DRAFT FLORA AND FAUNA ASSESSMENT

Rezoning Investigations

Jumping Creek Estate, Queanbeyan

Prepared for
CIC Australia Limited

28 July 2010

Draft Flora and Fauna Assessment

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EXECUTIVE SUMMARY

This report has described the biological environment of land comprising Jumping Creek Estate, Queanbeyan, with particular focus on threatened biodiversity values. The overall aim of the study was to identify species, communities and habitats of high conservation value, in order to inform the rezoning process currently being undertaken by Queanbeyan City Council.

The existing environment was examined in detail from a literature review and from data gathered during fieldwork 2008. Flora and fauna surveys resulted in the detection of 128 flora species and 97 fauna species in the study area.

Four vegetation communities were recorded in the study area: Box-Gum Woodland, Dry Forest, Burgan Shrubland and Exotic Vegetation. The Box-Gum Woodland in the study area constitutes the endangered ecological community White Box, Yellow Box, Blakely's Red Gum Woodland which is listed on Schedule 1 Part 3 of the *TSC Act* and the White Box, Yellow Box, Blakely's Red Gum Grassy Woodland and Derived Native Grasslands (Box-Gum Woodland) which is listed on the *EPBC Act*.

Four threatened fauna species were recorded in the study area during the survey period: the Gang-gang Cockatoo, Speckled Warbler, Painted Honeyeater and Eastern Bentwing Bat.

All of these threatened fauna species are listed as Vulnerable on Schedule 2 of the *NSW Threatened Species Conservation Act 1995*.

One threatened flora species, the Hoary Sunray, was recorded from several locations in the study area and is listed as endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999.*

One migratory species listed on the schedules of the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* was recorded within the study area, the Rufous Fantail.

Apart from threatened species and communities, riparian corridors and areas of relatively intact native vegetation on the margins of the study area were considered to posses considerable conservation values that warrant protection.

Given the heavily disturbed nature of the study area, it is considered feasible to provide for future residential development while protecting the site's key biodiversity values. Recommendations to achieve these dual outcomes are made in this report.

1. INTRODUCTION

1.1 Background

This report has been prepared by Bushfire and Environmental Services (BES), now Eco Logical Australia (ELA), at the request of CIC Australia on behalf of Queanbeyan City Council, to investigate the flora, fauna and habitat values associated with Jumping Creek Estate, Queanbeyan, and to identify areas of conservation value which should be protected. The outcomes of this report will inform the rezoning investigations to be undertaken by Council.

1.2 The Study Area and Locality

The study area for the purposes of this report is the parcel of land known as Jumping Creek, Lot 1 DP 711905 as shown in Figure 1 (Appendix A).

The study area is approximately 109.8ha of land located about 3 km ESE of the urban centre of Queanbeyan. The study area has an extensive history of disturbances, including farming and mining, resulting in widespread clearing and establishment of exotic vegetation. The study area contains a number of disturbed forest communities, but is mainly classified as exotic pasture.

The study area is generally bounded to the:

- North-West by Greenleigh Estate, an existing rural residential development;
- North by predominantly bushland zoned Environmental Protection;
- North-East by Cuumbeun Nature Reserve;
- East by bushland zoned Environmental Protection;
- South by Crown Land which is currently being assessed for a Native Title claim and is referred to as Ngunnawal Land.
- West and South-West by the Queanbeyan River

The study area is currently mainly zoned Rural 1(a). A road reservation for the future Ellerton Drive traverses the north western corner of the site with a small area of Residential C1 above this under the provisions of the QCC LEP.

1.3 Aim and Objectives

The aim of this study was to investigate the ecological attributes of the study area and assess their conservation values to inform the rezoning process currently being undertaken by Council.

The objectives of this study were to:

1. identify and describe the vegetation communities present in the study area and their conservation significance;
2. identify and describe the presence and condition of fauna habitats within the study area;
3. identify and map the threatened fauna species and other significant fauna species which are found to occur in the study area;
4. identify and map the threatened flora species and other significant flora species in the study area;
5. identify and map vegetation and habitat significant for the survival of threatened species and communities;
6. identify ecological constraints to development; and
7. provide recommendations to protect any significant biodiversity values.

2. METHODOLOGY

2.1 Review of Existing Data

A review of relevant information was undertaken at various times during the project, which involved:

a) reviewing available literature including relevant flora and fauna studies, legislation, environmental planning instruments, topographic maps, and aerial photographs of the study area;

b) searching the Atlas of NSW Wildlife for threatened flora and threatened fauna species recorded in the locality; and

c) searching the Commonwealth Environment Protection & Biodiversity Conservation Act Protected Matters Search Tool for matters of national environmental significance recorded in the locality.

2.2 Flora Survey Methods

Detailed botanical surveys were conducted in the study area during November and December 2008 (Figure 2, Appendix A).

Community Identification and Floristic Audit

The Random Meander technique documented by Cropper (1993) was used across the study area and surrounds, to document the flora species present, including those of conservation significance, and the location and extent of vegetation communities.

Several vegetation survey sheets were completed for the vegetation communities that occur within the study area. The vegetation was surveyed at all levels present: the canopy (trees), middle canopy (trees), understorey (shrubs), and groundcover plants (plants less then one metre in height). An abundance score was assigned to each species recorded. Dominant species and the projected foliage cover of each stratum were recorded at locations that typified the vegetation communities present in the study area. A general description of the vegetation was then prepared based on structural characteristics and dominant canopy species in accordance with Walker and Hopkins (1990) and Specht (1970). These techniques were used to classify and name the vegetation communities in the study area and immediate surrounds.

The vegetation communities identified in the study area were compared with the Final Determinations of the NSW Scientific Committee and the listing advice of the Commonwealth Threatened Species Scientific Committee to ascertain whether the communities comprised listed threatened ecological communities.

Targeted Searches

Specific searches for plant species of conservation significance known from the locality were conducted using systematic grid transects approximately 10 m apart in suitable habitats. This technique was used to target the Hoary Sunray *Leucochrysum albicans* var*. tricolor,* Button Wrinklewort *Rutidosis leptorrhynchoides,* Small Purple-pea *Swainsona recta* and Silky Swainson-pea *Swainsona sericea*.

These surveys were undertaken after inspection of local reference sites where the species were confirmed to be in flower. Conditions in the lead up to and during the survey period where conducive to good flowering seasons for each species.

Surveys where conducted by a team of two people walking parallel transects approximately 10 m apart which searching for the species. Targeted searches for the species were also undertaken separately during the vegetation and Box-Gum Woodland surveys, using the Random Meander technique (Cropper 1993).

Limitations

The floristic audit undertaken recorded as many species as possible and provides a comprehensive but not definitive species list. More species would probably be recorded during a longer survey over various seasons.

Nevertheless, the techniques used in this investigation are considered adequate to gather the data necessary to assess the constraints to future development of the study area by the flora species and vegetation communities found there.

Nomenclature

Most of the plant species names in this report are the current names published in the Flora of NSW (Harden 1990-2000). The taxonomic names have been supplemented with common names obtained from various sources. The scientific and conservation significance of individual plant species was established with reference to Briggs and Leigh (1996) and the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* in the national context, and to the *NSW Threatened Species Conservation Act 1995* in the state context.

Flora Survey Effort

The flora survey effort employed a total of 40 person-hours as documented in Table 1.

Table 1: Flora survey effort employed over the study area and surrounds.

DATE	METHOD	EFFORT	TARGET SPECIES
5 November 2008	Random meander	3 person-hours	All flora species
	Vegetation plots	1 person-hours	All flora species
	Targeted Grid Searches	12 person-hours	Silky Swainson-pea, Small Purple-pea, Hoary Sunray
6 November 2008	Random meander	4 person-hours	All flora species
	Vegetation plots	2 person-hours	All flora species
7 November 2008	Random meander	4 person-hours	All flora species
10 December 2008	Targeted Grid Searches	14 person-hours	Button Wrinklewort, Hoary Sunray
TOTAL FLORA SURVEY EFFORT		**40 PERSON-HOURS**	

2.3 Fauna Survey Methods

Field investigations for fauna were conducted in the study area between October and December 2008 in the locations shown in Figure 3 (Appendix A).

Habitat surveys

Systematic searches were conducted throughout the study area for habitats or resources of relevance for threatened fauna species with the potential to occur in the study area. Searches targeted trees containing hollows, feed-trees of the Glossy Black-cockatoo, roost sites of large forest owls, nests of raptors, mammal diggings, scratchings and scats, caves, abandoned mines, surface rock concentrations, termite mounds and water sources. The general quality and quantity of these resources was recorded. The locations of particular habitat features and evidence of any fauna species of conservation significance were recorded with a handheld Garmin Global Positioning System.

Stagwatching surveys

Stagwatching of selected hollow-bearing trees was undertaken at dusk by one ecologist in November and December 2008. Hollows were watched for the emergence of nocturnal mammals and birds for one hour after sunset, with the aid of binoculars and spotlights where necessary. Listening for vocalisations of nocturnal mammals and birds was also undertaken during stagwatching surveys and during subsequent spotlighting surveys.

Call playback surveys for nocturnal mammals and birds

The calls of the Koala, Squirrel Glider, Barking Owl and Bush Stone Curlew were broadcast through a 15W Toa megaphone from three locations within study area in November and December 2008. Calls were generally broadcast intermittently for a period of up to five minutes each, followed by a final listening period of 15 minutes. Post-playback listening periods extended into subsequent spotlighting surveys for a further one to two hours. Pre-playback listening surveys were generally undertaken during stagwatching surveys which involved a listening period of one hour after sunset.

Nocturnal spotlighting surveys

Spotlighting surveys using a Narva Colt 55 W hand-held spotlight were employed for a total of three hours in November and December 2008. Spotlighting was undertaken along tracks and transects through habitats likely to support threatened nocturnal fauna species. Binoculars were used to aid in the identification of species where necessary. Arboreal and terrestrial species were targeted with this technique, including amphibians in appropriate habitats. Spotlighting was undertaken while actively listening for vocalisations of nocturnal fauna species. In general, each spotlighting session commenced approximately 1.5 hours after sunset and was undertaken for 1 to 2 hours. Additional vehicle-based nocturnal observations were made when driving slowly along tracks in the study area at night.

Microchiropteran echolocation call recording surveys

Echolocation recording surveys were used to target microchiropteran bats in the study area over two nights in November and December 2008. Two AnaBat II bat detectors linked to ZCAIM digital data recorders were used on each night in suitable habitat (flyways adjacent to denser vegetation and or creeks) to record microchiropteran echolocation calls. All bat detectors were left in place overnight. Recorded data was analysed by Mr. Stephen Bloomfield of Lesryk Environmental Consultants.

Diurnal Bird Surveys

Targeted surveys for diurnal bird species were undertaken throughout the study area during November and December 2008. Threatened woodland birds with potential to occur in the area were particularly targeted by searches of relevant habitats for 8.5 person hours. Diurnal bird surveys utilised visual (aided by binoculars) and aural methods of detection, while actively searching or monitoring targeted habitats. Areas containing hollow-bearing trees were monitored whenever possible throughout the survey period for evidence of breeding by species such as the Gang-gang Cockatoo and Brown Treecreeper. Opportunistic observation and recording of diurnal birds was also undertaken at other times of the survey period during other flora and fauna surveys.

Diurnal Reptile surveys

Reptile surveys targeting the Pink-tailed Worm Lizard and to a lesser extent the Little Whip Snake, Striped Legless Lizard and Grassland Earless Dragon, were undertaken within open habitats (Box-Gum Woodland and exotic grasslands) containing scattered surface rocks. Surveys entailed active searches under rocks, logs, branches and debris for reptiles or evidence of reptiles (e.g. sloughed skins of the Pink-tailed Worm-lizard). Surveys were undertaken on 16 and 17 October 2008 for a total of 20 person-hours. Conditions suitable for detecting the Pink-tailed Worm-lizard, as temperatures during the surveys were under 25^0C and the area had received 12.8mm of rainfall 2 days before the survey (Queanbeyan Bowling Club weather station).

Golden Sun Moth surveys

Open grassy habitats were surveyed for the Golden Sun Moth during the known flying season in December 2008 for seven person-hours. Areas with a high proportion of Wallaby Grass or other grasses known to be favoured by the Golden Sun Moth were targeted.

Hand netting was used to capture any day-flying moths for identification. Conditions were predominantly warm and sunny with little or no wind, so suitable for the species to be active. Surveys were undertaken between mid morning and mid afternoon.

Opportunistic Surveys

Opportunistic observations of fauna activity, indirect evidence of fauna activity and fauna habitats were conducted throughout the survey period. Opportunistic observations of threatened species or species not detected by previous surveys were recorded. The locations of any threatened species were mapped via GPS recording.

Limitations

The results of fauna surveys can be optimised by conducting repeat investigations over a long period to compensate for the effect of unfavourable weather, seasonal changes and climatic variation. In general, the longer the survey or the higher the number of repeat surveys, the more species will be detected and more detail will be gained in relation to the abundance, distribution and habitat use of the fauna. Wherever possible, surveys were conducted using a range of methods best suited for detecting target species, at optimum times during appropriate conditions.

However, surveys are subject to constraints that determine the amount of time allocated, the methods used and the timing of the work. Thus, the results should be viewed in the light of these limitations. The fauna detected in current survey work are a comprehensive guide to the native fauna present, but are not necessarily a definitive list of the species occurring in the study area. Nevertheless, given the habitats present, the techniques used in this investigation are

considered adequate to gather the data necessary to identify species and habitats of high conservation value within the study area.

Fauna Survey Effort

The fauna survey effort employed a total of 48.5 person-hours and 4 nights of microchiropteran echolocation call recording as documented in Table 3.

Table 2: Fauna survey effort employed over the study area.

DATE	METHOD	EFFORT	TARGET SPECIES
15 October 2008	Bird	3 person hours	All species
16 October 2008	Reptile	14 person hours	All species
17 October 2008	Reptile	6 person hours	All species
6 November 2008	Stagwatching	1 person hour	Nocturnal birds and mammals
	Call playback	0.5 person hour	Squirrel Glider, Koala, Barking Owl, Bush Stone Curlew
	Spotlighting	1 person hour	Nocturnal birds, mammals & frogs
	AnaBat echolocation recording	2 detectors overnight	Microchiropterans
7 November 2008	Birds	1 person hour	Diurnal Birds
10 December 2008	Hand netting	14 person hours	Golden Sun Moth
16 December 2008	Birds	1 person hour	Diurnal Birds
	Stagwatching	1 person hour	Nocturnal birds and mammals
	Call playback	0.5 person hour	Squirrel Glider, Koala, Barking Owl, Bush Stone Curlew
	Spotlighting	2 person hour	Nocturnal birds, mammals & frogs
	AnaBat echolocation recording	2 detectors overnight	Microchiropterans
17 December 2008	Birds	3.5 person hours	Diurnal birds
TOTAL FAUNA SURVEY EFFORT		**48.5 person-hours, 4 nights AnaBat recording**	

Fauna survey conditions

Fauna surveys were designed to be undertaken at the optimum time of year and during weather conditions suitable for, or preferred by, target species. Conditions throughout the survey period are given in Table 3.

Table 3: Fauna survey conditions during the survey period

DATE	SURVEY TYPE	TEMPERATURE	WIND	CLOUD	MOON	RAIN
15 October 2008	Bird	17°C – 19°C	None	0/8	n/a	None
16 October 2008	Reptile	20°C – 21°C	None	0/8	n/a	None
17 October 2008	Reptile	22°C – 24°C	Light	1/8	n/a	None
6 November 2008	Nocturnal	19°C – 13°C	None	n/a	n/a	None
7 November 2008	Bird	14°C	None	n/a	n/a	None
10 December 2008	Sun Moth	17°C– 25°C	Light	2/8	n/a	None
16 December 2008	Bird	15°C– 16°C	None	1/8	n/a	None
16 December 2008	Nocturnal	22°C – 13°C	None	1/8	n/a	None
17 December 2008	Bird	10°C – 17°C	None	0/8	n/a	None

3. THE EXISTING ENVIRONMENT

3.1 Topography, Geology, and Soils

The study area lies at an altitude between approximately 580-690 metres Australian Height Datum and comprises varying topography, generally rising from the Queanbeyan River in the South-West to the slopes of Cuumbeun Nature Reserve in the North-East. A number of ephemeral watercourses meander through the study area, dominated by Jumping Creek (also known as Valley Creek) which drains to the Queanbeyan River.

3.2 Disturbances

The vast majority of the study area has been subjected to extensive disturbances, readily apparent from the degraded nature of the site. Mining for gold, copper and lead was undertaken in the area from about 1850 to the early 1900's (IT Environmental 1999) and processing may also have occurred. There is also evidence of limestone quarrying and processing.
The study area has also been heavily disturbed through grazing and agriculture practices. Remnants of an orchard and other exotic plantings are apparent, as well as extensive areas of invasive weed species. Over 62% of the site classified as exotic vegetation and 47% of plant species identified were exotic. All native vegetation in the study area has been heavily disturbed by clearing and/or weeds. Since the 1960's, the land has not been productively utilized, as evidenced by its generally degraded state and the presence of dumped rubbish and vehicles. More recently, the study area has been extensively used by off road vehicles, which has contributed to soil destabilisation and exasperated widespread erosion.

3.3 Flora

For the purposes of this analysis the vegetation within the study area will be described using the vegetation community descriptions and nomenclature of the Planning Framework for Natural Ecosystems of the ACT and NSW Southern Tablelands (Fallding 2002) which was used for the Queanbeyan Biodiversity Study (BES 2008). Four vegetation communities occur within the study area; Box-Gum Woodland, Dry Forest, Burgan Shrubland and Exotic Vegetation. The distribution of these communities within the study area is shown in Figure 4.

3.3.1 Box Gum Woodland

Box-Gum Woodland occurs patchily in a band on the spur extending from Lonergan Drive across Jumping Creek and on the ridge extending to the Talpa Hills as shown in Figure 4 (Appendix A). The community is likely to have once been more extensive within the study area and may have covered all the lower parts of the landscape. However, historic disturbances have been so intensive that the community is now extinct across much of its former range within the study area.

The community is characterised by a sparse canopy dominated by a few mature and regrowth Yellow Box *Eucalyptus melliodora* trees with occasional individuals of Blakely's Red Gum *Eucalyptus blakelyi*, Apple Box *Eucalyptus bridgesiana*, Red Box *Eucalyptus polyanthemos,* Red Stringybark *Eucalyptus macrorhyncha,* Bundy *Eucalyptus goniocalyx* and Brittle Gum *Eucalyptus mannifera*.

The community is generally heavily modified with abundant weeds in the understorey and groundcover, however in a few areas a more diverse native groundcover, and to a lesser extent, understorey persists. The understorey where it is present typically comprises occasional individuals of Blackthorn *Bursaria spinosa* subsp*. lasiophylla*, Black Wattle *Acacia mearnsii*, Cherry Ballart *Exocarpus cupressiformis*, Kurrajong *Brachychiton populneus*, Burgan *Kunzea ericoides* and Shiny Cassinia *Cassinia longifolia* with weedy shrubs the most common of which are Sweet Briar *Rosa rubiginosa,* Hawthorn *Crataegus monogyna*, Orange Firethorn *Pyracantha angustifolia*, Blackberry *Rubus fruticosus* aggregate and Tree of Heaven *Ailanthus altissima*.

The groundcover typically includes a mix of hardy natives and weeds such as Kangaroo Grass *Themeda australis*, Speargrasses *Austrostipa* spp., Wallaby Grasses *Austrodanthonia* spp., New Holland Daisies *Vittadinia* spp., Wattle Mat-rush *Lomandra filiformis*, Sheep's Burr *Acaena ovina*, Common Woodruff *Asperula conferta*, Common Everlasting *Chrysocephalum apiculatum,* Native Geranium *Geranium solanderi*, Cutleaf Goodenia *Goodenia pinnatifida*, Bluebells *Wahlenbergia* spp., Love Creeper *Glycine* spp., Grassland Wood Sorrel *Oxalis perennans*, Blushing Bindweed *Convolvulus erubescens*, and Climbing Saltbush *Einadia nutans*. The most abundant groundcover weeds include St John's Wort *Hypericum perforatum*, Serrated Tussock *Nassella trichotoma*, Soft Broome *Bromus hordeaceus*, Wild Oats *Avena fatua*, Chilean Needle Grass *Nassella neesiana*, Great Mullein *Verbascum thapsus*, Wild Sage *Salvia verbenaca,* Hop Clover *Trifolium campestre* and Horehound *Marrubium vulgare*.

3.3.2 Dry Forest

This vegetation community occurs predominately on the mid and upper-slopes on the northern margins of the study area but also on the steep slopes above the Queanbeyan River and Jumping Creek which are particularly rocky and exposed as shown in Figure 4 (Appendix A). The community is generally in relatively good condition however in places it has been reduced to a secondary grassland or is characterised by dense shrubland of Burgan regrowth.

The canopy is dominated by Bundy, Red Stringybark, Red Box and Scribbly *Gum Eucalyptus rossii,* and on the steep slopes above the Queanbeyan River by Apple Box. A few individuals of Yellow Box occur in places*.* The understorey includes species such as Burgan, Pink Five-Corners *Styphelia triflora*, Broom Bitter Pea *Daviesia genistifolia*, Native Indigo *Indigofera australis, Dillwynia sericea,* Shiny Cassinia*,* Woolly-head Pomaderris *Pomaderris eriocephala*,

Blackthorn, Black Wattle, Cherry Ballart, Hempbush *Gynatrix pulchella* and along the creek lines, Buffalo Wattle *Acacia kettlewelliae* and Dwarf Bottlebrush *Callistemon subulatus.*

The groundcover is generally dominated by natives the most common of which are Heath Bush-pea *Pultenaea procumbens*, Grey Guinea Flower *Hibbertia obtusifolia*, Common Raspwort *Gonocarpus tetragynus*, Creeping Hovea *Hovea linearis*, Rock Fern *Cheilanthes sieberi*, Creamy Candles *Stackhousia monogyna*, Native Geranium, Common Woodruff, Sticky Everlasting *Xerochrysum viscosum*, Ivy Goodenia *Goodenia hederacea*, Clustered Everlasting *Chrysocephalum semipapposum,* Kangaroo Grass, Speargrasses *Austrostipa* spp., Wattle Mat-rush, Spiney-headed Mat-rush *Lomandra longifolia*, Variable Swordsedge *Lepidosperma laterale* and, in places, Hoary Sunray *Leucochrysum albicans* subsp. *albicans* var. *tricolor.*

3.3.3 Burgan Shrubland

There are two large dense patches of Burgan *Kunzea ericoides* within the north-eastern and south-western extremities of the study area. The community comprises a dense shrubland to approximately 2 m in height and is dominated by Burgan almost to the exclusion of all other vegetation, although there are patches of native and exotic groundcovers typical of the disturbed habitats within the study area. The community is an artefact of the disturbance history and is common in the region where grazing pressure has been relaxed on areas that have been long cleared and heavily grazed.

3.3.4 Exotic Vegetation

This community occurs throughout the bulk of the study area and is the artefact of the extensive heavy disturbances that have occurred there. The community is characterised by the almost complete dominance of exotic species with occasional individuals or patches of the most hardy natives. The community includes extensive infestations of weeds such as Blackberry, Sweet Briar, Tree of Heaven, St John's Wort, Serrated Tussock, Soft Broome, Chilean Needle Grass, Great Mullein, Wild Sage, Saffron Thistle *Catharmus lanatus,* Paterson's Curse *Echium plantagineum,* Hop Clover and Horehound. Along Jumping Creek and other drainage lines Hawthorn, Blackberry, Lombardy Poplar *Poplus nigra* and Willows Salix Spp. are particularly prevalent. The hardy native groundcovers which occur in places include Short Wallaby Grass *Austrodanthonia carphoides*, Speargrass *Austrostipa scabra*, *Vittadinia muelleri*, Sheeps Burr and Bluebells.

3.3.5 Flora Species

A total of 128 flora species were identified during the flora surveys, and these are listed in Table 4. Eighty-seven native species and 41 introduced species were identified.

Table 4: Plant species identified in the study area

(* denotes introduced species, bold denotes threatened species).

SCIENTIFIC NAME	COMMON NAME	3.3.1	3.3.2
*Acacia baileyana**	Cootamundra Wattle	x	x
Acacia genistifolia	Early Wattle	x	
Acacia irrorata	Green Wattle	x	
Acacia kettlewelliae	Buffalo Wattle		x
Acacia obtusifolia	Blunt-leaved Wattle		x
Acacia mearnsii	Black Wattle	x	x
Acacia rubida	Red-stemmed Wattle	x	
Aceana ovina	Sheep's Burr	x	
*Acetosella vulgaris**	Sheep Sorrel	x	x
*Ailanthus altissima**	Tree of Heaven	x	x
Aira sp.*	A hairgrass	x	
Amyema sp.	A mistletoe	x	
Asperula conferta`	Common Woodruff	x	
Asplenium flabellifolium	Necklace Fern		x
Austrodanthonia carphoides	Short Wallaby Grass	x	x
Austrodanthonia racemosa	Clustered Wallaby Grass	x	
Austrodanthonia sp.	Wallaby Grass	x	
Austrostipa bigeniculata	Double-jointed Spear Grass	x	
Austrostipa scabra	Speargrass	x	x
*Avena fatua**	Wild Oats	x	
Bothriochloa macra	Red Grass	x	
Brachychiton populneus	Kurrajong	x	x
Brachyscome sp.	A Daisy	x	
Brassica sp.*		x	
*Briza maxima**	Quaking Grass		x
*Bromus hordeaceus**	Soft Brome	x	x
Bulbine bulbosa	Golden Lily	x	
Bursaria spinosa subsp. *lasiophylla*	Blackthorn	x	x
Callistemon subulatus	Dwarf Bottlebrush		x
Calytrix tetragona	Fringe-myrtle	x	
Cassinia longifolia	Shiny Cassinia	x	x

*Catharmus lanatus**	Saffron Thistle	x	
Chielanthes austrotenuifolia	Rock Fern	x	
Chielanthes sieberi	Mulga Fern		x
Chrysocephalum apiculatum	Common Everlasting	x	
Chrysocephalum semipapposum	Clustered Everlasting		x
*Cirsium vulgare**	Spear Thistle	x	
Clematis aristata	Old Man's Beard		x
Clematis mycrophylla	Small-leaved Clematis	x	
Convulous erubescens	A Bindweed	x	
*Crassula multicava**	A Stonecrop	x	
*Crataegus monogyna**	Hawthorn	x	
Cryptandra amara	Bitter Cryptandra	x	x
Cynoglossum suaveolens	Sweet Hound's-tongue		x
Cymbonotus lawsonianus	Bears-ear	x	
Davisia genistifolia	Broom Bitter Pea		x
Dillwynia sericea	Parrot Pea		x
*Echium plantagineum**	Paterson's Curse	x	x
Einadia nutans	Climbing Saltbush	x	x
Elymus scaber	Wheatgrass	x	
Eragrostis sp.	A Love-Grass		x
Eucalyptus blakelyi	Blakely's Red Gum	x	
Eucalyptus bridgesiana	Apple Box	x	
Eucalyptus goniocalyx	Bundy		x
Eucalyptus macrorhyncha	Red Stringybark		x
Eucalyptus melliodora	Yellow Box	x	x
Eucalyptus muelleriana	Yellow Stringybark	x	
Eucalyptus polyanthemos	Red Box		x
Eucalyptus rossii	Scribbly Gum		x
Exocarpus cupressiformis	Cherry Ballart		x
Geranium solanderi	Native Geranium	x	x
Glycine spp.	Love Creeper		
Glycine tabacina	Love Creeper	x	
Gonocarpus tetragynus	Poverty Raspwort	x	x

Goodenia hederacea	Variable-leaved Goodenia	x	x
Goodenia pinnatifida	Cutleaf Goodenia	x	
Gratiola sp.	A Booklime		x
Gynatrix pulchella	Hemp Bush		x
Haloragis heterophylla	Rough Raspwort	x	
Hibbertia obtusifolia	Grey Guinea-flower	x	x
Hordeum spp.*	Barley Grass	x	x
Hovea linearis	Narrow-leaf Hovea		x
Hydrocotyle laxiflora	Stinking Pennywort	x	x
Hymenanthera dentata	Tree Violet	x	
*Hypericum perforatum**	St. John's Wort	x	x
Hypochaeris glabra	Smooth Catsear	x	
*Hypochaeris radicata**	Flatweed	x	
Indigofera australis	Native Indigo		x
Kunzea ericoides	Burgan	x	x
Lepidosperma laterale	Variable Sword-sedge		x
Leptorhynchos squamatas	Scaly Buttons	x	
Leucochrysum albicans* subsp. *Albicans* var. *tricolor	**Hoary Sunray**		x
*Linaria pelisseriana**	Pelisser's Toadflax	x	
Lomandra bracteata		x	
Lomandra filiformis	Wattle Mat-rush	x	x
Lomandra longifolia	Spiny-headed Mat-rush		x
*Lycium ferocissium**	African Boxthorn	x	
Microlaena stipoides	Weeping Meadow Grass	x	
*Marrubium vulgare**	Horehound	x	x
*Modiola caroliniana**	Red-flowered Mallow	x	
Monotoca scoparia	Prickly Broom-heath		x
*Nassella neesiana**	Chilean Needle Grass	x	
*Nassella trichotoma**	Serrated Tussock	x	
Opuntia sp.*	A Prickly Pear	x	
Oxalis perennans	Grassland Wood Sorrel	x	
*Paronychia brasiliana**	Chilean Whitlow Wort	x	
Persicaria prostrata	Creeping Knotweed		x

*Petrorhagia nanteuilii**	Proliferous Pink	x	x
*Pinus radiata**	Radiata Pine	x	x
*Plantago lanceolata**	Lamb's Tongue	x	x
Plantago varia	Variable Plantain		x
Pomaderris eriocephala	Woolly-head Pomaderris		x
*Populus nigra**	Black Poplar	x	
Pultenaea procumbens	Heath Bush-pea		x
*Pyracantha angustifolia**	Orange Firethorn	x	
*Rosa rubiginosa**	Briar Rose	x	x
*Rubus fruiticosus**	Blackberry	x	x
Rumex brownii	Swamp Dock	x	x
Salix sp.*	Willow	x	
*Salvia verbenaca**	Wild Sage	x	
Senecio sp.*	A fireweed	x	
Solanum sp.*		x	
Solenogyne dominia	Smooth Solenogyne	x	
Stackhousia monogyna	Creamy Candles		x
Stellaria pungens	Prickly Starwort		x
Styphelia triflora	Pink Five-corners	x	x
Themeda australis	Kangaroo Grass	x	x
*Tolpis umbellata**		x	
*Trifolium arvense**	Haresfoot Clover	x	x
*Trifolium campestre**	Hop Clover	x	x
Triptilodiscus pygmaeus	Common Sunray	x	
*Verbascum thapsus**	Great Mullein	x	x
Verbena sp.*	A Purpletop	x	
Vittadinia cuneata	Fuzzweed	x	
Vittadinia muelleri	Narrow Leaf New Holland Daisy	x	
Wahlenbergia communis	Tufted Bluebell	x	
Wahlenbergia spp.	Bluebell	x	
Xerochrysum viscosum	Sticky Everlasting		x

3.4. Fauna

3.4.1 Fauna Habitats

The quality of fauna habitats present in the study area is generally low, reflecting the extensive disturbances that have occurred over most of the site. The vast majority of native vegetation has been previously cleared, much of which has been replaced by exotic species.

Generally, fauna habitat types include ephemeral creeks, riparian areas associated with Queanbeyan River, open grassy areas, native regrowth woodland, densely vegetated areas of Burgan and Blackberry, and various rocky habitats.

Native forest and woodland ranges from a sparse open grassy understorey to patches of dense native and exotic understorey. These areas typically provide a range of tree and shrub foraging resources such as nectar, pollen, fruit, seeds and associated insects. Open grassy areas provide foraging resources for kangaroos, wallabies, wombats, and granivourous and insectivorous birds. Limited shelter and nesting resources for birds are provided by trees and shrubs, which include a low number of hollow-bearing trees, also providing potential sheltering resources for some mammals, such as the Common Brush-tail Possum and insectivorous bats, and possibly reptiles and frogs.

Dense understorey habitats are mainly provided by Burgan regrowth and also Blackberry, supporting a range of smaller native and exotic bird and mammal species. Dense understorey vegetation also exists along sections of some creeks, particularly the lower sections of Jumping Creek.

Riparian habitats associated with the Queanbeyan River are in parts heavily disturbed, but still provide important habitats and connectivity for a range of bird species in particular. These habitats on the western fringe of the study area are associated with a permanent water source, which supports a range of bird and aquatic fauna not found elsewhere in the study area.

Jumping Creek and other tributaries in the study area are ephemeral and often heavily disturbed by clearing, introduced species, erosion, earthworks and/or abandoned vehicles. These riparian habitats are much poorer than the Queanbeyan River, and subsequently support a much limited range of fauna. The lower section of Jumping Creek is lined by rock habitats, which provides for cooler, moister and more sheltered microhabitats than other sections of the creek system in the study area. This habitat supports a range of mammal, bird, reptile and amphibian species.

Scattered surface rock habitats were thinly distributed over much of the study area, providing shelter sites for small reptiles and invertebrates. Large areas of rock, including substantial cliffs were associated with the lower section of Jumping Creek.

3.4.2 Fauna Species

Targeted fauna surveys and opportunistic observations during the survey period resulted in the detection of 97 faunal species in or adjacent to the study area. A total of 21 mammals, 60 birds, eight reptiles and eight amphibians were recorded (Table 5). Five introduced mammals and three introduced birds were recorded during the survey period.

Three threatened fauna species were recorded during the survey period, consisting of one threatened bat (Eastern Bentwing Bat) and three threatened birds (Gang-gang Cockatoo, Painted Honeyeater and Speckled Warbler). A further two threatened bat species (Greater Broadnosed Bat and Large-footed Myotis) were tentatively identified (Figure 5, Appendix A).

Table 5: Fauna species recorded in the study area

(* denotes introduced species, bold denotes threatened or listed migratory species)

CATEGORY	COMMON NAME	SCIENTIFIC NAME	DETECTION METHOD
Mammals	Cat *	*Felis cattus**	Observed
	Chocolate Wattled Bat	*Chalinolobus morio*	Anabat (confident identification)
	Common Brushtail Possum	*Trichosurus vulpecula*	Observed
	Common Wombat	*Vombatus ursinus*	Scat
	Dog *	*Canis lupus familiaris*	Observed
	Eastern Freetail Bat	*Mormopterus sp. 2*	Anabat (probable identification)
	Eastern Freetail Bat	*Mormopterus sp. 4*	Anabat (probable identification)
	Eastern Grey Kangaroo	*Macropus giganteus*	Observed
	European Hare*	*Lepus europaeus**	Observed
	European Rabbit *	*Oryctolagus cuniculus**	Observed
	Gould's Wattled Bat	*Chalinolobus gouldii*	Anabat (confident identification)
	Greater Broadnosed Bat	***Scoteanax rueppellii***	Anabat (probable identification)
	Eastern Bentwing Bat	***Miniopterus schreibersii***	Anabat (confident identification)
	Large-footed Myotis	***Myotis adversus***	Anabat (Possible identification)
	Large Forest Bat	*Vespadelus darlingtoni*	Anabat (Confident identification)

CATEGORY	COMMON NAME	SCIENTIFIC NAME	DETECTION METHOD
	Little Forest Bat	*Vespadelus vulturnus*	Anabat (Confident identification)
	Longeared Bat	*Nyctophilus sp.*	Anabat (Possible identification)
	Red Fox *	*Vulpes vulpes**	Observed
	Southern Forest Bat	*Vespadelus regulus*	Anabat (Confident identification)
	Swamp Wallaby	*Wallabia bicolor*	Observed
	White-striped Freetail Bat	*Nyctinomus australis*	Anabat (Confident identification)
Birds	Australian Owlet-nightjar	*Aegotheles cristatus*	Call recognition
	Australian Magpie	*Gymnorhina tibicen*	Observed
	Australian Raven	*Corvus coronoides*	Observed
	Australian Wood Duck	*Chenonetta jubata*	Observed
	Black-faced Cuckoo-shrike	*Corocina novaehollandiae*	Observed
	Brush Cuckoo	*Cacomantis variolosus*	Call recognition
	Clamorous Reed Warbler	*Acrocephalus stentorius*	Call recognition
	Common Bronzewing	*Phaps chalcoptera*	Observed
	Common Starling *	*Sturnus vulgaris* *	Observed
	Crested Pigeon	*Geophaps lophotes*	Observed
	Crimson Rosella	*Platycercus elegans*	Observed
	Dusky Woodswallow	*Artamus caynopterus*	Observed
	Eastern Rosella	*Platycercus eximius*	Observed
	Eastern Spinebill	*Acanthorhynchus tenuirostris*	Observed
	Eastern Yellow Robin	*Eopsaltria australis*	Observed
	Eurasian Coot	*Fulica atra*	Observed
	European Blackbird *	*Turdus merula* *	Call recognition
	European Goldfinch *	*Carduelis carduelis* *	Observed
	Fan-tailed Cuckoo	*Cacomantis flabelliformis*	Call recognition
	Forest Kingfisher	*Halycon macleayii*	Observed
	Galah	*Cacatua roseicapilla*	Observed
	Gang-gang Cockatoo	***Callocephalon fimbriatum***	Observed
	Golden Whistler	*Pachycephala pectoralis*	Observed
	Grey Butcherbird	*Cracticus torquatus*	Observed

CATEGORY	COMMON NAME	SCIENTIFIC NAME	DETECTION METHOD
	Grey Currawong	*Strepera versicolor*	Observed
	Grey Fantail	*Rhipidura fuliginosa*	Observed
	Grey Shrike-thrush	*Colluricincla harmonica*	Call recognition
	Jacky Winter	*Microeca fascinans*	Observed
	Laughing Kookaburra	*Dacelo novaeguineae*	Observed
	Leaden Flycatcher	*Myiagra rubecula*	Observed
	Little Pied Cormorant	*Phalacrocorax melanoleucos*	Observed
	Magpie-lark	*Grallina cyanoleuca*	Observed
	Noisy Friarbird	*Philemon corniculatus*	Call recognition
	Noisy Miner	*Manorina melanocephala*	Observed
	Pacific Black Duck	*Anas superciliosa*	Observed
	Painted Honeyeater	***Grantiella picta***	Observed
	Peregrine Falcon	*Falco peregrinus*	Observed
	Pied Currawong	*Strepera graculina*	Observed
	Red-browed Firetail Finch	*Aegintha temporalis*	Observed
	Red Wattlebird	*Anthocaera carunculata*	Observed
	Restless Fly Catcher	*Myiagra inquieta*	Call recognition
	Rufous Whistler	*Pachycephala rufiventris*	Observed
	Shining Bronze-Cuckoo	*Chrysococcyx lucidus*	Call recognition
	Silvereye	*Zosterops lateralis*	Observed
	Southern Boobook	*Ninox novaeseelandiae*	Call recognition
	Speckled Warbler	***Pyrrholaemus sagittatus***	Observed
	Striated Pardalote	*Pardalotus striatus*	Observed
	Striated Thornbill	*Acanthiza lineata*	Observed
	Sulphur Crested Cockatoo	*Cacatua pastinator*	Call recognition
	Superb Fairy-wren	*Malurus cyaneus*	Observed
	Weebill	*Smicrornis brevirostris*	Observed
	White-eared Honeyeater	*Lichenostomus leucotis*	Observed
	White-throated Gerygone	*Gerygone olivacea*	Call recognition
	White-throated Nightjar	*Eurostopodus mysticlais*	Call recognition
	White-throated Treecreeper	*Cormobates leucophaeus*	Observed
	White-winged Chough	*Corcorax melanorhamphos*	Observed

CATEGORY	COMMON NAME	SCIENTIFIC NAME	DETECTION METHOD
	Yellow-faced Honeyeater	*Lichenostomus chrysops*	Observed
	Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	Observed
	Yellow-tailed Black Cockatoo	*Calyptorhynchus funereus*	Observed
Reptiles	Eastern Bearded Dragon	*Pogona barbata*	Observed
	Copper-tailed Skink	*Ctenotus taeniolatus*	Observed
	Boulenger's Skink	*Morethia boulengeri*	Observed
	Brown Snake	*Demansia textilis*	Observed
	Jacky Lizard	*Amphibolurus muricatus*	Observed
	Garden Skink	*Lampropholis delicata*	Observed
	Skink	*Ctenotus orientalis*	Observed
	Striped Skink	*Ctenotus robustus*	Observed
Amphibians	Bibron's Toadlet	*Pseudophryne bibronii*	Call recognition
	Brown-striped Frog	*Limnodynastes peronii*	Call recognition
	Common Eastern Froglet	*Crinia signifera*	Call recognition
	Brown Froglet	*Crinia parinsignifera*	Call recognition
	Eastern Banjo Frog	*Limnodynastes dumerilii*	Call recognition
	Lesueur's Frog	*Litoria lesueuri*	Call recognition
	Spotted Grass Frog	*Limnodynastes tasmaniensis*	Call recognition
	Toadlet	*Uperoleia sp.*	Call recognition

4. CONSERVATION SIGNIFICANCE

The *NSW Threatened Species Conservation Act 1995* (*TSC Act*) and the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act*) provide for the listing of threatened flora and fauna species.

The *EPBC Act* also provides for the listing of migratory species. The *NSW Fisheries Management Act 1994* (*FM Act*) provides for the listing of threatened fish species and marine vegetation.

The *TSC Act* classifies threatened flora and fauna species as Endangered (Schedule 1, Part 1), Vulnerable (Schedule 2), or Presumed Extinct (Schedule 1, Part 4). Records of these species may be obtained by searching the Atlas of NSW Wildlife.

The *EPBC Act* classifies threatened flora and fauna species as Extinct, Critically Endangered, Endangered or Vulnerable. An indication of the threatened and migratory species likely to be encountered in a locality may be obtained by using the *EBPC Act* Protected Matters Search Tool.

Both of these databases were searched on 20 January 2009 for threatened flora, threatened fauna and migratory species known to occur or with the potential to occur within the Queanbeyan LGA.

The *FM Act* classifies threatened fish and marine vegetation as Endangered, Vulnerable, or Presumed Extinct. An indication of the species likely to be encountered in a locality may be obtained by reviewing the recommendations for threatened species listed on the schedules of the *FM Act*.

4.1 Threatened Flora

The outcomes of database searches for threatened flora are shown in Table 6 with the status of each species listed as endangered (E) or Vulnerable (V).

The potential for each of these species to occur in the study area and the importance of the habitats are discussed in Table 6.

Table 6: Threatened flora species recorded or likely to occur in the locality.

THREATENED FLORA SPECIES	STATUS*		POTENTIAL TO OCCUR IN THE STUDY AREA AND IMPORTANCE OF HABITAT WITHIN THE STUDY AREA
	TSC Act	EPBC Act	
Caladenia tessellata Thick-lipped Spider Orchid	E	V	**Unlikely.** This species is generally found in grassy sclerophyll woodland on clay loam or sandy soils and is known from one record in the Queanbeyan LGA, within Dry Forest along the Queanbeyan River corridor. This species is highly unlikely to occur in the heavily disturbed

THREATENED FLORA SPECIES	STATUS*		POTENTIAL TO OCCUR IN THE STUDY AREA AND IMPORTANCE OF HABITAT WITHIN THE STUDY AREA
	TSC Act	EPBC Act	
			parts of the study area. It is possible although unlikely that it may occur in less disturbed areas, however it was not detected within the study area despite surveys during the flowering period.
Calotis glandulosa Mauve Burr-daisy	V	V	**Unlikely.** This species appears to be a coloniser of bare patches and occurs, often on roadsides, in the subalpine habitats of the Australian Alps. The species is known from montane grasslands dominated by Poa species, Natural Temperate Grassland dominated by Kangaroo Grass, and Snow Gum Woodlands in the Monaro and Shoalhaven regions. The study area does not provide suitable habitat for this species and it was not detected there despite surveys during the flowering period. It has not been recorded in the Queanbeyan LGA and is highly unlikely to occur within the study area.
Leucochrysum albicans var. *tricolor* Hoary Sunray	-	E	**Present**. The Hoary Sunray is associated primarily with Grassy Woodlands in the region and is locally common, occurring throughout much of the LGA, particularly in the north-eastern parts. The species persists in areas that are not heavily grazed and as such commonly occurs in road reserves. The species occurs in a few locations within the study area but is only common in the Dry Forest on the north-western and south-western margins of the study area.
Pomaderris pallida Pale Pomoderris	V	V	**Possible**. This species usually grows in open forest or shrub communities surrounded by Brittle Gum, Red Stringybark or *Callitris* spp. Woodland. In the Queanbeyan LGA, it is only known from two records in Dry Forest within the Queanbeyan River Corridor below Googong Reservoir and east of Wickerslack Lane. This species was not detected during the survey period but may possibly be present on the steep slopes above the Queanbeyan River in the extreme west of the study area. This habitat would not be affected by development of the study area.
Rutidosus leptorhrhynchoides Button Wrinklewort	E	E	**Unlikely.** This species is known to occur at several sites to the west of Mount Jerrabomberra, including a population of around 1500 in Queanbeyan Nature Reserve, primarily in association with Box-Gum Woodland. A population of around 700 plants is also known from “The Poplars”, where the species occurs in semi-natural grassland. Several individuals also occur in a small reserve in Jerrabomberra Estate. This species tends to occupy areas where there is relatively less competition from herbaceous species (either due to the shallow nature of the soils, or at some sites due to the competitive effect of woodland trees). It exhibits an ability to colonise disturbed areas (eg. vehicle tracks, bulldozer scrapings and areas of soil erosion), however it is susceptible to grazing and is now known only from un-grazed or lightly grazed sites. The species was not detected within the study area despite targeted surveys of potentially suitable habitats during the flowering period. It is considered highly unlikely that the species would occur within the study area given the extensive disturbances that have occurred there.

THREATENED FLORA SPECIES	STATUS*		POTENTIAL TO OCCUR IN THE STUDY AREA AND IMPORTANCE OF HABITAT WITHIN THE STUDY AREA
	TSC Act	EPBC Act	
Swainsona recta Mountain Swainson-pea	E	E	**Unlikely**. This species is associated with grassy Box-Gum Woodlands and grows in association with understorey dominants that include Kangaroo Grass, poa tussocks and spear-grasses. It is known to occur within the LGA along the Queanbeyan River as well as in the northwest of Royalla in association with Box-Gum Woodland, in Native Grassland at Tuggeranong and Royalla and also to the west of Letchworth outside the LGA in grassland - woodland mosaic. A population of 800-1000 plants of this species has also been recorded in the railway easement between ACT and NSW adjacent to far north-western corner of Tralee Station, around 9 km southwest of Queanbeyan. Further potential habitat occurs at Tralee Station, in association with grassland in the broad valley of Dunns Creek. The species was not detected within the study area despite targeted surveys of potentially suitable habitats during the flowering period. It is considered highly unlikely that the species would occur within the study area given the extensive disturbances that have occurred there.
Swainsona sericea Silky Swainson-pea	V	-	**Unlikely.** The Silky Swainson-pea is associated with Grassy Woodlands and Native Grasslands and is relatively widespread within the region. It is known from a number of sites within the LGA including native grassland in the Jerrabomberra Creek area, from a paddock to the east of Tralee Station, at Googong in a grassland area beneath a canopy of Yellow Box, and from a grassy paddock in Royalla. Further potential habitat occurs at Tralee Station, in association with Kangaroo Grass grassland in the central-west of the property. The species was not detected within the study area despite targeted surveys of potentially suitable habitats during the flowering period. It is considered highly unlikely that the species would occur within the study area given the extensive disturbances that have occurred there.
Thesium australe Austral Toadflax	V	V	**Unlikely.** This species is generally associated with damp sites in native grasslands and grassy woodlands and is a hemi-parasite of Kangaroo Grass. It has not been previously recorded in the Queanbeyan LGA however there is potential habitat for the species anywhere where there is an abundance of Kangaroo Grass and thus particularly in association with Grassy Woodlands and Native Grasslands that are in good condition and where grazing has been relatively light. Kangaroo Gras is not abundant anywhere within the study area and it is considered highly unlikely that the species would occur there.

Note: Habitat requirements for flora species in Table 3 have been sourced from Barrer (1993 and 1997), Eddy *et. al* (1998), Harden (1994), NPWS (accessed 2007); www.npws.nsw.gov.au (accessed 2007), KMA (1993 and 2006), NSW DECC www.threatenedspecies.environment.nsw.gov.au (accessed 2007) and PlantNET http//plantnet.rbgsyd.gov.au (accessed 2007), and Thompson and Mullins (2004).

One threatened flora species, the Hoary Sunray was recorded in the study area (Figure 5, Appendix A). The ecological constraints posed by the species are discussed in subsequent sections of this report.

4.2 Other Flora of Conservation Significance

The study area includes individuals of Kurrjong *Brachychiton populneus* subsp. *populneus* and Hempbush *Gynatrix pulchella* which are identified by Barrer (1993) as of local conservation significance. Neither of these species are included in the list of Rare or Threatened Australian Plants (ROTAP) (Briggs and Leigh 1996). Similarly, the association of Hempbush and Woolly-head Pomaderris is considered to be of conservation significance by Barrer (1993), and these species occur together in the Dry Forest in the north-eastern extremities of the study area.

4.3 Threatened Fauna

The outcomes of database searches for threatened fauna and the review of recommendations for threatened species listed on the schedules of the *TSC* and *EPBC Act* are shown in Table 7 below with the status of each species listed as endangered (E) or Vulnerable (V). Additional species

The potential for each of these species to occur in the study area and the importance of the habitats within the study area to these species are discussed in Table 7.

Additional threatened species recorded in the study area or that may inhabit the study area have also been included by correlating species habitat requirements with the existing environment. Marine and aquatic species have been omitted as they would not occur in the study area.

Table 7: Threatened fauna species recorded or likely to occur in the locality.

THREATENED FAUNA SPECIES	STATUS		POTENTIAL TO OCCUR IN THE STUDY AREA AND MPORTANCE OF HABITATS PRESENT
	TSC Act	EPBC Act	
Bats			
Large (Eastern) Bentwing Bat *Miniopterus schreibersii oceanensis*	V	-	**Present.** This bat generally uses caves as roosting sites but may also utilise abandoned mines, tunnels and other structures. Forages high for insects in woodlands and forests. The species was recorded in the study area from a very low number of echolocation calls. It has previously been recorded in the Queanbeyan LGA near the centre of Queanbeyan City, in the Googong and Carwoola areas. Limited foraging habitat is present in the study area and the species is expected to forage in or pass through the study area on occasions. No evidence of roosting was found and no important roosting habitat is present in the study area.
Eastern False Pipistrelle *Falsistrellus tasmaniensis*	V	-	**Possible**. This species appears to prefer moist habitats, with trees taller than 20 m. It generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings. In the Queanbeyan LGA it is has been recorded in Dry Forest in the northern part of Cuumbeun NR near Scabbing Flat Creek and in the Googong area. Limited foraging habitat occurs in the study area and a few larger hollow-bearing trees provide limited roosting

THREATENED FAUNA SPECIES	STATUS		POTENTIAL TO OCCUR IN THE STUDY AREA AND MPORTANCE OF HABITATS PRESENT
	TSC Act	EPBC Act	
			resources. The species was not recorded during the survey period but could potentially occur in the study area as suitable foraging habitat and a few potential roosting resources are present. However, the study area does not contain important habitat for this species.
Greater Broad-nosed Bat *Scoteanax rueppellii*	V		**Possible**. This species occurs in a range of forested habitats, although is most common in taller, wet forest types along the east coast and ranges. Generally roosts in tree hollows and forages for insects, often at a relatively low height along gullies. The Greater Broad-nosed Bat was tentatively identified from one echolocation call in the study area. There appear to be no confirmed records of the species in the Queanbeyan LGA, which would be at or beyond the western most limit of the species distribution in NSW. Limited habitat exists in the study area, mostly in association with the Queanbeyan River and the main drainage lines, however the study area is unlikely to be important for this species given the lack of confirmed records.
Grey-headed Flying-fox *Pteropus poliocephalus*	V	V	**Unlikely**. The species roosts in permanent camps and forages for nectar in flowering trees and shrubs over vast areas. The species is not regularly recorded in the Queanbeyan LGA. Permanent roosting habitat is not present. While it is possible that the species could occur in the study area and forage on flowering eucalypts, it is considered unlikely. The heavily disturbed habitats in the study area would not be important for this species.
Large-footed Myotis *Myotis macropus*	V		**Possible**. This species is generally associated with rivers or creeks and forages over water for insects and small fish. May roost in tree hollows, caves, dense foliage or other structures. This species was tentatively identified during the survey period from echolocation call analysis but there are very few records from the Queanbeyan LGA. The study area does provide some suitable foraging and roosting habitat along the larger drainage lines and in association with the adjacent Queanbeyan River, and the species may potentially occur in those areas. The results of this survey suggest the study area may not be frequented by the species or represent particularly important habitat to the species.
Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris*	V		**Possible**. This species occurs widely in NSW within forested and sparsely forested habitats, where it forages for insects and generally roosts in tree hollows but may also utilise other cavities. Not recorded during the survey period and not regularly recorded in the Queanbeyan LGA, the species could still potentially occur in the study area as suitable foraging and limited roosting habitat is present. However, given the disturbed habitats present and limited occurrence of the species in the area, the study area is very unlikely to be important for this species.
Other Mammals			
Koala *Phascolarctos cinereus*	V	-	**Unlikely**. This species inhabits eucalypt woodlands and forests with a fragmented distribution through eastern Australia. The species is irregularly recorded in the Queanbeyan LGA and records are generally associated with the Queanbeyan River corridor. These records include a 1984 record from the

THREATENED FAUNA SPECIES	STATUS		POTENTIAL TO OCCUR IN THE STUDY AREA AND MPORTANCE OF HABITATS PRESENT
	TSC Act	EPBC Act	
			north of Googong Dam and a 2007 sighting near Greenleigh, just to the north of the study area. The species is likely to occur in surrounding bushland, but given the extensive tree removal from the study area, the Koala is unlikely to occur in the study area itself, apart from the vegetated fringes adjoining more intact vegetation. The study area does not contain important habitat for this species.
Spotted-tailed Quoll *Dasyurus maculatus*	V	E	**Unlikely**. This species has been recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Quolls utilise hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky cliff faces as den sites and consumes a variety of prey species such as gliders, possums, small wallabies, rats, birds, bandicoots, rabbits and insects. The species has been recorded in the Queanbeyan River corridor and on the north-western foreshore of Googong Reservoir. The study area provides very limited foraging and sheltering resources for this species. While the species is likely to occur in adjacent habitats and could possibly occur in the study area on occasions, it is unlikely to occur in the study area on a regular basis.
Birds			
Australian Painted Snipe *Rostratula (benghalensis) australis*	E	V	**Unlikely.** This migratory species is usually found in densely vegetated, shallow, temporary or infrequently filled wetlands, preferring the fringes of these habitats where there is a cover of grasses, lignum, low scrub or open timber. It has been recorded at the Paroo wetlands, Lake Cowell, Macquarie Marshes and Hexham Swamp, although is most common in the Murray-Darling Basin. This species has not been recorded within the Queanbeyan LGA. The study area provides unlikely habitat and given the scarcity of the species in the area, it is unlikely to occur there.
Barking Owl *Ninox connivens*	V	-	**Unlikely**. This species is associated with open forests and woodlands across much of northern and eastern Australia but is considered to be sparse on the higher parts of the tablelands and rare in the ACT. The species preys on a range of terrestrial and arboreal mammals, birds and insects. Breeding habitat and roosts are usually associated with large hollows in eucalypts and patches of dense cover in riparian areas or around wetlands. There are no recent records of the species in the Queanbeyan LGA and the study area contains poor habitat for the species. No evidence of the species was found during the survey period. While the species could potentially occur in adjacent forested areas, the poor quality of habitats in the study area suggests it is unlikely to occur there.
Brown Treecreeper *Climactis picumnus*	V	-	**Possible**. This species is found in eucalypt woodlands, including Box-Gum Woodland. It is usually sedentary and utilises hollows greater than 6cm diameter in standing dead or live trees and tree stumps for nesting. The Brown Treecreeper has been recorded in Dry Forest along the Queanbeyan River corridor and was recorded breeding at an unspecified location in the vicinity of the study area (Scott & Furphy 1990). Surrounding woodland and forest

THREATENED FAUNA SPECIES	STATUS		POTENTIAL TO OCCUR IN THE STUDY AREA AND MPORTANCE OF HABITATS PRESENT
	TSC Act	EPBC Act	
			provides suitable habitat for the species and it is likely to be found there. The study area provides considerably poorer quality habitat than surrounding areas, and while the species may occur in the study area on occasions, it was not detected during the survey period. Potential breeding resources are very scarce and the study area is not likely to comprise important habitat for the species.
Diamond Firetail *Stagonopleura guttata*	V	-	**Possible**. This species is found in grassy eucalypt woodlands, including Box-Gum Woodlands and also occurs in Native Temperate Grasslands and in secondary grasslands. It is often found in riparian areas and is known from the Queanbeyan River corridor and from several other areas in the Queanbeyan LGA. The species was not recorded during the survey period, although the study area does provide some lower quality habitat within areas containing a grassy groundcover. As adjacent areas are expected to contain suitable habitats, the species may occur in the study area on occasions. The degraded nature of habitats in the study area suggests that the species would not reside entirely in the study area or rely on any habitats contained there.
Gang-gang Cockatoo *Callocephalon fimbriatum*	V	-	**Present**. This species is known from the Dry Forest along the Queanbeyan River corridor, and two birds were observed passing through the study area during the survey period. The species may forage in eucalypts or acacias in the study area on occasions, but no nesting activity was recorded during the survey period. The likelihood of nesting in the study area is low given the very low number of hollow-bearing tree (most unsuitable for this species) and the species preference for taller forests with abundant hollows. Given the abundance of resources for this species in the surrounding areas, the study area is unlikely of be important for the Gang-gang Cockatoo.
Glossy Black-cockatoo *Calyptorhynchus lathami*	V	-	**Unlikely**. This species occurs in forests and woodlands where She-oak feeding resources are prevalent and large tree hollows exist for breeding. The species is known from the Southern Tablelands however it is relatively rare in the region. The study area does not contain suitable foraging or nesting resources and this species is very unlikely to occur there.
Hooded Robin *Melanodryas cucullata*	V	-	**Possible.** This species generally prefers lightly wooded country, usually open eucalypt woodland, and often occurs in or near clearings or open areas. It requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses. The species was not recorded during the survey period, but has apparently been recorded from the study area south of Jumping Creek (Rowell and Crawford 1997) and from an unspecified location in the general area by Scott and Furphy (1990). The study area does not appear to provide high quality habitats for this species, although the species could be expected to occur on occasions in more intact forest and woodland, which generally occurs around the fringes or beyond the study area.
Little Eagle *Hieraaetus*	V		**Possible**. This species occurs in a range of open wooded habitats throughout the mainland Australia, avoiding densely forested areas. The Little Eagle forages on a range of birds, reptiles and mammals and occasionally insects

THREATENED FAUNA SPECIES	STATUS		POTENTIAL TO OCCUR IN THE STUDY AREA AND MPORTANCE OF HABITATS PRESENT
	TSC Act	EPBC Act	
morphnoides			and carrion. Breeding occurs mainly in Spring, with a large stick nest constructed in a tall, live tree. The study area contains some suitable foraging resources for the species (mainly rabbits and hares), and it could occur there on occasions. The species was not recorded during the survey period, and no evidence of old nest sites was found. Given the disturbance history and habitat quality, the study area is not expected to be important to the species.
Masked Owl *Tyto novaehollandiae*	V	-	**Unlikely**. This species inhabits eucalypt forests and woodlands from the coast to the western plains, where it forages primarily on terrestrial mammals and nests in hollow trees. There are no recent records of the species in the Queanbeyan LGA and it was not recorded during the survey period. Apart from young rabbits, foraging resources in the study area are sparse. There do not appear to be any good quality roosting or breeding resources in the study area and the species is unlikely to occur there.
Painted Honeyeater *Grantiella picta*	V		**Present.** This nomadic and widespread honeyeater species occurs at low densities and forages mainly on mistletoe fruit, and occasionally insects and nectar. Not regularly recorded in the Queanbeyan LGA – one individual was recorded in the study area on one occasion. Some potential foraging habitat occurs in the study area and the species may forage there on occasions. This is unlikely to be important habitat for the species given the overall lack of trees in the study area and abundance of trees in the wider landscape. The species is not likely to be more than an occasional visitor to the study area.
Powerful Owl *Ninox strenua*	V	-	**Unlikely.** Habitat for this owl species tends to be within taller eucalypt forest containing a diverse array of understorey plants and appropriate habitat for its primary prey species (gliders and possums). There are no recent records of the species in the LGA however there is a recent record from Canberra. Given the paucity of prey species and lack of breeding and roosting resources, this species is unlikely to occur in the study area.
Regent Honeyeater *Xanthomyza phrygia*	E	E	**Unlikely.** This species inhabits temperate woodlands and open forest of the inland slopes of south-eastern Australia. The species is often found in woodlands with large numbers of mature trees, high canopy cover and an abundance of mistletoes. It feeds on nectar from a wide range of eucalypts and mistletoes, with key foraging species including Yellow Box, Blakely's Red Gum and White Box. This species has not been recorded within the Queanbeyan LGA, although potential habitat occurs there in association with larger patches of remnant vegetation, particularly Box-Gum Woodlands and where there is an abundance of mistletoes. It is possible that this species could forage briefly in the study area, but the general lack of trees suggests it would be unlikely.
Scarlet Robin *Petroica boodang*	V		**Possible.** The Scarlet Robin inhabits forests and woodlands but may occur in open habitats in the non-breeding season. While preferred habitats often have a grassy, open understorey, fallen timber and logs are important habitat components. The species usually forages from low perches and feeds on ground-dwelling invertebrates, although sometimes forges in the shrub or canopy. Breeding occurs between July and January, with an open cup nest constructed of plant material and cobwebs. The species was not recorded

THREATENED FAUNA SPECIES	STATUS		POTENTIAL TO OCCUR IN THE STUDY AREA AND MPORTANCE OF HABITATS PRESENT
	TSC Act	EPBC Act	
			during the survey period, and most of the study area contains marginal or unsuitable habitat. Areas of more intact native vegetation in the study area provide potential habitat for the species, and these areas will generally be retained by the proposal. The species could occur on the periphery of the study area given its semi-nomadic movements in the non-breeding season, but no high quality or important habitat for the species is likely to be removed by the proposal.
Speckled Warbler *Pyrrholaemus sagittatus*	V	-	**Present**. The Speckled Warbler lives in a wide range of eucalypt dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy. This species was recorded in the south east of the study area near the Queanbeyan River and in a gully towards the north of the study area. Also recorded in an unspecified location in the general area by Scott and Furphy (1990). Suitable habitat for this species exists along the Queanbeyan River corridor, gullies containing native vegetation and to a lesser extent within other more intact vegetation fringing the study area. The heavily modified riparian habitats within the study area are less likely to provide habitat for this species.
Superb Parrot *Polytelis swainsonii*	V	V	**Unlikely.** This species occurs throughout eastern inland NSW and inhabits Box-Gum Woodlands. It utilises hollows in large Blakely's Red Gum, Yellow Box, Apple Box and Red Box for nesting. This species forages in Box-Gum Woodland up to 10km from nesting sites and feeds in trees, on the ground and in understorey shrubs. Some potential habitat for this species occurs in the study area although the lack of records from the LGA and the degraded nature of these habitats suggest the species is unlikely to regularly occur in the study area.
Swift Parrot *Lathamus discolor*	E	E	**Unlikely.** This migrant to the south-east mainland occurs where eucalypts are flowering profusely or where there are abundant lerp infestations. The species forages in winter-flowering trees from March to October, after which time it returns to Tasmania to breed. Although this species is known from the Murrumbidgee catchment, it has not been recorded in the Queanbeyan LGA but may potentially occur where suitable habitats are present. Unlikely to occur in the study area given the scarcity of foraging resources.
Turquoise Parrot *Neophema pulchella*	V		**Possible**. This species favours open woodland habitats and generally feeds on seeds from grasses, herbs and shrubs. It nests in hollow trees or logs, which may be close to the ground. The species is not regularly recorded in the Queanbeyan LGA, but was recently sighted near Googong Dam Road. The species was not recorded during the survey period, but could conceivably occur in woodland habitats in the study area to forage. However, the degraded nature of these habitats suggests that they would not provide any important foraging resources or important nesting resources given the scarcity of tree or stump hollows. The dearth of records in the locality suggests the species is unlikely to occur in the study area on a regular basis, particularly considering the relatively low quality of habitats present.

THREATENED FAUNA SPECIES	STATUS		POTENTIAL TO OCCUR IN THE STUDY AREA AND MPORTANCE OF HABITATS PRESENT
	TSC Act	EPBC Act	
Varied Sittella *Daphoenositta chrysoptera*	V		**Possible.** The Varied Sittella occurs in a range of woodland and forest habitats and feeds on invertebrates gleaned from tree trunks or branches. Prefers rough-barked and mature trees for foraging. A well camouflaged open cup nest is constructed in the tree canopy from plant fibres and cobwebs. Generally breeds in Spring in the south of Australia. Most of the study area provides unsuitable habitat for the species, although the species could occur in areas of more intact native forest and woodland, primarily around the edges of the study area. The species was not recorded during the survey period, but is expected to occur in the surrounding area. Most areas of suitable habitat for the species would not be removed by the current proposal and connectivity through the study area for the species would be improved by the rehabilitation of riparian corridors.
Reptiles			
Grassland Earless Dragon *Tympanocryptis pinguicolla*	E	E	**Unlikely.** This species is restricted to a small number of native temperate grassland sites dominated by wallaby grasses, spear grasses, Poa Tussock, Red Grass, and occasionally Kangaroo Grass. Introduced pasture grasses occur at many of the sites supporting this species, which has also been recorded in secondary grassland. Within its habitat, this species apparently prefers areas with a more open structure, characterised by small patches of bare ground between the grasses and herbs. In addition to tussocks, partially embedded surface rocks, and spider and insect holes are used for shelter. The species has been recorded at a number of locations within the Queanbeyan LGA including at the Letchworth and The Poplars. The study area does not contain typical habitat for this species, and habitats present are of relatively low quality. Targeted reptile surveys involving rolling of rocks in possible habitat did not record the species. The Grassland Earless Dragon has not been recorded in the locality, nor does typical habitat occur in the locality. The species is unlikely to occur in the study area.
Little Whip Snake *Suta flagellum*	V	-	**Unlikely**. This species occurs in native temperate grassland and grassy woodlands. It also occurs in secondary grasslands derived from clearing of woodlands and is found on well drained hillsides, mostly associated with scattered loose rocks. Most specimens have been found under rocks or logs lying on, or partially embedded in, the soil. There are no recent records of the species in the Queanbeyan LGA. Some areas of potential, but degraded habitat occur in the study area however the species was not recorded during targeted reptile surveys involving rolling of rocks, logs and other debris. Given the lack of detection during the survey period, lack of records in the LGA, and lack of good quality habitat in the study area, the species is considered unlikely to occur there.
Pink-tailed Worm-lizard *Aprasia*	V	V	**Unlikely**. This species inhabits sloping, open woodland areas with predominantly native grassy ground layers, particularly those dominated by Kangaroo Grass. Sites are typically well-drained, with rocky outcrops or scattered, partially-buried rocks. This species is known from several areas in

THREATENED FAUNA SPECIES	STATUS		POTENTIAL TO OCCUR IN THE STUDY AREA AND MPORTANCE OF HABITATS PRESENT
	TSC Act	EPBC Act	
parapulchella			the Queanbeyan LGA, including at "Talpa" near Googong, north of Fernleigh Park, Beatty Hill, near Karabar and Fairlane Estate on the western side of the Queanbeyan River. While habitat in the study area is heavily degraded and not of high quality in terms of vegetation type or geology, some areas do contain scattered partially embedded rocks with a partially native grassy groundcover. Targeted reptile surveys involving rock rolling within potential habitat failed to find evidence of the species (i.e. individuals or sloughed skins). This result, combined with the lack of good quality habitat, suggests that the species is probably unlikely to occur in the study area. Most of the potential habitat for the species will be retained by the current proposal (concept plan).
Rosenberg's Goanna *Varanus rosenbergi*	V	-	**Possible**. Rosenberg's Goanna is found in heath, open forest and woodland. Termite mounds are a critical habitat component for this species, as they are used for nesting. This wide ranging species shelters in hollow logs, rock crevices and in the burrows of other species, including rabbits, or in burrows they dig for themselves. Within the Queanbeyan LGA, there are recorded sightings of this species, in the Gale Precinct, in Cuumbeun NR south of Captains Flat Road, along the Queanbeyan River in the south east of Karabar and in the northeast of Googong. The species was not recorded during the survey period however this species is likely to occur in better quality habitat to the north, east and south of the study area. The species could conceivably occur on the fringes of the study area or more vegetated areas of the study area on occasions given the proximity of likely habitat surrounding Jumping Creek Estate. A low number of termite mounds were scattered through the study area, although no evidence of their use as breeding sites were found. Some low quality although potential foraging and sheltering habitat occurs among more vegetated and rocky parts of the study area. These areas constitute possible or occasional habitat rather than high quality or important habitat. The open, disturbed areas that characterise the study area offer very few resources for this species. The occurrence of this species in the study area is likely to be at best occasional, rather than regular.
Striped Legless Lizard *Delma impar*	V	V	**Unlikely**. This species occurs mainly in native temperate grassland but has also been recorded in grasslands that have a high exotic component. It has also been found in secondary grassland near native temperate grassland and occasionally in open Box-Gum Woodland. Typical habitat for this species is grassland dominated by perennial tussock-forming grasses such as Kangaroo Grass, spear-grasses and poa tussocks, and occasionally wallaby grasses. It is sometimes found in grasslands with significant amounts of surface rocks, which are used for shelter. This species has not been recorded in the Queanbeyan LGA and was not recorded in the study area during targeted reptile surveys. The study area does not contain typical or high quality habitat for the species and it is considered unlikely to occur there.

THREATENED FAUNA SPECIES	STATUS		POTENTIAL TO OCCUR IN THE STUDY AREA AND MPORTANCE OF HABITATS PRESENT
	TSC Act	EPBC Act	
Amphibians			
Green and Golden Bell Frog *Litoria aurea*	E	V	**Unlikely.** This species inhabits marshes, dams and stream-sides, particularly those containing bullrushes or spikerushes. Optimum habitat includes water-bodies that are unshaded, free of predatory fish such as Plague Minnow, have a grassy area nearby and diurnal sheltering sites available. There is an extant population near Captains Flat, and the species is also known from just outside the LGA along the Queanbeyan River corridor, however the species is thought to be extinct in the Queanbeyan LGA. The only potential habitat in the study area is near the intersection of Jumping Creek and the Queanbeyan River. Limited surveys did not detect the species, and it is considered very unlikely to occur in the area.
Southern Bell Frog *Litoria raniformis*	E	V	**Unlikely.** This species is usually found in or around permanent or ephemeral Black Box/Lignum/Nitre Goosefoot swamps, Lignum/Typha swamps and River Red Gum swamps or billabongs along floodplains and river valleys and in irrigated rice crops, particularly where there is no available natural habitat. The study area provides a small area of marginal habitat in the west, however no recent records are known from the Queanbeyan LGA. The species is not expected to occur in the study area.
Yellow-spotted Bell Frog *Litoria castanea*	E	E	**Unlikely.** This species requires large permanent ponds or slow flowing streams with plenty of emergent vegetation, such as bulrushes. This species is not known from the Queanbeyan LGA and has not been recorded in the wild since the 1970s. A small area of potential habitat occurs in the west of the study area, but the species is highly unlikely to occur in the area.
Fish			
Macquarie Perch *Macquaria australasica*		E	This species has been recorded in the Queanbeyan River, and is stocked at Googong Dam so could occur in the river adjacent to the study area. No suitable habitat apart from the western edge of the study area. Study area habitats not important to the species however adjacent habitats in the study area should be managed to prevent adverse impacts to the river system.
Murray Cod *Maccullochella peelii peelii*		V	This species has been recorded in the Queanbeyan River, and is stocked at Googong Dam so could occur in the river adjacent to the study area. No suitable habitat apart from the western edge of the study area. Study area habitats not important to the species, however adjacent habitats in the study area should be managed to prevent adverse impacts to the river system.
Silver Perch *Bidyanus bidyanis*	V		This species has been recorded in the Queanbeyan River, and is stocked at Googong Dam so could occur in the river adjacent to the study area. No suitable habitat apart from the western edge of the study area. Study area habitats not important to the species however adjacent habitats in the study area should be managed to prevent adverse impacts to the river system.

THREATENED FAUNA SPECIES	STATUS		POTENTIAL TO OCCUR IN THE STUDY AREA AND MPORTANCE OF HABITATS PRESENT
	TSC Act	EPBC Act	
Invertebrates			
Golden Sun Moth *Synemon plana*	E	E	**Unlikely.** The Golden Sun Moth occurs in natural temperate grasslands and grassy Box-Gum Woodlands, particularly where the ground layers are dominated by wallaby grasses. The species has recently been recorded in areas dominated by other grass species, including introduced species such as the Chilean Needlegrass. Habitats are typically low and open. The bare ground between tussocks is thought to be an important microhabitat feature for the Golden Sun Moth, as it is typically these areas on which the females are observed displaying to attract males. Only a few records occur in the Queanbeyan LGA, in the north of The Poplars, west of Jerrabomberra and in the Talpa - Googong areas. The study area contains some potential, although degraded and lower quality habitat for this species. Surveys for this species were undertaken within possible habitat during the known flying period, although no individuals were recorded. Given also the extensive disturbance history of the site, lack of high quality habitat and lack of habitat in adjoining areas, the species is considered unlikely to occur in the study area.

A total of four threatened fauna species were recorded in the study area during the survey period: the Eastern Bentwing-bat, Gang-gang Cockatoo, Painted Honeyeater and Speckled Warbler. A further two bat species were tentatively identified. The locations of these species are shown in Figure 5 (Appendix A).

Several other threatened mammal, bird and reptile species may occur in the study area on occasions, largely due to the suitability of adjacent habitats for these species.

The ecological constraints to the rezoning of the study area posed by these species are discussed in subsequent sections of this report.

4.4 Migratory Species

The outcome of the *EPBC Act* database search for migratory species is shown in Table 8 below. The potential for each of these species to occur in the study area and the importance of habitats in the study area is discussed in Table 8.

Species encountered in marine environments have been omitted, as these habitats do not occur in the study area.

Table 8: Migratory species recorded or likely to occur in the locality.

SPECIES	POTENTIAL TO OCCUR IN THE STUDY AREA AND IMPORTANCE OF HABITATS PRESENT
Australian Painted Snipe *Rostratula australis*	This migratory species is usually found in vegetated, shallow (<50cm), temporary or infrequently filled wetlands, preferring the fringes of these habitats where there is a cover of grasses, lignum, low scrub or open timber. It has been recorded at the Paroo wetlands, Lake Cowell, Macquarie Marshes and Hexham Swamp, although it is most common in the Murray-Darling Basin. The study area contains largely unsuitable habitat for this species. This species is not regularly recorded in the Queanbeyan LGA, was not recorded during the survey period and is not expected to occur in the study area.
Rainbow Bee-eater *Merops ornatus*	The Rainbow Bee-eater is found in open forests, woodlands, shrublands and cleared areas, usually near water. Nesting sites are made in tunnels in sandy banks. The species has been recorded within the Queanbeyan River Corridor and just outside the Queanbeyan LGA near the Queanbeyan River on the northern foreshore of Googong Reservoir. Potential habitat for the species within the LGA is likely to be concentrated along the larger creek and river corridors including the Queanbeyan River. This species was not recorded during the survey period, but potential habitat occurs along the banks of the Queanbeyan River just beyond the study area. Other marginal habitat occurs along creeks within the study area. Protection of riparian corridors is likely to contain most potential habitat of this species in and around the study area.
Regent Honeyeater *Xanthomyza phrygia*	This species inhabits temperate woodlands and open forest of the inland slopes of south-eastern Australia. The species is often found in woodlands with large numbers of mature trees, high canopy cover and an abundance of mistletoes. It feeds on nectar from a wide range of eucalypts and mistletoes, with key foraging species including Yellow Box, Blakely's Red Gum and White Box. This species has not been recorded within the Queanbeyan LGA, although potential habitat occurs there in association with larger patches of remnant vegetation, particularly Box-Gum Woodlands and where there is an abundance of mistletoes. It is possible that this species could forage briefly in the study area, but the general lack of trees and lack of records suggest it would be unlikely.
Rufous Fantail *Rhipidura rufifrons*	This species is known to utilise dense understorey vegetation in damp forests or beside rivers, although it also occurs in open country during migration. This species was recorded to the south east of the study area beside the Queanbeyan River during the survey period. Suitable habitat occurs along the river corridor and marginal habitat also occurs along the creek lines in the study area. Most of the study area does not provide suitable habitat. Protection of creek corridors and adjacent areas would retain all potentially important habitat for this species.
Satin Flycatcher *Myiagra cyanoleuca*	This species inhabits lowland eucalypt forests and woodlands. It is known to nest in dense gully vegetation, although it avoids rainforests. The species has been recorded just outside the Queanbeyan LGA near the Queanbeyan River on the northern foreshore of Googong Reservoir. Potential habitat for this species may occur in less disturbed and moist habitats associated with the Queanbeyan River adjacent to the study area, but the study area itself does not appear to provide any substantial habitat for the species.

SPECIES	POTENTIAL TO OCCUR IN THE STUDY AREA AND IMPORTANCE OF HABITATS PRESENT
White-bellied Sea-eagle *Haliaeetus leucogaster*	This species inhabits coastal environments and inland rivers, lakes, dams and other substantial sources of water. It has been recorded just outside the Queanbeyan LGA near the Queanbeyan River on the northern foreshore of Googong Reservoir. While the species could possibly occur along parts of the Queanbeyan River, the study area does not provide suitable habitat for this species and it is unlikely to occur there.
White-throated Needletail *Hirundapus caudacutus*	One record of this species occurs in the Queanbeyan LGA from the centre of Queanbeyan City. The species may occur within study area on occasions, potentially even roosting temporarily on tree trunks or on cliff faces. However, the study area does not provide any habitats of particular importance to this species, which is not likely to frequent the study area.

One migratory species listed in Table 8, the Rufous Fantail, was recorded in the south eastern corner of the study area during the survey period. No other migratory species are likely to occur in the study area on a regular basis. The ecological constraints to the rezoning of the study area posed by migratory species are discussed in a subsequent section of this report.

4.5 Endangered Populations

The *TSC Act* provides for the listing of endangered populations on Schedule 1, Part 2. There are no endangered populations listed on the schedules of the *TSC Act* found in the Queanbeyan LGA. No further consideration or assessment is given to endangered populations in this report.

4.6 Endangered Ecological Communities

The *TSC Act* and *EPBC Act* provide for the listing of threatened ecological communities. The Box-Gum Woodland within the study area comprises the endangered ecological community White Box, Yellow Box, Blakely's Red Gum Woodland which is listed on Schedule 1 Part 3 of the *TSC Act* and the White Box, Yellow Box, Blakely's Red Gum Grassy Woodland and Derived Native Grasslands (Box-Gum Woodland) which is listed on the *EPBC Act*.

No other vegetation communities within the study area have characteristics associated with threatened ecological communities listed on either the *TSC Act* or *EPBC Act*.

4.7 Habitat Corridor and Connectivity Values

The study area has a number of values relating to habitat corridors and connectivity to adjoining vegetated areas.

The Queanbeyan River corridor is a significant habitat for many species, including threatened species. Part of this corridor lies immediately adjacent to the study area, so is directly linked to some habitats within study area. In particular, the riparian corridors that meander through the study area provide aquatic and terrestrial habitat connectivity between Cuumbeun Nature

Reserve and adjacent vegetated areas, and the Queanbeyan River and associated habitats. These corridors may also be used by some threatened species traversing the study area given the lack of substantial vegetation over much of the site. Much of the riparian corridor within the study area is severely degraded and dominated by weeds. The proposal would maintain and rehabilitate the main riparian corridors in the study area.

Other intact native vegetation in the study area generally occurs on the fringes and is currently well connected to adjoining bushland. These areas are also likely to enhance habitat connectivity through the study area for many species, including threatened woodland bird species. Isolated large trees within the study area are also likely to provide 'stepping stone' type connectivity for some bird species through an otherwise heavily disturbed environment.

The connectivity values of the study area mentioned above should be maintained and enhanced, particularly given the quality of habitats surrounding the study area and the known or likely occurrence of threatened biota within these areas.

5. ECOLOGICAL CONSTRAINTS

5.1 Threatened Flora

Hoary Sunray *Leucochrysum albicans* var*. tricolor*

The Hoary Sunray occurs in at least three locations within the study area as shown in Figure 5 (Appendix A). The bulk of the individuals occur at the sites in the north-eastern and south-western extremities of the study area with the site in the north-east of the study area comprising three individuals only.

The bulk of the Hoary Sunray population within the study area is beyond the proposed residential development, although the sites in the south-west and north-east are close to the margins of areas where residential development is proposed. In theses areas some modification of the development layout and safeguards during construction are likely to be necessary to retain and protect the Hoary Sunray individuals that occur in these areas. However, the Hoary Sunray is widespread and locally common in adjacent lands including around Mt Jerrabomberra, Barracks Creek, the Gale Precinct, north of Wickerslack Lane and through Cuumbeun Nature Reserve, Greenleigh and the Ridgeway Estate. The local population of the species comprises many thousands of individuals and the loss of a few individuals within the study area is unlikely to significantly affect the local population. The species appears able to persist in urban areas as demonstrated by its widespread occurrence throughout Greenleigh and Ridgeway Estate.

The study area is not expected to contain important habitat for any other threatened flora species.

5.2 Other Flora of Conservation Significance

As identified in Section 4.2, the study area includes individuals of Kurrjong and Hempbush which are identified by Barrer (1993) as of local conservation significance. Similarly, the understorey association of Hempbush and Woolly-head Pomaderris is considered to be of conservation significance by Barrer (1993).

The understorey of the Dry Forest in the north-eastern extremities of the study area supports both Hempbush and Woolly-head Pomaderris. However the area supporting these species is well beyond the proposed residential development, and as such, does not pose a constraint to the proposed development.

Three individuals of Kurrajong were detected within the study area, all of which were in or close to areas proposed for residential development. However, these individuals are not considered to constrain the proposed development, as whilst it may be uncommon in the Queanbeyan area, Kurrajong is widespread in the Bioregion, and is not listed as a threatened or ROTAP species.

In this context the loss of Kurrajong individuals within the study area comprises a negligible impact.

No other species of regional or local significance were detected within the study area and non are considered likely to occur in those areas proposed for residential development.

5.3 Vegetation Communities

The bulk of the vegetation within the study area has been heavily modified by historic clearing associated within agriculture and mining, particularly in the lower lying parts of the study area, where heavy grazing and subsequent erosion has removed topsoil leaving bare ground and regrowth vegetation dominated by weeds and species indicative of heavy disturbances. The vegetation in this area is highly modified has little recovery potential and is subsequently of little conservation significance, although it is likely to have once supported the endangered ecological community, Box-Gum Woodland.

In a few places the disturbances appear to have been less intensive and whilst the vegetation is modified structurally and supports an abundance of weeds, a reasonable abundance and diversity of natives persist and the recovery potential is moderate to good. The vegetation in these parts of the study area are of greater conservation significance and continue to comprise the endangered ecological communities White Box, Yellow Box, Blakely's Red Gum Woodland (Box-Gum Woodland) which is listed on Schedule 1 Part 3 of the *TSC Act* and the White Box, Yellow Box, Blakely's Red Gum Grassy Woodlands and Derived Native Grasslands which is listed on the *EPBC Act*. The constraint posed by the remnant Box-Gum Woodland within the study area is discussed in more detail in subsequent sections.

The margins of the study area also support approximately 20 ha of Dry Forest which is generally in good condition. The Dry Forest vegetation communities which occur in the study area are widespread and well reserved in the locality, including within Cuumbeun Nature Reserve, and thus unlikely to pose a significant constraint to the proposed development. In any case, the vast bulk of the Dry Forest within the study area is beyond the footprint of the proposed residential development with only approximately 1.3 ha or 6.4% of the Dry Forest within the study area affected by the development footprint.

5.3 Threatened Fauna

Four threatened fauna species were recorded in the study area (Figure 5, Appendix A), and a number of other threatened fauna species are likely to occur in adjoining areas and may also occur in the study area on occasions. Generally, habitat quality for threatened fauna in the study area has been substantially reduced by a range of long-term disturbances. The constraints relating to threatened fauna are discussed below.

Mammals

The Eastern Bent-wing Bat was recorded in the study area via echolocation call recording. The Large-footed Myotis and Greater Broadnosed Bat were also tentatively identified in echolocation recording surveys. It is possible that other threatened bat species would occur in the study area on occasions, such as the Yellow-bellied Sheathtailed Bat, Eastern False Pipistrelle, and Greater Long-eared Bat *Nyctophilus timoriensis* (syn. *N. corbeni*), all of which have been recorded in the locality.

The study area contains foraging habitat for all of these bat species, which is primarily associated with more intact areas of native vegetation and major drainage lines. With the majority of native vegetation and riparian areas being retained and in many cases rehabilitated, the adverse impacts to foraging habitat will be minor.

Potential roosting habitat for bats occurs in the form of larger hollow-bearing trees and possibly crevices and old mines. Few hollow-bearing trees were observed in the study area, and the vast majority of these trees would be retained within areas of native vegetation. Numerous hollow-bearing trees were observed in adjacent vegetation to the north, east and south of the study area.

A few small crevices were noted along the steep rocky slopes adjacent to Jumping Creek, but none appeared suitable for cave roosting bats such as the Eastern Bent-wing. Several old mine shafts in the study area were investigated for the presence of bats, but were either collapsed vertical shafts, providing very limited shelter, or horizontal tunnels with entrances severely obstructed by exotic vegetation (Blackberry). No evidence of roosting was found and these habitats do not currently provide important roosting sites for bats.

Threatened bats pose negligible constraints to the development of the study area, as long as the majority of large hollow-bearing trees can be retained, and riparian habitats and buffers can be rehabilitated.

Other mammals such as the Koala and Spotted-tailed Quoll may occur in the surrounding area, but do not pose constraints to the development of the study area given the heavily degraded habitats and unlikely occurrence of these species.

Birds

The Speckled Warbler was recorded in the study area on two occasions, each time from near riparian habitats containing predominantly native vegetation, which are connected to larger areas of adjacent habitat. This species is likely to be a permanent resident of these parts of the study area and adjoining habitats, although the majority of gully habitats in the study area are highly degraded and not suitable for the species. Retaining and restoring gully habitats and

other adjacent areas of more intact native vegetation, together with the establishment of riparian buffers, would maintain the key areas of habitat for this species and may ultimately provide better quality habitat and improve connectivity via substantial rehabilitated riparian buffers.

The Gang-gang Cockatoo was recorded flying through the study area and adjacent lands, and the species is a regular and wide ranging inhabitant of the locality. The species may forage in the study area occasionally given the presence of scattered foraging resources. No evidence of breeding was observed, and study area contains only a few potentially suitable hollow-bearing trees. The majority of foraging and nesting habitat for this species will be retained and additional habitat established through the rehabilitation of riparian buffers. The study area does not contain important habitat for this species, which poses few constraints to the development of the study area.

The Painted Honeyeater was observed on one occasion, and is a rare nomadic or summer migratory species in the locality. No evidence of breeding in the study area was observed. Some foraging resources are present in the study area, particularly in mature trees containing mistletoes. While some of these trees will be removed for the proposal, the majority of eucalypts will be retained and the extent of habitat will eventually be increased thought the rehabilitation of riparian buffers. Given that the development of study area is concentrated in heavily disturbed areas containing predominantly exotic vegetation with relatively few eucalypts, this species does not pose any major constraints to the proposal.

No other threatened woodland birds were recorded in the study area during the survey period, however the Hooded Robin and Brown Treecreeper have been recorded in or adjacent to the study area in the past. It is also possible that other woodland birds known from the locality, such as the Diamond Firetail, Little Eagle, Scarlet Robin, Turquoise Parrot and Varied Sittella, could occur in the study area on occasions given the presence of suitable habitat in adjacent vegetated areas. However, the study area does not appear to be regularly used by these species or contain habitats of importance to these species. They may occur in the study area on occasions, but given the proposed retention and rehabilitation of woodland habitats, no further habitat retention measures are considered necessary for these species. These species do not pose additional constraints to the proposed development of the study area.

Given that threatened woodland birds will continue to use riparian habitats in the study area and adjacent woodland and forest, increased protection and appropriate management of these habitats is warranted. Controls on domestic pets (particularly cats), access, firewood collection and urban encroachment (including depositing of garden and other waste material) should be implemented as part of the proposal.

The proposed retention of native vegetation and rehabilitation of riparian buffers will maintain and enhance habitats and corridors for a diversity of non-threatened birds.

Reptiles

No threatened reptiles were recorded in the study area during targeted surveys. Limited areas of sub-optimal habitat exist for Rosenberg's Goanna and the Pink-tailed Worm-lizard. The wide ranging Rosenberg's Goanna is known to occur in surrounding areas and could occur in the study area on occasions, particularly in the more intact habitats on the periphery. The species use of the study area is likely to be occasional at best, as part of a much larger home range or dispersal route. Heavily disturbed parts of the study area generally lack resources for the species. Only a few terrestrial termite mounds (potential breeding sites) were observed in the study area, while these resources are known to occur at much higher densities elsewhere in nearby woodland and forest. Most of the habitat in the study area will be retained or has the potential to be retained by the current proposal, including maintenance and rehabilitation of movement corridors via the riparian buffers. No further habitat retention measures are required for this species.

The Pink-tailed Worm-lizard appears unlikely to occur in the study area given the negative results of the field surveys, which targeted the most likely areas of habitat for the species. Additionally, most potential habitat for the Pink-tailed Worm-lizard is not proposed for intensive development, but occurs within proposed public open space areas and large private allotments where native vegetation and habitats have the potential to be retained. Retention of surface rock habitats in these areas will also benefit a range of non-threatened reptiles recorded during the survey.

No other threatened reptiles are likely to occur in the study area, and overall, threatened reptiles do not pose any major constraints to the proposed development.

Amphibians

No threatened amphibians were recorded during the survey period, and none are expected to occur in the study area given the type and condition of habitats present. Despite less than ideal survey conditions for amphibians, a reasonable diversity of non-threatened frog species was recorded. Habitat for these species will be maintained by the rehabilitation of substantial riparian buffers.

Invertebrates

The only threatened invertebrate with the potential to occur in the study area is the Golden Sun Moth, however the species was not recorded during targeted surveys and habitat is mostly marginal. Most of the habitats in the study area have been extensively disturbed over a long period. Given the negative survey results, the condition of available habitats and the lack of suitable surrounding habitats, the species is considered unlikely to occur in the study area. The Golden Sun Moth does not pose constraints to development of the study area.

5.4 Migratory Species

One migratory species, the Rufous Fantail, was recorded in the Queanbeyan River corridor adjacent to the study area. Similar habitat may also be utilised by the migratory Rainbow Bee-eater. Habitat for these two species is much less suitable within the study area, but they could possibly occur in association with riparian sections in the study area. Riparian vegetation should be retained, buffered and rehabilitated within the study area to maintain potential habitat for these species. Maintaining the integrity of the Queanbeyan River corridor adjacent to the study area is likely to be more important to these species. No other migratory species are likely to occur in the study area other than on rare occasions and as such do not pose additional constraints to the future development of the area.

5.5 Endangered Ecological Communities

The study area supports approximately 15.75 ha of disturbed Box-Gum Woodland, approximately 3.5 ha of which occurs in areas proposed for residential development. The local occurrence of the Box-Gum Woodland extends beyond the study area into contiguous vegetation particularly to the south of the study area on the ridge towards the Talpa Hills. The entirety of the Box-Gum Woodland within the study area is heavily disturbed, although the bulk of the community within the study area would still be considered to be in medium to good condition using the condition Biometric condition classes (Gibbons *et. al*. 2005).

The Box-Gum Woodland with the study area comprises a considerable constraint to the proposed development, and ideally the proposal should be designed to retain the community as far as is possible. Those areas where the community is adversely impacted by the proposal should be appropriately offset elsewhere within the study area and or elsewhere within the local occurrence of the community. Much of the proposed riparian buffer areas currently dominated by weeds are likely to have previously contained Box-Gum Woodland and this community will be re-established in these buffers.

Whilst the extent of the local occurrence of the Box-Gum Woodland has not been determined precisely, the extent of the local occurrence of the Box-Gum Woodland is estimated to be more than one hundred hectares, if the Box-Gum Woodland on the western side of the Queanbeyan River is included as part of the local occurrence. In this context, the loss of 3.5 hectares of heavily disturbed Box-Gum Woodland in association with the proposal is unlikely to comprise a significant impact and could be appropriately offset.

5.6 Habitat Corridor and Connectivity

The Queanbeyan River corridor occurring in the west of the study area is known to provide habitat for threatened and migratory species and functions as part of a much more extensive corridor. This is one of the key habitats within the study area and requires adequate buffering

from any future development. A minimum 40m zone from the river should be retained, rehabilitated where necessary and managed to maintain its ecological function.

A similar retained area and management regime should be applied to other major drainage lines within the study area to maintain riparian connectivity with bushland areas to the north, east and south.

A third type of habitat connectivity in the study area that should be maintained is associated with more intact (non-riparian) areas of native vegetation, mainly around the fringes of the study area. These areas may be disturbed, but are currently well connected to adjacent bushland areas of higher quality and/or the riparian corridors discussed above, and would aid the movement of fauna through the site. These areas are also likely to provide occasional habitat for some threatened species occurring in adjacent bushland.

5.7 Ecological Constraint Categories

The categorisation of ecological constraints can assist with the identification of appropriate planning strategies to protect and sustain the integrity of ecological infrastructure in the long-term. This categorisation depends on a combination of factors including the conservation significance of the ecological constraint, its function in the ecological landscape, and the potential for impacts on the constraints arising from future uses in its vicinity.

The ecological constraints to the rezoning of the study area have been categorised as high, medium or low-level constraints, as depicted in Figure 6 (Appendix A).

- A high level of constraint was applied to endangered ecological communities or endangered species, which included areas of Box Gum Woodland and Hoary Sunray.
- A medium level of constraint was applied to intact native vegetation, hollow-bearing trees and termite mounds (due to their biodiversity value and potential use on occasions by ‘vulnerable’ fauna species), and riparian corridors.
- A low level of constraint was applied to areas of exotic vegetation which held little habitat value.

6. CONCLUSIONS

This report describes the biological environment of the Jumping Creek Estate, Queanbeyan, investigates the presence and conservation significance of flora and fauna and makes recommendations for maintaining the area's key biodiversity values. Most of the Jumping Creek site is heavily disturbed from a history of farming and mining, however still retains some biodiversity values.

These biodiversity values included one endangered ecological community, three 'vulnerable' threatened fauna species and one 'endangered' threatened flora species, listed on the schedules of the *NSW Threatened Species Conservation Act 1995* and/or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999.* One migratory species listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* was also recorded during the survey period. Riparian habitats and some intact native vegetation were also considered to have considerable biodiversity value.

The extensive areas of exotic vegetation on the site are well suited as a basis for future residential development. It is considered feasible to provide for future residential development while maintaining the area's key biodiversity values.

A number of other strategies have been recommended below to maintain the key biodiversity values of the study area and to inform the rezoning process. These strategies should mitigate the effects on threatened species or their habitats of rezoning parts of the study area for residential purposes, and minimise the impacts of rezoning on the flora and fauna values of the study area in general.

7. RECOMMENDATIONS

A number of recommendations to preserve the key biodiversity values of Jumping Creek Estate and adjoining areas are outlined below.

1. Future residential development areas should be located primarily within areas of exotic and heavily disturbed vegetation.
2. The Box-Gum Woodland within the site should ideally be retained and rehabilitated. Where this is not possible, the Box-Gum Woodland that is impacted should be appropriately offset.
3. The future residential development should ideally be designed to enable the Hoary Sunray individuals within the site to be retained. Where this is not possible, the impacts on the species should be appropriately offset.
4. The majority of intact native vegetation in the study area should be retained as habitat for native species (including threatened woodland birds), particularly areas adjacent to higher quality habitats.
5. Retained native vegetation should remain connected to adjoining areas of intact forest, woodland or riparian habitats to enhance the movement of fauna (particularly woodland birds) through the area.
6. Strategic rehabilitation of retained vegetation should be undertaken where necessary to enhance biodiversity values.
7. Riparian corridors through the study area should be established, rehabilitated and appropriately managed.
8. Stormwater drainage and other runoff should be appropriately controlled to minimise impacts to creeks in the study area and the adjacent Queanbeyan River.
9. Hollow-bearing trees should be retained wherever possible given their important function as fauna sheltering and breeding habitat.
10. Trees supporting Mistletoe species should be retained wherever practical given their importance as a foraging resource for species including the threatened Painted Honeyeater.
11. Termite mounds should be retained wherever practical given their possible use as breeding sites by goanna species, including the threatened Rosenberg's Goanna.
12. Future residential areas should maintain an appropriate setback or buffer from adjoining areas of intact native vegetation (particularly Cuumbeun Nature Reserve and the Queanbeyan River corridor), and/or employ appropriate management strategies around a perimeter zone to minimise the extent of edge effects on these better quality habitats that are likely to contain threatened species.
13. Given that bushland adjacent to the study area is likely to contain threatened woodland birds and Rosenberg's Goanna, controls on domestic pets, collection of bushrock and

timber (standing and fallen) and depositing of garden and other waste are desirable to minimise impacts to threatened species and their habitats.

14. Any future road network should be designed to minimise impacts on retained vegetation and riparian corridors.

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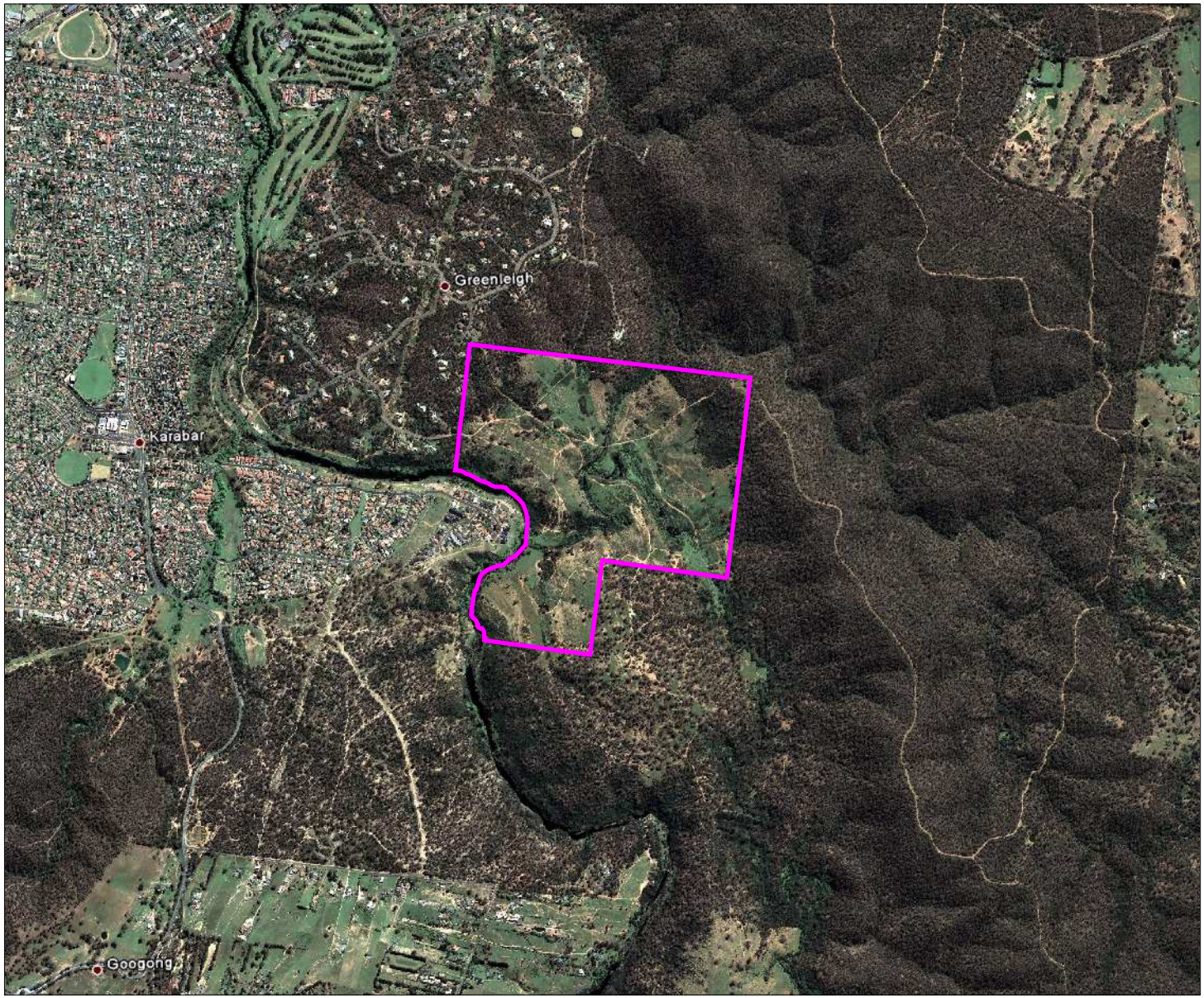
APPENDIX A: FIGURES

Figure 1: Location of Jumping Creek Estate, Queanbeyan



Study area

Base air photo:
Google Earth

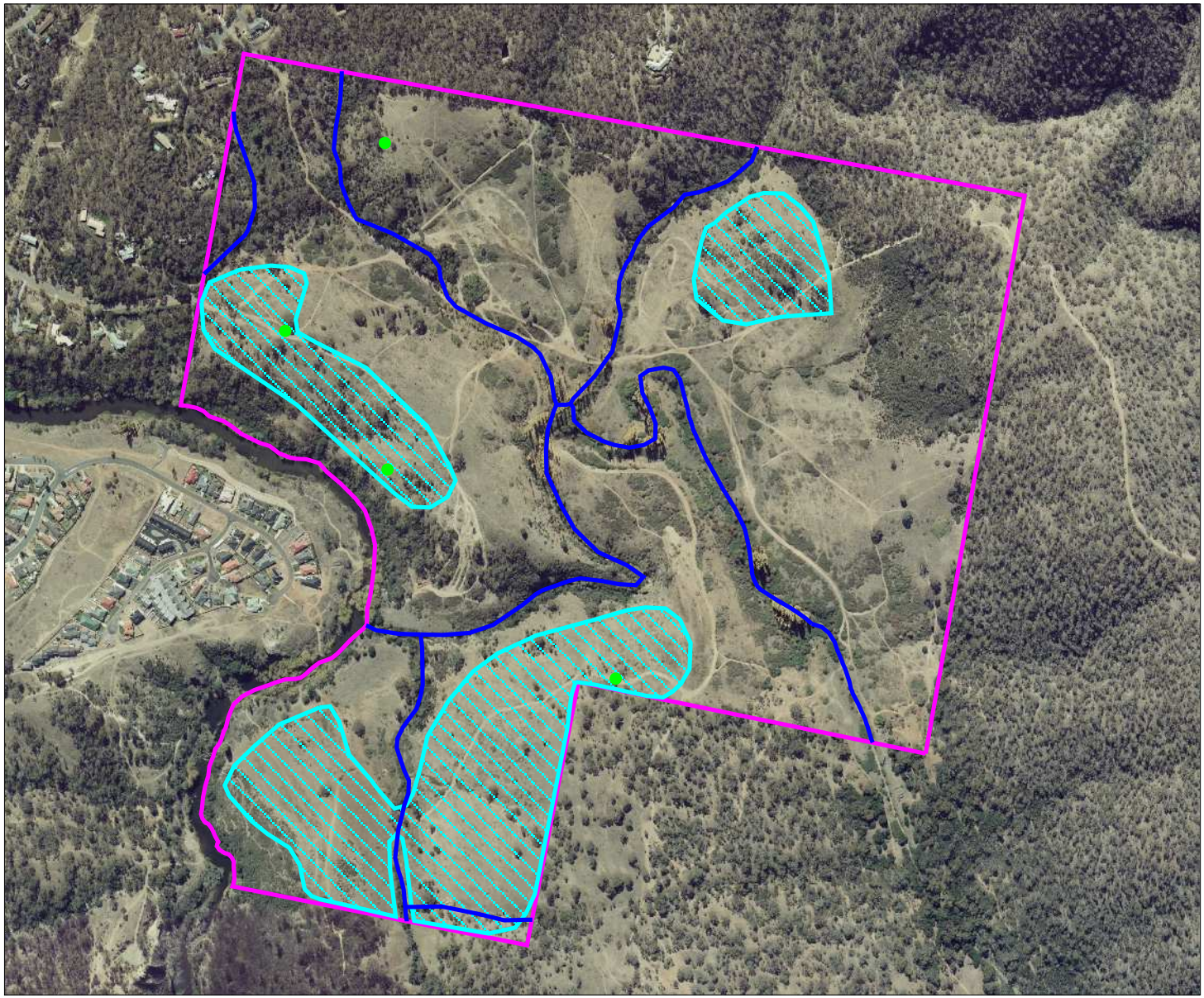
0.5 0 0.5 1
Kilometres

N

eco logical AUSTRALIA

© ELA

Figure 2: Study area and location of flora surveys



Study area (coverage of general flora, fauna and habitat surveys)

Vegetation plot

Button Wrinklewort, Hoary Sunray, Silky Swainson-pea, Small Purple-pea targeted surveys

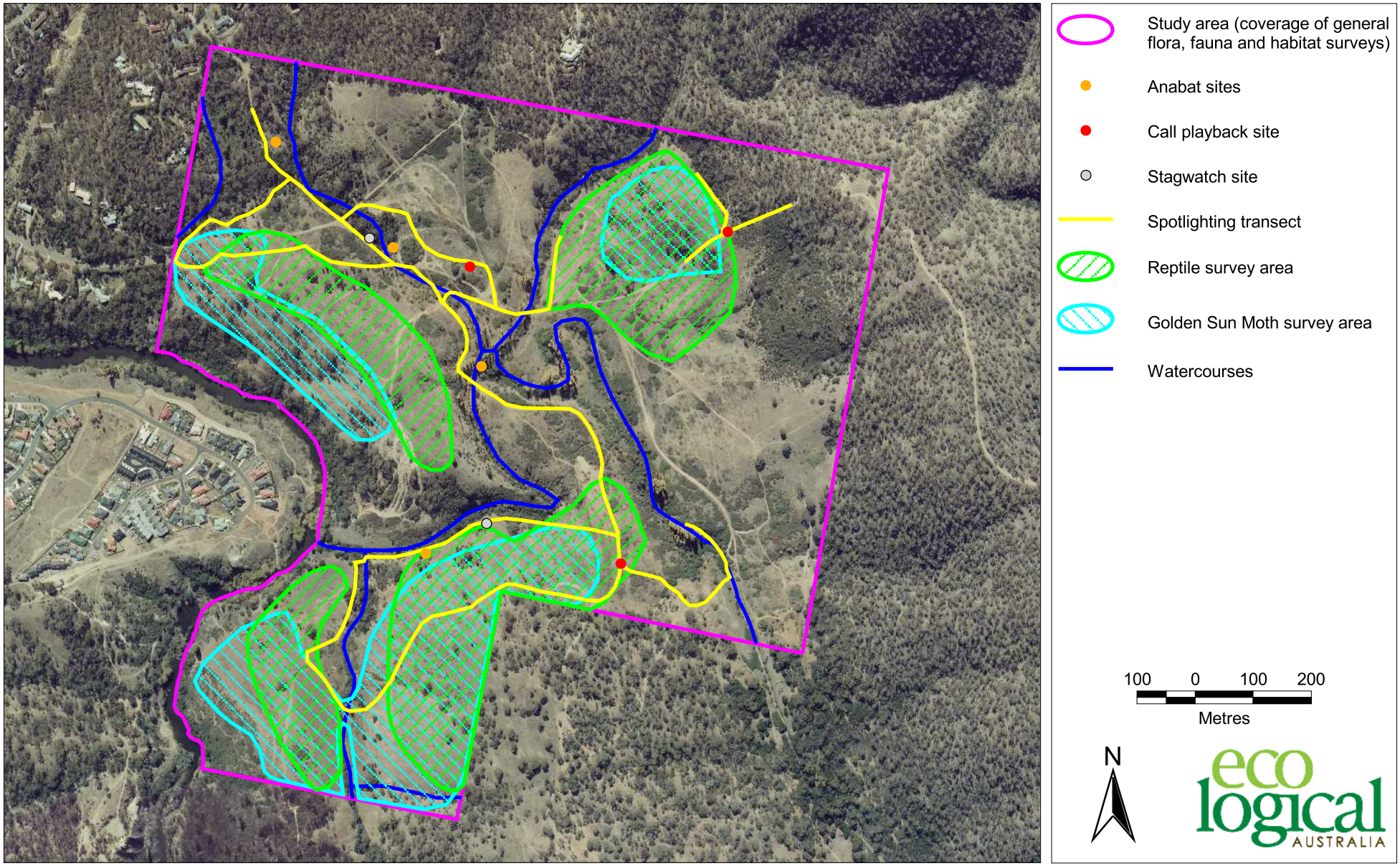
Watercourses

100 0 100 200

Metres

N

Figure 3: Study area and location of fauna surveys



© ELA

Figure 4: Vegetation of the study area

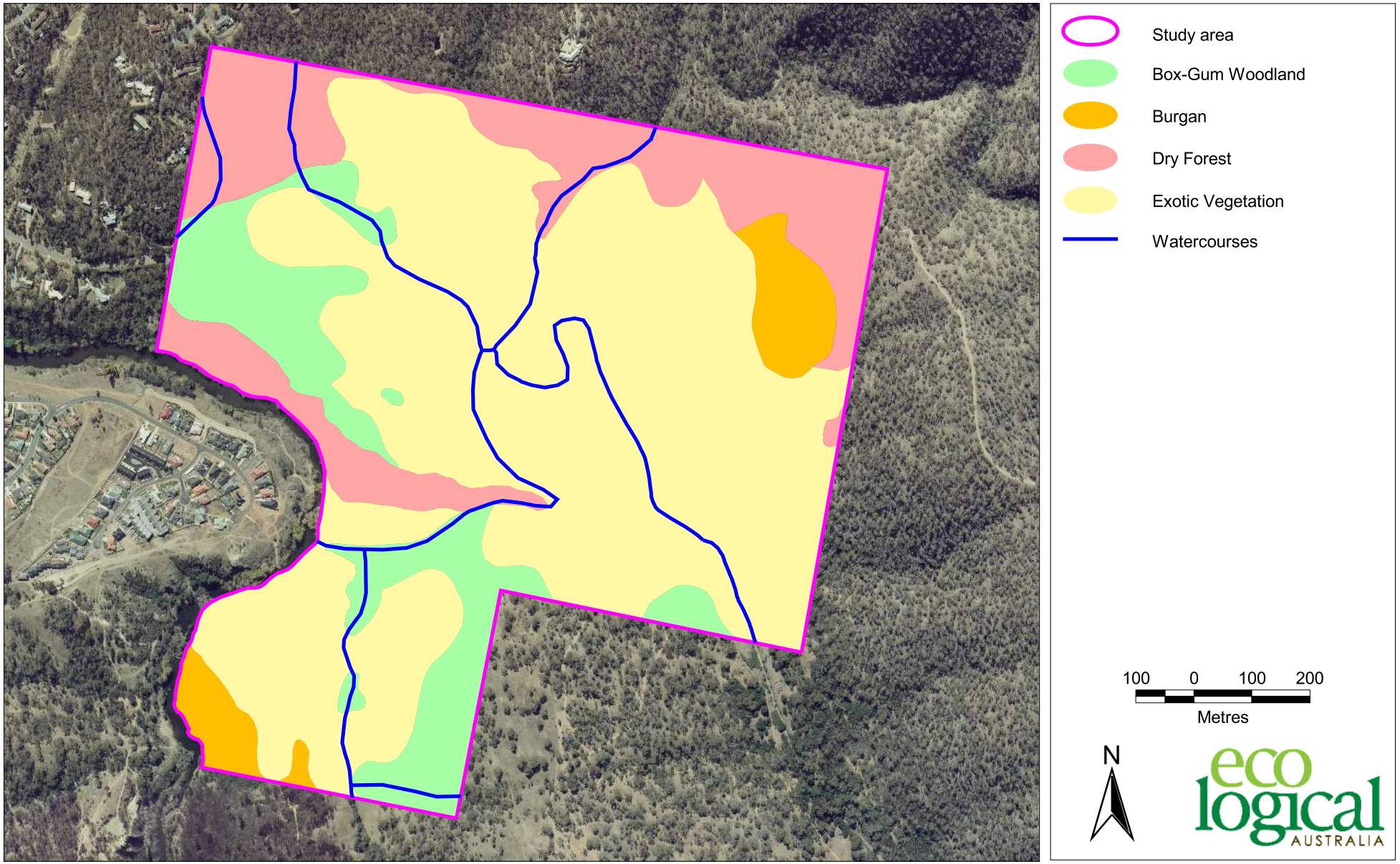


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Figure 5: Species, communities and habitats of conservation significance

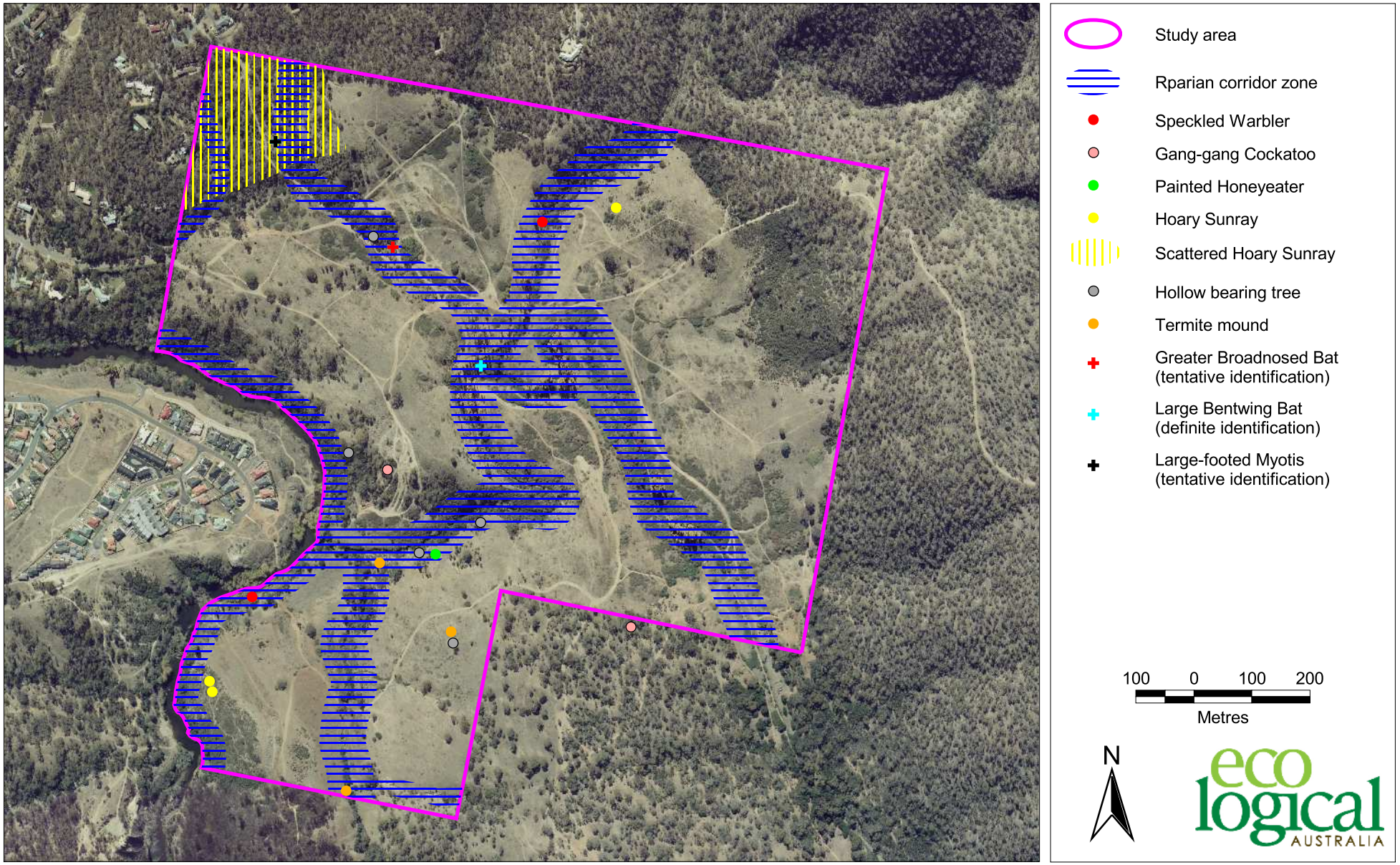

Figure 6: Ecological constraints to development

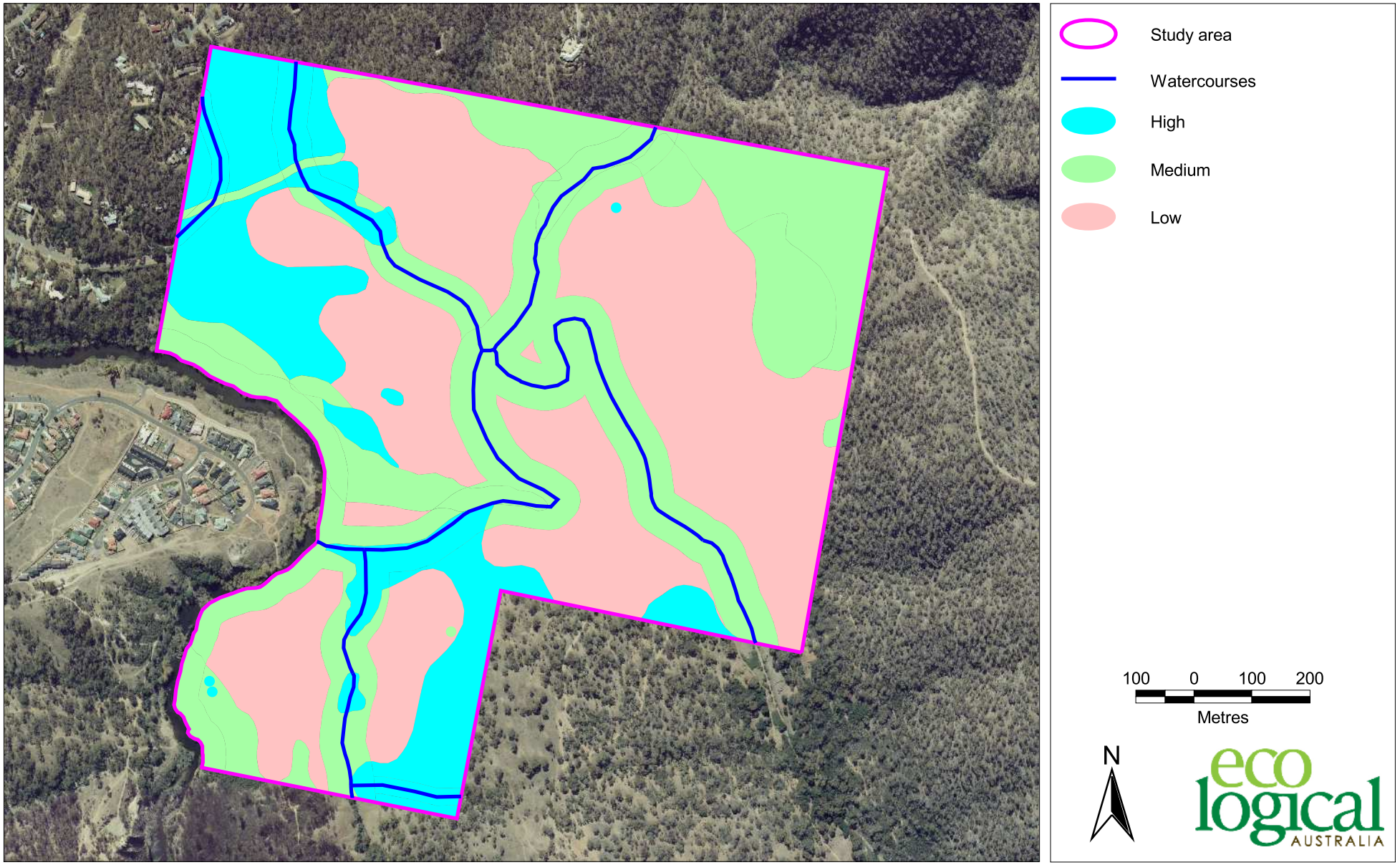

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Figure 7: Concept plan

Rev	Date	Description	Drawn	Approved
A	02/07/2010	Preliminary Plans	PG	JE

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Orientation

Client CIC

Drawn	Date	Designed	Date
PG	02/07/10	JE	02/07/10
Checked	**Date**	**Verified**	**Date**
PG	02/07/10	JE	02/07/10

Jumping Creek
CONCEPT PLAN
SHEET 1 OF 1

Date	Scale	Size
June 2010	1:2500	A1

Drawing Number 10/859 COP-A
Revision A

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