp. X Genista monspessulana Broom	Invasive	Species or species habitat may occur within area
Lycium ferocissimum African Boxthorn, Boxthorn	Invasive	Species or species habitat may occur within area
Nassella neesiana Chilean Needle grass	WoNS	Species or species habitat may occur within area
Nassella trichotoma Serrated Tussock, Yass River Tussock, Yass Tussock, Nassella Tussock (NZ)	WoNS	Species or species habitat may occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine	Invasive	Species or species habitat may occur within area
Rubus fruticosus agg. Blackberry, European Blackberry	WoNS	Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtiji Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow	WoNS	Species or species habitat may occur within area
Ulex europaeus Gorse, Furze	WoNS	Species or species habitat may occur within area

Threatened Ecological Communities [Dataset Information]	Status	Comments
Natural Temperate Grassland of the Southern Tablelands of NSW and the Australian Capital Territory	Endangered	Community likely to occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community likely to occur within area

Heritage

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

Historic

ANZ Bank NSW

Beggan Beggan Homestead Group NSW

Binalong Courthouse Group NSW

Binalong Courthouse NSW

Boorowa Courthouse NSW

Bundarbo Homestead, Outbuildings and Garden NSW

CBC Bank (former) NSW

CBC Bank, Residence, Fences, Hitching Posts and Stables NSW

Comur Street Group NSW

Cooma Cottage, Hardwicke and Douro Landscape Area NSW

Cooma Cottage, Stables, Outbuildings and Surrounds NSW

Cunningham Plains Homestead (former), Barn and Garden NSW

Dendavilleigh NSW

F L Kelly and Company (former) NSW

Grampian Street Group NSW

Kerrowgair NSW

Linton and Garden NSW

Murrumburrah Courthouse NSW

Murrumburrah Public School and Residence NSW

Police Residence and Cells NSW

Public School Group NSW

Rathluba NSW

Redbank and Stables NSW

Reedy Creek Homestead (former Inn) NSW

Ronnoco NSW

Rose Cottage and Kitchen NSW

St Clements Anglican Church NSW

St Clements Rectory NSW

Stables of Redbank NSW

State Bank Rural Bank (former) NSW

The Elms NSW

Vale View Homestead, Woolshed & Building and Landscape Elements NSW

Westpac Bank NSW

Yass Courthouse Group NSW

Yass Courthouse NSW

Yass Junction Railway Station NSW

Yass Police Station NSW

Yass Post Office Group NSW

Yass Post Office Including Hitching Posts NSW

Yass Urban Conservation Area NSW

Indigenous

Narrangullen Area NSW

Natural

Coolac Geological Site NSW

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

Wee Jasper Grevillea Iaspicula Site 1 NSW

Wee Jasper Nature Reserve NSW

Wetlands

Wetlands of International Importance (Ramsar sites) [Dataset Information]

FIVEBOUGH AND TUCKERBIL SWAMPS — Within same catchment as Ramsar site

Other

Reserves and Conservation Areas [Dataset Information]

Black Andrew Nature Reserve, NSW

Burrinjuck Nature Reserve, NSW

Hattons Corner Nature Reserve, NSW

Oak Creek Nature Reserve, NSW

Wee Jasper Nature Reserve, NSW

Regional Forest Agreements [Dataset Information]
Note that all RFA areas including those still under consideration have been included.

Southern RFA, New South Wales

Caveat

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

Acknowledgment

This database has been compiled from a range of data sources. The Department acknowledges the following custodians who have contributed valuable data and advice:

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

- Other groups and individuals

ANUCliM Version 1.8, Centre for Resource and Environmental Studies, Australian National University was used extensively for the production of draft maps of species distribution. The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.