

# Environmental

Services

## **Biodiversity Study Findings Report**

Queanbeyan Local Government Area

July 2008

Our Reference: E1070065



PO Box 106  
St Georges Basin NSW 2540

Tel 02 4443 5555  
Fax 02 4443 6655

ABN 97 597 607 196  
[www.b-es.com.au](http://www.b-es.com.au)

## BIODIVERSITY STUDY - FINDINGS REPORT

Our Reference: E1070065

Queanbeyan Local Government Area

Prepared July 2008

for

Queanbeyan City Council

**PROJECT TEAM:**

Ryan Smithers  
Nicole Cowlshaw  
David Coombes  
Geoff Butler

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## 1. INTRODUCTION

This report has been prepared by Bushfire and Environmental Services (BES) at the request of Queanbeyan City Council (QCC).

The Queanbeyan Local Government Area (LGA) Biodiversity Study (QBS) will comprise one of the studies informing the preparation of a comprehensive Local Environment Plan (LEP) and associated Local Environment Study (LES), currently being prepared for the Queanbeyan LGA and due for completion in March 2009.

### 1.1 Background

Queanbeyan is one of the fastest growing regional centres in Australia, with an estimated population growth of around 3% per year (Queanbeyan City Council, 2006). Correspondingly, development pressures are extending further from the city centre into natural areas and rural lands. However, at present, only 7% of land in the Queanbeyan LGA is zoned for residential uses with more than 60% of land within the Queanbeyan LGA currently zoned for rural development. Historically, rural development and associated agricultural practices have resulted in extensive clearing and fragmentation of native vegetation and associated habitats within the Queanbeyan LGA. Notwithstanding historical and ongoing development pressures on biodiversity values within the LGA, the importance of protecting biodiversity values has been recognised to some extent within the existing LEPs, with some 20% of land within the LGA zoned for environmental protection, 5% for National Parks, and 2% for Open Space.

A range of other threats to the biodiversity values of the LGA exist at various scales as identified in Table 1 (Fallding, 2002). Despite these threats, the Queanbeyan LGA continues to contain a diversity of landforms, vegetation communities and associated habitats. These in turn support a diverse range of flora and fauna species, many of which are of high conservation value and include a number of rare, threatened and endangered species as well as endangered ecological communities (EECs).

The growth of Queanbeyan will continue to place pressure on the biodiversity of the city. However, timely strategic planning for future development in the LGA can provide a framework for protecting and enhancing the biodiversity values of the city, whilst accommodating sustainable development. In this context, the Queanbeyan Local Government Area Biodiversity Study will inform investigations being undertaken by QCC into the rezoning of land within the Queanbeyan LGA, with the aim of addressing both the need for land to accommodate future development associated with the continuing growth of the city and the need to protect and enhance the important biodiversity values that the city continues to support.

**Table 1: Threats to the natural ecosystems of the Queanbeyan LGA (Excerpt from Table 4.1 Fallding, 2002).**

Threat	Examples of actions affecting threat
<b>Continental scale</b>	
<i>Climate change and global warming</i>	Energy use in transport, energy efficiency in building design
<b>Regional and Landscape scale</b>	
<i>Clearing and fragmentation of native vegetation (L)</i>	Clearing for rural uses, urban development, roads or cultivation
<i>Over-extraction of natural resources, such as water, and removal of bushrock (L) or firewood</i>	Farm dam construction, irrigation, bushrock and firewood removal
<b>Local Scale</b>	
<i>Land subdivision, building construction and design, especially urban development</i>	Design for land characteristics, including slope, erodibility and stability
<i>Land filling, earthworks, soil erosion, sedimentation and compaction</i>	Building construction and earthworks management, design and siting of development
<i>Roads and traffic</i>	Roadside management practices (clearing, slashing), maintenance of habitat and vegetation, design of crossings suitable for wildlife
<i>Waste disposal and rubbish dumping</i>	Education programs, public land management and signage
<b>Site Scale</b>	
<i>Modification of native vegetation and habitat (and loss of connectivity)</i>	Loss of hollow-bearing trees, removal of fallen timber, destruction of isolated paddock trees, simplification of understorey for rural production
<i>Inappropriate mowing or grazing regimes</i>	Continuous heavy grazing, leading to soil compaction and elimination of native species, too infrequent grazing, too low or too frequent slashing
<i>Inappropriate bush fire management regimes (L)</i>	Long periods without fire, or fire at too frequent intervals or at high intensity is detrimental for the survival of many species
<i>Agricultural practices</i>	Cultivation, application of fertiliser, soil acidification, stock management practices
<i>Pollution and land contamination</i>	Use of fertilisers, herbicides and pesticides
<i>Alteration to hydrological systems; increased nutrients; salinity (L)</i>	Construction of farm dams, clearing of aquifer recharge or discharge areas, fertiliser use, design and siting of on-site effluent disposal systems
<i>Introduction and spread of non-native plants or pathogens</i>	Noxious weed listings, weed control practices, roadside vegetation management, use of appropriate species in amenity and garden plantings
<i>Introduction of non-native animals (L)</i>	Feral animal control, domestic animal management

**Notes for Table 4.1:**

(L) - means the threat is listed or linked to a key threatening process under the TSC Act, FM Act, NC Act or EPBC Act, and therefore must be considered in determining development proposals.

Whilst some of the above threats may be beyond direct control, there is considerable scope to consider and to influence these threats at all stages in the development process.



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## 1.2 Study Area

### 1.2.1 Extent

The study area for this report is the entirety of the Queanbeyan LGA, covering a total surface area of approximately 17,253 ha, and bounded to the east and south by the Palerang LGA, and to the west and north by the Australian Capital Territory (ACT). However this report focuses primarily on those parts of the Queanbeyan LGA that are not the subject of existing Local Environmental Studies (LESs) or National Parks estate. The areas excluded from the study are:

- Wanna Wanna, Cuumbeun and Stoney Creek Nature Reserves; and
- Googong, Tralee (south), Tralee (north), Tralee Station and Environa/Robin areas, which have been designated for residential, employment or environmental conservation zones, or as future investigation areas (beyond 2031), and are each subject to existing or future LESs (Department of Planning, 2007).

These lands comprise a total area of 3,547 ha and are shown in Figure 1 (Appendix A).

This report focuses primarily on the 13,293 ha of land beyond the lands described above, as shown in Figure 1 (Appendix A), with particular emphasis on those parts of the Queanbeyan LGA where there is the most pressure for rural residential development. These lands have a total area of approximately 5,590 ha and comprise land that is zoned:

- 1(d) Rural residential and does not have a current development consent and/or is undeveloped as shown on the Yarrowlumla LEP 2002; and
- 1(b) Rural B under the Queanbeyan LEP 1998.

For the purposes of this report these lands are hereafter referred to as the detailed investigation areas.

### 1.2.2 Biophysical Overview

The Queanbeyan LGA lies within the catchment of the Murrumbidgee River. The Queanbeyan River winds through the eastern parts of the LGA before joining the Molonglo River near the northern boundary of the LGA. The Molonglo River then flows west and eventually joins the Murrumbidgee River to the west of the LGA and Canberra.

The Queanbeyan LGA supports a variety of landforms including the riparian corridors of the Molonglo River, Queanbeyan River, and Jerrabomberra Creek, and a series of broad valleys separated by broad ridges and hills including the Queanbeyan Escarpment, Mount Jerrabomberra and in the south, Beatty Hill and Enchanted Hill. Elevation within the study area ranges between approximately 550 m around Queanbeyan City to 900-1000 m in association with some of the hills in the southern parts of the study area. The geology of the study area is

primarily Ordovician metasediments and Silurian volcanics and soils are generally shallow, stony and relatively infertile, particularly along high ridges and upper slopes. Deeper, better drained and more fertile soils occur on flats and valley bottoms (ACT Environment Commissioner, 2006).

The vegetation communities within the LGA include dry forests, grassy woodlands, native grasslands and secondary grasslands derived from these communities, including native pastures. The condition of these vegetation communities ranges from relatively intact both structurally and floristically to highly modified.

The climate is typically temperate, with mild to warm summers and cool to cold winters. However there are a number of local climatic variations including the “frost pockets” affected by cold air drainage that occur along Jerrabomberra Creek.

### **1.3 Aim and Objectives**

The aim of this report is to verify existing vegetation mapping and undertake targeted surveys to enable the mapping of relative conservation values across the study area. On the basis of these datasets the report will recommend appropriate zones, environmental sensitive layers and local provisions designed to protect biodiversity values within the new LEP for the Queanbeyan LGA.

The specific objectives of the Queanbeyan Local Government Area Biodiversity Study are to:

- a) Review existing information including the environmental zones, area and local provisions within the Yarrowlumla LEP 2002 and the Queanbeyan LEP 1998, LESs and other relevant flora and fauna studies held by QCC and the Department of Environment and Climate Change (DECC) for the Queanbeyan LGA;
- b) Define and map the relative conservation value of vegetation with the Queanbeyan LGA consistent with the existing terminology used by DECC and the Murrumbidgee Catchment Management Authority (MCMA);
- c) Undertake field work to verify the vegetation mapping of Fallding (2002);
- d) Identify regional and local habitat, riparian and wildlife corridors within the Queanbeyan LGA;
- e) Conduct targeted field work within areas having known development pressures, and in particular areas currently zoned for rural residential development, and to report on the threatened species and their habitats and endangered ecological communities found there;
- f) Identify and map areas more suited to development and those more suited for environmental protection on the basis of the desktop and field studies;

- g) Analyse the areas mapped as more suited to development and those more suited to environmental protection and include recommendations for suggested zones, environmental layers and local planning provisions; and
- h) Assess the regional significance of the open space corridors identified on the Residential and Economic Strategy Map and the area proposed to be used for the realignment of the Old Cooma Road where it intersects with the proposed Edwin Land Parkway.

A complex local, regional, state, national and international legislative and policy framework governs the management of biodiversity within the Queanbeyan LGA. It is not the object of this report to review the objectives and implications of all individual components of this framework, as this has been undertaken to a large extent elsewhere (Fallding 2002). Rather, this report;

- reviews relevant biodiversity information in Fallding (2002) and other relevant biodiversity studies that are available;
- reviews the interface between the existing LEPs and the biodiversity values of the LGA;
- defines the attributes of High Conservation Value (HCV), Medium Conservation Value (MCV) and Low Conservation Value (LCV) vegetation within the LGA;
- presents the results of the vegetation validation and targeted surveys for threatened ecological communities, fauna and flora species undertaken as part of the study; and
- identifies the distribution of HCV, MCV and LCV vegetation within the study area.

In this context, Section 2 identifies the datasets reviewed in the preparation of this report. Section 3 then summarises the biodiversity values of the Queanbeyan LGA identified by Fallding (2002) and other studies and datasets pertaining to the biodiversity values of the LGA. Section 4 reviews the interface between the biodiversity values of the LGA and the existing zoning regime. Section 5 describes the attributes that define the relative conservation value of vegetation within the LGA.

Section 6 identifies the results of the fieldwork undertaken as part of the study, and discusses the distribution of key conservation values within the study area including, EECs, over-cleared vegetation, threatened flora and fauna habitats and regional and local biolinks. Section 7 identifies the results of the relative conservation value mapping, discusses the influence of the key criteria determining conservation value, and identifies those areas more suited to development or environmental protection. Section 8 provides recommendations for suggested zones, environmental layers and local planning provisions.

A4 maps of the key datasets captured and/or analysed are included in Appendix A. However, these datasets are available as ArcView shapefiles and are best viewed in a GIS environment.

## 2. METHODS

### 2.1 Review of Existing Data

A detailed review and analysis of the following relevant information was undertaken for the production of this report, which involved:

- a) Review and analysis of available literature including relevant Local Environmental Studies, flora and fauna studies (Barrer 1997 and 1993, BES 2007 a & b, Crawford 1998, Kevin Mills & Associates (KMA), 2003 and 2006, Rowell and Crawford 1997, Thompson and Mullins 2004), biophysical information, aerial photographs and topographic maps of the study area;
- b) Environmental planning instruments including the Queanbeyan LEP 1998 and Yarrowlumla LEP 2002;
- c) Relevant Fact Sheets and NSW Scientific Committee Final Determinations for threatened species and endangered ecological communities;
- d) The planning framework of Fallding (2002) as it applies to the Queanbeyan LGA;
- e) The vegetation mapping of Fallding (2002) within the study area;
- f) GIS vegetation layers including HCV vegetation (SKM, 2007), remnant vegetation (NPWS data layer), Forest Ecosystems (Thomas *et. al* 2000) and pre-settlement grassland (Rehwinkel, 1997);
- g) Records of threatened flora and threatened fauna species within the Queanbeyan LGA included in the Atlas of NSW Wildlife; and
- h) Records of matters of national environmental significance in the locality obtained from the *Commonwealth Environment Protection & Biodiversity Conservation Act 1999* Protected Matters Search Tool.

### 2.2 Fieldwork

An assessment of biodiversity values across the study area was undertaken through vegetation and habitat mapping and targeted surveys for threatened species and EECs as described below.

#### 2.2.1. Verification of Fallding (2002) Vegetation Mapping

A key objective of the QBS was the verification within the study area of the vegetation mapping of Fallding (2002). Fallding (2002) identified and mapped five broad vegetation communities within the Queanbeyan LGA on the basis of existing regional vegetation datasets and with the aid of modelling of remotely sensed data relating to vegetation structure and floristics. As such the resolution of the Fallding (2002) mapping was determined by the resolution of the remotely sensed data which underpinned the modelling, which was 25 m<sup>2</sup>.

For the purposes of the QBS it was determined that it was not feasible or necessary to verify the vegetation mapping at this resolution, and consequently individual polygons within the Fallding dataset were merged into adjacent larger polygons such that the minimum polygon size was approximately 1 ha. This enabled a reduction of the individual polygons within the study area from more than 7,000 to a more manageable 550, which were then attributed unique identifiers enabling field verification.

The modified Fallding data was then printed over high resolution colour aerial photography of the study area and printed at A4 size. A spreadsheet enabling data to be recorded for each uniquely identified polygon was also produced. These two datasets enabled a systematic and practical methodology for verifying each uniquely identified polygon. Where errors in the boundaries between polygons were observed in the field new polygons were annotated onto the hardcopy printouts. The digital dataset was then modified in ArcView GIS to reflect the changes made in the field.

Vegetation condition was mapped consistent with the Biometric condition classes (Gibbons *et al.* 2005). As such, the secondary grasslands class was reclassified as either Moderate to Good or Low condition class of the broad vegetation community from which it was considered to derive. Areas identified as supporting predominantly non native vegetation were classified as Non-native vegetation.

### **2.2.2. Mapping Endangered Ecological Communities**

Within the detailed investigation areas, EECs and their condition was mapped concurrently with the vegetation validation. EECs were mapped with reference to statutory definitions and relevant identification guides (NSW Scientific Committee 2002, Environment ACT 2005, Rehwinkel 2007, NSW DECC 2007).

Condition was mapped using the Biometric condition classes for the Box Gum Woodlands. The condition of Natural Temperate Grasslands (NTG) was assessed with reference to the NTG assessment method (Version 7 October 2007) produced by Rainer Rehwinkel of DECC. Where the NTG condition was not obvious, quadrat data was collected and analysed as per the assessment methodology to determine conservation status.

Areas identified as EECs were annotated onto aerial photos in the field and later digitised as per the methods described in Section 2.1.1.

Where there was a fine scale mosaic of Natural Temperate Grasslands, Box-Gum Woodlands, secondary grasslands derived from both communities, and other vegetation types, these areas were mapped as a mix of EECs, rather than undertake a labour intensive attempt to map the fine scale variability. Where large polygons were encountered, generally greater than a hectare, the individual polygon was defined.

Beyond the detailed investigation areas, the extent of EECs was determined with reference to the validated vegetation mapping. The survey coverage of areas beyond the detailed investigation areas was less intensive and as such the accuracy of the EEC mapping is less robust. In some instances, particularly in those parts of the study area that are relatively remote and difficult to access such as parts of Enchanted Hill, the Pemberton Hills, and some areas in the ranges in the south-eastern margins of the study area, the presence of Box-Gum Woodland EEC has been extrapolated from the Mapping of Fallding (2002). Where possible, limited validation was undertaken remotely by assessing the abundance of characteristic trees using binoculars from vantage points.

### **2.2.3. Targeted Flora Surveys**

Plant species of conservation significance known from the Queanbeyan LGA or the southern tablelands region were targeted opportunistically when undertaking the vegetation mapping verification, EEC mapping and fauna surveys during spring and early summer 2007. Where flora of conservation significance were identified, similar habitats in the immediate vicinity were searched to ascertain the extent and abundance of the species in the location.

### **2.2.4. Targeted Fauna Surveys and Habitat Assessments**

Within the detailed investigation areas targeted fauna surveys and habitat assessments were undertaken during December 2007. The surveys were concentrated primarily on vegetation communities that were likely to be classified as MCV and thus, notwithstanding other constraints, are potentially more suitable for development than HCV vegetation.

The fauna surveys involved a number of survey methods as described below:

#### **Opportunistic Diurnal Surveys and Habitat Analysis**

Searches were conducted for habitats or resources of relevance for threatened and migratory fauna species known from the general region which might be anticipated to occur given the vegetation communities and habitats present. Surveys for threatened diurnal woodland birds were undertaken opportunistically across the study area. The specific methods used to target fauna species are described further below where appropriate.

Opportunistic records of fauna species of conservation significance were recorded wherever they were encountered.

A description of the fauna habitats was prepared using a rapid assessment proforma to assess the quality and abundance of habitat resources for fauna species of conservation significance.

The information collected included:

- The type of vegetation present;
- The presence/absence, abundance and extent of rock habitats for target threatened reptiles;
- The presence/absence, abundance of termite mounds for Rosenberg's Goanna;
- The presence/absence, quality and extent of suitable grassy habitat for the Golden Sun Moth;
- The presence/absence and abundance of tree hollows and their suitability for specific target fauna species *i.e.* woodland birds, microchiropteran bats, and threatened owls;
- The presence of suitable water habitats for the Green and Golden Bell Frog and migratory wetland birds;
- The presence of foraging substrates; and
- Other features affecting suitability for threatened fauna such as habitat complexity, the abundance of shelter, the presence/absence of biolinks, and levels of disturbance.

The habitat assessments were linked to points and polygons that were recorded using handheld GPS and annotated onto base maps identifying areas where particular habitats occurred and/or the extent of threatened fauna habitats of a similar relative value.

### **Targeted Reptile Surveys**

Reptile surveys primarily targeting the Pink-tailed Worm Lizard were undertaken where suitable rock habitats were encountered. Reptiles were actively searched for under rocks, logs and debris. As much as possible, rocks and logs were placed back in their original positions.

### **Targeted Golden Sun Moth Surveys**

Grassy areas supporting suitable or potential habitat for the Golden Sun Moth were sampled by two surveyors walking along linear transects while searching for moths and butterflies. Green-meshed butterfly nets were used to capture moths and butterflies for identification when necessary.

### **Targeted Green and Golden Bell Frog Surveys**

Nocturnal searches for the Green and Golden Bell Frog were undertaken within areas of suitable habitat in the study area. Listening for calls and call playback techniques were employed shortly after dark on a single night during optimum conditions at Jerrabomberra Creek and two larger dams in the vicinity. A minimum of ten minutes was spent listening for frog calls at each of the sites, followed by intermittent call playback for the Green and Golden Bell Frog for five to ten minutes. Calls were broadcast via a portable MP3 player and 10W Toa megaphone, followed by a listening period of ten minutes at each site.

### **Targeted Owl Surveys**

At two locations near the north-east of the study area, the calls of the Barking Owl and Masked Owl were broadcast through a Toa megaphone shortly after dark on two nights. Calls were broadcast intermittently for a period of approximately five minutes, followed by a listening period of 15 minutes and spotlighting around the immediate playback site for a further five minutes.

### **Targeted Microchiropteran Survey**

AnaBat echolocation recording was used to assess microchiropteran bat activity in a number of locations. One AnaBat II bat detector linked to a ZCAIM digital data recorder was set up at stationary positions to record microchiropteran bat echolocation calls overnight on three nights. Survey locations were chosen to sample habitat possibly important as corridors for microchiropteran species. Within these habitats the detector was placed on the ground and angled upwards at between 30 and 40 degrees along obvious flyways or openings in the canopy. Recorded data was sent to Mr. Adam Fawcett of Forests NSW (Department of Primary Industries) for analysis to identify species.

## **2.2.5. Assessment of Regional and Local Biolinks**

Regional and local biolinks were identified through a combination of the field work and desktop analyses. Areas that potentially provided linkages between larger or important areas of habitat were identified in the background research and were assessed in the field through the vegetation validation, habitat assessments and targeted fauna surveys.

## **2.2.6. Limitations**

The field surveys undertaken for this report are considered adequate to gather the data necessary to meet the project outcomes. However, surveys are inevitably subject to constraints that determine coverage, the amount of time allocated, the methods used and the timing of the work. Thus, the results of the surveys undertaken for this report should be viewed in the light of these limitations, which are described below.

### **Vegetation Mapping**

The resolution at which vegetation type and condition were mapped varied within the study area with finer resolution mapping undertaken with the detailed investigation areas. The large size of the study area and limitation to access in places necessitated a rapid assessment approach to the vegetation validation and mapping. Given these limitations it is acknowledged that there is likely to be unmapped variation of both vegetation type and condition within polygons in places. These variations are generally limited to areas of less than a hectare, particularly within the detailed investigation areas, but may be larger elsewhere within the study area, particularly in those areas where access was poor. In particular, within larger polygons, small areas of non-native vegetation as in association with dwellings and associated disturbances, may be included within polygons mapped as native vegetation.



Areas where access was poor and polygons were not checked are identified in the validated vegetation attribute table (in the GIS files).

### **Targeted Flora Surveys**

Similarly, given the large size of the study area targeted flora surveys were limited primarily to the random meander method, with flora species targeted opportunistically. Under these circumstances it is probable that occurrences of target flora species remain undetected within the study area. Nevertheless, the targeted flora surveys undertaken for this study resulted in the detection of a number of new records for threatened flora species and provide an indication of the abundance and distribution of the target flora throughout the study area.

### **Fauna Surveys and Habitat Assessments**

The results of fauna surveys can be optimised by conducting investigations over a long period to compensate for the effects of unfavourable weather, seasonal changes and climatic variation. In general, the longer the survey the more species will be detected. Results can also be improved by using a wide range of techniques, since some species are more likely to be detected by a particular method. Such techniques include scat analysis, small-cage trapping, pitfall trapping, hair tubing and harp trapping.

Some targeted fauna surveys were limited by weather conditions during the survey period. Golden Sun Moths are most likely to be observed during the middle of warm, still and sunny days. The mostly cloudy and sometimes rainy conditions during the survey period limited the effectiveness of surveys for the Golden Sun Moth, as did the timing of surveys at some sites.

Limited access to some properties restricted other fauna surveys. Nevertheless, the techniques used in this investigation are considered adequate to gather the data necessary to meet the study objectives.

### 3. BIODIVERSITY VALUES OF THE QUEANBEYAN LGA

Fallding (2002) devised a planning framework for natural ecosystems in the NSW Southern Tablelands and ACT region, which analysed the landscapes, habitats, vegetation communities and land uses of the region, and outlined principles for planning, development and conservation. It aimed to guide strategic planning at the regional and local scales, such that biodiversity values were appropriately considered and incorporated into planning decisions and documents, including during the development of new LEPs.

Fallding (2002) synthesised the existing biodiversity datasets pertaining to the Southern Tablelands and ACT region. The discussion of the key biodiversity values of the Queanbeyan LGA in subsequent sections of this report draws primarily from Fallding (2002), but also from other studies (Barrer 1997 and 1993, BES, 2007 a & b, Crawford 1998, KMA 2003 and 2006, Rowell and Crawford 1997, Thompson and Mullins 2004) and datasets (DECC Grassy Ecosystems Site Data) where they provide more detailed descriptions of the biodiversity values of the study area.

#### 3.1 Landscape Units

Fallding (2002) divided the NSW and ACT Southern Tablelands Region into 18 landscape units, of which three occur in the Queanbeyan LGA; the Canberra – Queanbeyan Landscape Unit, Royalla Landscape Unit and Lake George Range Landscape Unit as described in Table 2.

**Table 2: Landscape Units of the Queanbeyan LGA (Fallding, 2002).**

Landscape Unit	Biophysical Characteristics
<b>Canberra – Queanbeyan</b>	Large areas of native vegetation have been cleared for agriculture, grazing and urban development and infrastructure within the Queanbeyan LGA. Once extensive areas of Native Grassland have been largely cleared for urban development and infrastructure and although some areas of Box-Gum Woodland remain, they are intersected and fragmented by road networks.
<b>Royalla</b>	Flats and undulating hills with Grasslands and Box-Gum Woodlands characterise the Royalla unit, while higher slopes are occupied by Dry Forests and, beyond the Queanbeyan LGA, Wet Forests. The vegetation is generally highly modified and/or cleared, although small areas of considerable diversity remain.
<b>Lake George Range</b>	This unit is characterised by undulating hills with Dry Forests, Box-Gum Woodlands and Grasslands occupying the lower parts of the landscape. Again, the latter two communities are largely cleared or modified and areas of Dry Forests have also been cleared in places.

### 3.2 Vegetation Communities

From a synthesis of existing vegetation datasets, Fallding (2002) identified five broad vegetation communities within the Queanbeyan LGA as described below. These broad vegetation communities include the assemblages that have been recognised at a local level (Barrer 1997 and 1993) and the communities recognised by other relevant regional datasets such as the vegetation mapping undertaken for the Comprehensive Regional Assessment (CRA) (Thomas *et al.* 2000) and the Murrumbidgee Catchment Management Authority (MCMA) vegetation types.

**Native Grassland** - occurs in valleys subject to poor soil drainage and cold air drainage, on exposed hillsides, as well as in basalt landscapes, and may be fringed by woodland in some areas. This community comprises the Natural Temperate Grasslands of the Southern Tablelands of NSW and ACT (NTG) endangered ecological community listed on the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

**Box-Gum Woodland** - is characterised by grassy woodlands with a tree cover of between 10 and 30 % and dominated by tree species including White Box, Yellow Box and Blakely's Red Gum (Fallding, 2002). This community occurs on the deeper soils of the foot-slopes and mid-slopes, and occasionally on upper-slopes. Parts of the community comprise the Box-Gum Woodland ECC listed on both the *NSW Threatened Species Conservation Act 1995* (TSC Act) and EPBC Act.

**Grassland-Woodland Mosaic** - is comprised of a mosaic of Native Grasslands and cold climate woodland communities that are dominated by Snow Gum, Manna Gum, Apple Box, Black Gum, Candlebark and Swamp Gum, and also areas of Yellow Box and Blakely's Red Gum (Box-Gum) woodlands. The Grassland-Woodland Mosaic community generally occurs on flat areas, valleys and undulating landscapes. This community includes the regionally declining vegetation community Eastern Tableland Moist Woodland on High Altitudes (Murrumbidgee CMA Vegetation Types) known locally as Snow Gum Grassy Woodland, of which approximately 65% of the extent is estimated to be cleared. Parts of the community also comprise the NTG and Box-Gum Woodland ECCs.

**Dry Forests** – comprises forests and woodlands dominated by one or more of the following eucalypt species; Red Stringybark, Red Box, Scribbly Gum, Brittle Gum, Broad-leafed Peppermint, Bundy and Mealy Bundy. The understorey is often sparse and dominated by tussock grasses such as Red-anthered Wallaby Grass. Dry Forests typically occur on shallower soils and steeper slopes than those that support grassy woodlands. This community includes those parts of the Queanbeyan Box-Gum Woodland community where Yellow Box is not dominant or co-dominant.

**Secondary Grasslands** – comprises native grasslands derived from the clearing of forest and woodland communities.

### **3.3 Endangered Ecological Communities**

The vegetation communities identified by Fallding (2002) as occurring within the Queanbeyan LGA include the following three EECs:

- *Natural Temperate Grasslands of the Southern Tablelands of NSW and ACT (EPBC Act)* (Natural Temperate Grassland);
- *White Box, Yellow Box, Blakely's Red Gum Woodland (TSC Act)* (Box-Gum Woodland); and
- *White Box, Yellow Box, Blakely's Red Gum Grassy Woodlands and Derived Native Grasslands (EPBC Act)* (Box-Gum Woodland).

The Box-Gum Woodland EEC is covered by listings at both state and federal level, which each have slightly different definitions of the community. For the purposes of this report the Box-Gum Woodland EEC has been defined using the NSW definition and including recent changes proposed by DECC to the identification key for the community.

Natural Temperate Grassland (NTG) and the Box-Gum Woodland EEC are poorly represented in conservation reserves and sites with high ecological integrity are generally rare, isolated and fragmented.

Despite the gazettal of a number of recent conservation reserves which have protected these EECs within the Queanbeyan LGA, the remaining NTG and Box-Gum Woodlands largely occur on private agricultural or grazing lands and are subject to a number of threats, including inappropriate grazing, pasture improvement or cropping, urban, rural residential and other infrastructure development, weed invasion and bushrock collection (Fallding, 2002).

#### **3.3.1 Natural Temperate Grasslands**

The pre-European distribution of NTG within the Queanbeyan LGA has been mapped as part of a larger project (Rehwinkel 1997). This data suggests that NTG occurred primarily in four discreet patches within the LGA:

- In a narrow band associated with the broad valley flats in the upper catchment of Jerrabomberra Creek on the eastern side of the creek from Royalla through to Burra Road;
- In the Googong area south of Googong Road;
- In the extreme north-east of the LGA in association with the Molonglo River in the Burbong area; and
- West of the suburbs of Jerrabomberra and Letchworth.

However mapping of the pre-European distribution of NTG was undertaken at a scale that did not capture the many smaller areas of NTG that were likely to be present where conditions suitable for the development of NTG occurred. These conditions can be broadly summarised as follows:

- Valleys, often broad and flat, affected by cold air drainage and thus often characterised by fringing Snow Gum and Candlebark trees;
- Soils subject to poor drainage in winter and cracking during summer droughts; and
- In association with the floodplains of major creeks and rivers.

Subsequent detailed surveys by DECC and others have also identified NTGs beyond the mapped pre-European distribution in a number of locations including the central-western parts of Tralee Station around Dunns Creek, on “The Poplars”, to the north of Tralee Station (KMA, 2006), the upper catchments of Four Mile Creek and Guises Creek, in the lower parts of Guises Creek adjacent to the Goulburn-Bombala railway, and near Captains Flat Road east of Stony Creek Nature Reserve (NR).

### **3.3.2 Box-Gum Woodland**

The NSW definition of the Box-Gum Woodland EEC has been used to define the community for the purposes of this report. Sites considered to comprise the EEC can be characterised generally as those areas where:

- White Box, Yellow Box, and or Blakely’s Red Gum are dominant or co-dominant or would have been dominant or co-dominant; and
- The groundcover is predominantly native grasses and forbs with only small patches of shrubs; or
- There is an abundance of shrubs, they comprise post disturbance coloniser species; or
- The site is highly disturbed either the understorey, overstorey, or both would, under appropriate management, respond to assisted natural regeneration, such as where the natural soil and associated seed bank are still at least partially intact.

Sites where the community is unlikely to respond to assisted natural regeneration are generally limited to sites where:

- There has been intensive and ongoing cropping of annual crop species; or
- The characteristic trees are located within urban backyards; or
- The groundcover is dominated by aggressive exotic perennial grasses such as African Lovegrass, Chilean Needle Grass, Serrated Tussock, Phalaris, Tall Fescue, Yorkshire Fog, or Cocksfoot.

Within the Queanbeyan LGA, Yellow Box is the most abundant of the three tree species that characterise the community, with Blakely's Red Gum substantially less abundant, and White Box absent from the LGA.

Whilst Fallding (2002) maps extensive areas of Box-Gum Woodland throughout the LGA, some of these areas are unlikely to meet the definition of the EEC as the characteristic canopy species are likely to have always been absent or were never likely to have been dominant or co-dominant. Some areas mapped as Box-Gum Woodland are also known to be unlikely to respond to assisted natural regeneration as a result of extensive disturbances associated with clearing, grazing, pasture improvement or cropping. However, given the limited extent of pasture improvement and cropping within the Queanbeyan LGA, much of the vegetation that is or was once dominated by one of the characteristic tree species of the Box-Gum Woodland, is likely to continue to meet the definition of the Box-Gum Woodland EEC.

Occurrences of the Box-Gum Woodland EEC are known to occur in many locations within the LGA including on the lower western slopes of Mount Jerrabomberra, Queanbeyan Nature Reserve, south of Queanbeyan City in Dodsworth, which is contiguous with surrounding Box-Gum Woodland habitat on the Queanbeyan Escarpment and beyond, in the Googong area, between Old Cooma Road and Tempe Crescent, north of Wickerslack Lane, in the Barracks Creek area south of Karabar (BES, 2007 a & b), and in places on Tralee Station (KMA, 2006).

### **3.4 Threatened Species**

The Queanbeyan LGA is known to support populations and important habitats for a number threatened flora and fauna species. Records of these species are concentrated in the northern half of the Queanbeyan LGA, close to urban areas, although this is likely to be due at least in part to greater survey effort in these areas.

The threatened species known or likely to occur within the Queanbeyan LGA are identified below, as are the nature of their preferred habitats, and the likely extent of these habitats within the LGA, and any known records of these species.

#### **3.4.1 Threatened Flora Species**

The threatened flora species that are known or likely to occur in the Queanbeyan LGA are listed in Table 3 below. Their known and likely habitat is also described.

**Table 3: Threatened flora species recorded or potentially occurring in the study area**

THREATENED FLORA SPECIES	STATUS		POTENTIAL HABITAT AND KNOWN LOCATIONS IN THE QUEANBEYAN LGA
	TSC Act	EPBC Act	
<i>Caladenia tessellata</i> Thick-lipped Spider Orchid	E	V	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.
<i>Calotis glandulosa</i> Mauve Burr-daisy	V	V	This species appears to be a coloniser of bare patches and occurs in the subalpine habitats of the Australian Alps, often on roadsides. The species is known from montane grasslands dominated by <i>Poa</i> species, NTG dominated by Kangaroo Grass, and Snow Gum Woodlands in the Monaro and Shoalhaven regions. It has not been recorded in the Queanbeyan LGA however there is potential habitat in association with the NTG within the LGA.
<i>Leucochrysum albicans</i> subsp. <i>albicans</i> var. <i>tricolor</i> Hoary Sunray	-	E	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.
<i>Pomaderris pallida</i> Pale Pomoderris	V	V	This species usually grows in open forest or shrub communities surrounded by Brittle Gum, Red Stringybark or Cypress Pine 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.
<i>Rutidosus leptorhynchoides</i> Button Wrinklewort	E	E	This species is known to occur at several sites to the west of Mount Jerrabomberra, including a population of around 1500 in Queanbeyan NR, 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.
<i>Swainsona recta</i> Mountain Swainson- pea	E	E	This species is associated with Box-Gum Woodlands and grows in association with 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 NTG at Tuggeranong and Royalla and also to the west of Letchworth 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 south-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.

THREATENED FLORA SPECIES	STATUS		POTENTIAL HABITAT AND KNOWN LOCATIONS IN THE QUEANBEYAN LGA
	TSC Act	EPBC Act	
<i>Swainsona sericea</i> Silky Swainson-pea	V	-	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 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.
<i>Thesium australe</i> Austral Toadflax	V	V	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.

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](http://www.npws.nsw.gov.au) (accessed 2007), KMA (1993 and 2006), NSW DECC [www.threatenedspecies.environment.nsw.gov.au](http://www.threatenedspecies.environment.nsw.gov.au) (accessed 2007) and PlantNET <http://plantnet.rbgsyd.gov.au> (accessed 2007), and Thompson and Mullins (2004).

### 3.4.2 Threatened Fauna Species

The threatened fauna species that are known or likely to occur in the Queanbeyan LGA are listed in Table 4 below. Known and potential habitats for these species within the LGA are also described.

**Table 4: Threatened fauna species recorded or occurring in the study area**

THREATENED FAUNA SPECIES	STATUS		POTENTIAL HABITAT AND KNOWN LOCATIONS IN THE QUEANBEYAN LGA
	TSC Act	EPBC Act	
<b>Microchiropteran Bats</b>			
Eastern Bentwing Bat  <i>Miniopterus schreibersii oceanensis</i>	V	-	This bat uses caves as roosting sites and woodlands or forests for foraging. It has been recorded in the Queanbeyan LGA near the centre of Queanbeyan City, in the Googong area, in the Carwoola area, as well as just outside the LGA along the Queanbeyan River corridor south of Carwoola. Foraging, roosting and potential breeding habitat for this species is likely to be relatively widely distributed within the LGA in association with areas of woodland, forest, or scattered trees. Important roosting sites are most often associated with deeper caves or abandoned mines, and are likely to be scarce in the LGA.



THREATENED FAUNA SPECIES	STATUS		POTENTIAL HABITAT AND KNOWN LOCATIONS IN THE QUEANBEYAN LGA
	TSC Act	EPBC Act	
Eastern False Pipistrelle  <i>Falsistrellus tasmaniensis</i>	V	-	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 has been recorded in Dry Forest in the northern part of Cuumbeun NR near Scabbing Flat Creek and in the Googong area. Foraging, roosting and potential breeding habitat for this species is likely to be relatively widely distributed within the LGA in association with patches of remnant forest and with respect to roosting and breeding habitat, anywhere where hollow-bearing trees remain.
<b>Other Mammals</b>			
Koala  <i>Phascolarctos cinereus</i>	V	-	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 associated with the Queanbeyan River corridor. These records include a 2007 sighting on the eastern outskirts of Queanbeyan City and a 1984 record from the north of Googong Dam.
Spotted-tailed Quoll  <i>Dasyurus maculatus</i>	V	E	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. It is possible that it may occur elsewhere although potential habitat within the LGA may be relatively limited due to lack of high quality habitat supporting abundant hollow-bearing trees and fallen logs.
<b>Birds</b>			
Australian Painted Snipe  <i>Rostratula benghalensis australis</i>	V	V	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 is most common in the Murray-Darling Basin. This species was recorded during the survey period but has not otherwise been recorded within the Queanbeyan LGA. It is possible that the species occurs occasionally in areas of wet grassland associated with the river and creek corridors within the LGA.
Barking Owl  <i>Ninox connivens</i>	V	-	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 LGA however there may be suitable habitats in association with the extensive areas of Dry Forests found on the Queanbeyan Escarpment and in the Queanbeyan River Corridor.

THREATENED FAUNA SPECIES	STATUS		POTENTIAL HABITAT AND KNOWN LOCATIONS IN THE QUEANBEYAN LGA
	TSC Act	EPBC Act	
Brown Trecreeper  <i>Climactis picumnus</i>	V	-	This species is found in eucalypt woodlands, including Box-Gum Woodland. It is sedentary and utilises hollows greater than 6cm diameter in standing dead or live trees and tree stumps for nesting. The Brown Trecreeper has been recorded in Dry Forest along the Queanbeyan River corridor in Carwoola and is thought to be relatively common in the Googong area. Potential habitat for this species is also known to occur to the west of Googong at Tralee Station.
Diamond Firetail  <i>Stagonopleura guttata</i>	V	-	This species is found in grassy eucalypt woodlands, including Box-Gum Woodlands and also occurs in NTG, and in secondary grasslands. It is often found in riparian areas and is known from the Queanbeyan River corridor, south of Carwoola and has also been recorded east of Tralee, in woodland at Tralee Station, east of Jerrabomberra and, immediately beyond the Queanbeyan LGA, to the east of Googong and west of Burra Creek.
Gang-gang Cockatoo  <i>Callocephalon fimbriatum</i>	V	-	This species has been recorded in Dry Forest along the Queanbeyan River corridor, just outside the Queanbeyan LGA south of Carwoola and in Queanbeyan East. Potential foraging habitat for this species is likely to be relatively widely distributed within the LGA in association with remnant woodlands and forests. Potential breeding habitat is likely to be much more restricted as the species prefers taller forests with an abundance of old growth attributes.
Glossy Black- cockatoo  <i>Calyptorhynchus lathamii</i>	V	-	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 potential habitat for the species in the study area would appear to be limited by the relatively low abundance of feed trees. However there is likely to be some foraging habitat and possibly breeding habitat associated with the Dry Forests of the Queanbeyan Escarpment and adjacent areas.
Hooded Robin  <i>Melanodryas cucullata</i>	V	-	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 is known from a cluster of records just outside the LGA south of Carwoola along the Queanbeyan River corridor and around the north-western shores of Googong Reservoir. It has also been recorded on Tralee Station, near Jerrabomberra and outside the Queanbeyan LGA west of Burra Creek. Potential habitat for the species is likely to be relatively widespread within the LGA in association with remnant woodlands and forests and concentrated in those areas where larger more structurally diverse patches of remnant vegetation are concentrated such as in the north-eastern and eastern extremities of the LGA and in the Mt Jerrabomberra, Barracks Creek, Jerrabomberra Creek and the Queanbeyan River Corridor areas.

THREATENED FAUNA SPECIES	STATUS		POTENTIAL HABITAT AND KNOWN LOCATIONS IN THE QUEANBEYAN LGA
	TSC Act	EPBC Act	
Masked Owl <i>Tyto novaehollandiae</i>	V	-	This species inhabits eucalypt forests and woodlands from the coast to the western plains. The study area is likely to include a reasonable amount of potential habitat for the species as it prefers habitats that provide a mosaic of sparse grassy and dense shrubby ground cover on gentle terrain. However it is also known to prefer forests with high densities of old hollow trees and to avoid young regrowth areas. There are no recent records of the species in the LGA however the most likely suitable habitats for the species within the study area would appear to be in association with the extensive areas of Dry Forests found on the Queanbeyan Escarpment and in the Queanbeyan River Corridor.
Powerful Owl <i>Ninox strenua</i>	V	-	Habitat for this owl species tends to be within eucalypt forest containing a diverse array of understorey plants and appropriate habitat for its primary prey species (gliders and large possums and especially Ringtail Possums). Given the likely paucity of large hollows suitable for breeding and the relatively low abundance of preferred prey species resulting primarily from historical vegetation modification, potential habitat for this species is likely to be relatively limited within the study area. There are no recent records of the species in the LGA however there is a recent record from Canberra. The most likely suitable habitats for the species within the study area would appear to be in association with the extensive areas of Dry Forests found on the Queanbeyan Escarpment and in the Queanbeyan River Corridor.
Regent Honeyeater <i>Xanthomyza phrygia</i>	E	E	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.
Speckled Warbler <i>Pyrrholaemus sagittatus</i>	V	-	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. Large, relatively undisturbed remnants are required for the species to persist in an area. In the Queanbeyan LGA, the species is known to occur in the Tralee – Poplars-Jerrabomberra Creek area, around the Queanbeyan River corridor and on the western shores of Googong Reservoir. Potential habitat within the LGA is likely to be relatively widely distributed in association with larger patches of remnant native vegetation.

THREATENED FAUNA SPECIES	STATUS		POTENTIAL HABITAT AND KNOWN LOCATIONS IN THE QUEANBEYAN LGA
	TSC Act	EPBC Act	
Superb Parrot <i>Polytelis swainsonii</i>	V	V	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. Potential habitat for this species is relatively widespread within the LGA in association with grassy woodlands, however it has not been recorded within the LGA with the majority of records being in the northern parts of the ACT, including in residential areas.
Swift Parrot <i>Lathamus discolor</i>	E	E	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.
<b>Reptiles</b>			
Grassland Earless Dragon <i>Tympanocryptis pinguicolla</i>	E	E	This species is restricted to a small number of NTG 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. Potential habitat for the species is likely to be present in those areas supporting Native Grasslands or pasture with partially embedded surface rocks.
Little Whip Snake <i>Suta flagellum</i>	V	-	This species occurs in NTG 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.
Pink-tailed Worm-lizard <i>Aprasia parapulchella</i>	V	V	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 occurs at "Talpa" near Googong and is also known from east of Jerrabomberra Creek north of Fernleigh Park on a lightly timbered southwest slope, with scattered surface rocks, Queanbeyan East, east of Karabar along the Queanbeyan River, and from Beatty Hill. However potential habitat for the species is likely to be present in those areas within the LGA supporting Grassy Woodlands or Native Grasslands or pasture with partially embedded surface rocks.

THREATENED FAUNA SPECIES	STATUS		POTENTIAL HABITAT AND KNOWN LOCATIONS IN THE QUEANBEYAN LGA
	TSC Act	EPBC Act	
Rosenberg's Goanna  <i>Varanus rosenbergi</i>	V	-	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. The species shelters in hollow logs, rock crevices and in the burrows, of other species, including rabbits, or in burrows they dig for themselves. The Canberra – Queanbeyan Landscape Unit, which lies in and beyond the north-western part of the Queanbeyan LGA contains the most frequent sightings of Rosenberg's Goanna. 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. Suitable foraging and breeding habitat for this species has also been reported to occur in North Terrace and Jerrabomberra Heights.
Striped Legless Lizard  <i>Delma impar</i>	V	V	This species occurs mainly in NTG but has also been recorded in grasslands that have a high exotic component. It has also been found in secondary grassland near NTG 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. The Canberra – Queanbeyan Landscape Unit contains the largest known regional population of Striped Legless Lizards. This species has not been recorded in the Queanbeyan LGA however potential habitat for the species is likely to be present in those areas within the LGA supporting Grassy Woodlands or Native Grasslands or pasture with groundcovers dominated by suitable grass species.
<b>Amphibians</b>			
Green and Golden Bell Frog  <i>Litoria aurea</i>	E	V	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. Potential habitat for this species in the Queanbeyan LGA is provided by various creeks, swamps and vegetated farm dams.
Southern Bell Frog  <i>Litoria raniformis</i>	E	V	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 species is not known from the Queanbeyan LGA, although 340 records of this species occur in the Murrumbidgee catchment area, including one record near the Queanbeyan River on the northern foreshore of Googong Reservoir.

THREATENED FAUNA SPECIES	STATUS		POTENTIAL HABITAT AND KNOWN LOCATIONS IN THE QUEANBEYAN LGA
	TSC Act	EPBC Act	
Yellow-spotted Bell Frog  <i>Litoria castanea</i>	E	E	This species requires large permanent ponds or slow flowing streams with plenty of emergent vegetation, such as bulrushes. There are only three records of this species in the Murrumbidgee catchment, two to the north of the Queanbeyan LGA and one to the south, however this species has not been recorded in the wild since the 1970s. Potential although marginal habitat for the species occurs in association with the larger creek and river corridors within the LGA such as along Jerrabomberra Creek and the Queanbeyan River.
<b>Invertebrates</b>			
Golden Sun Moth  <i>Synemon plana</i>	E	E	The Golden Sun Moth occurs in NTG and grassy Box-Gum Woodlands in which the ground layer is dominated by wallaby grasses. These grassland 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. Habitat may contain several wallaby grass species, which are typically associated with other grasses including spear-grasses and Kangaroo Grass. The Canberra – Queanbeyan Landscape Unit supports the largest and most south-eastern recorded sites of this species, although only a few records occur in the Queanbeyan LGA, in the north of The Poplars, west of Jerrabomberra and in the Talpa - Googong areas. Potential habitat for the Golden Sun Moth is also thought to occur at Tralee Station. Potential habitat for the species is likely to be relatively restricted but reasonably widespread within the LGA in association with those patches of Grassy Woodland and Native Grasslands that support an abundance of wallaby grass.

Note: Habitat requirements and records for threatened fauna species in Table 4 have been sourced from Barrer (1993 and 1997), Blakers et.al. (1984), Churchill (1998), Clout (1989), Cogger (1996), Commonwealth DEH (1999), Commonwealth DEH (2001), KMA (1993 and 2006), NSW DECC [www.threatenedspecies.environment.nsw.gov.au](http://www.threatenedspecies.environment.nsw.gov.au) (accessed 2007), Ehmann (1997), NSW DECC (2005), NSW NPWS (1999a&b), NSW NPWS (2000), NSW NPWS [www.npws.nsw.gov.au](http://www.npws.nsw.gov.au) (accessed 2007), Strahan (1995), and Thompson and Mullins (2004).

### 3.4.3 Migratory Species

The Queanbeyan LGA is known to support habitats for a number of listed migratory species.

The migratory fauna species that are known or considered likely to occur in the Queanbeyan LGA are listed in Table 5 below. Their known and likely habitats are also described.

**Table 5: Migratory species recorded or potentially occurring in the study area**

SPECIES	POTENTIAL HABITAT AND KNOWN LOCATIONS IN THE QUEANBEYAN LGA
Australian Painted Snipe <i>Rostratula benghalensis australis</i>	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. This species was recorded during the survey period but has not otherwise been recorded within the study area. It is possible that the species occurs occasionally in areas of wet grassland associated with the river and creek corridors within the LGA.
Rainbow Bee-eater <i>Merops ornatus</i>	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 is likely to be relatively widespread within the LGA but concentrated along the larger creek and river corridors such as along Jerrabomberra Creek and the Queanbeyan River.
Regent Honeyeater <i>Xanthomyza phrygia</i>	This species inhabits temperate woodlands and open forest of the inland slopes of south-east Australia. The species is often found in woodlands with large numbers of mature trees, high canopy cover and an abundance of mistletoes. The species 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 in association with larger patches of remnant vegetation, particularly Box-Gum Woodlands and where mistletoe is abundant.
Rufous Fantail <i>Rhipidura rufifrons</i>	This species is known to utilise dense understorey vegetation in damp forests or beside rivers, although it also occurs in open country during migration. The species is known from the Murrumbidgee catchment to the west of the ACT but has not been recorded in the Queanbeyan LGA. Potential habitat for this species may occur in less disturbed and moist habitats associated with the Queanbeyan River.
Satin Flycatcher <i>Myiagra cyanoleuca</i>	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.
White-bellied Sea-eagle <i>Haliaeetus leucogaster</i>	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. Within the LGA habitat for the species is likely to be restricted primarily to Googong Reservoir and areas immediately adjacent.
White-throated Needletail <i>Hirundapus caudacutus</i>	One record of this species occurs in the Queanbeyan LGA from the centre of Queanbeyan City. The species is likely to occur within the LGA from time to time feeding ahead of weather changes and may roost on tree trunks in woodlands and forests or on cliff faces.

### 3.4.4 Regionally significant flora species

A number of flora species considered to be regionally significant have been recorded within the Queanbeyan LGA. These include but are not limited to:

- The Fan Grevillea *Grevillea ramosissima* and Twining Fringed Lily *Thysanotus patersonii* (Barrer, 1993), which are known to occur on the north-western, western and northern slopes of Mount Jerrabomberra (Crawford, 1998, KMA, 1993);
- Black Cyprus Pine *Callitris endlicheri* and *Pomaderris andromedifolia*, which are considered by Barrer (1993) to be locally significant, were recorded in North Terrace and in a gully in Jerrabomberra Heights, respectively (Crawford, 1998);
- The Australian Anchor Plant *Discaria pubescens* is known from at least one location in the Dodsworth area (SMEC 2007); and
- *Eucalyptus williamsiana* which has been recorded in and around the Googong reservoir water treatment plant (BES 2007c).

A number of other species considered regionally significant are described in Barrer (1993).



## 4. THE EXISTING LEPs AND BIODIVERSITY

Local Environmental Plans (LEPs) are a primary planning instrument governing the management of biodiversity at a local government area level. This section of the report describes the interface between the existing LEPs that apply to the Queanbeyan LGA and the known biodiversity values of the LGA.

### 4.1 Local Environment Plans Pertaining to the Study Area

Three LEPs govern development in the Queanbeyan LGA; the Queanbeyan LEP 1998; Queanbeyan LEP 1991 and the Yarrowlumla LEP 2002. The Queanbeyan LEP 1998 applies to the northwest of the LGA, comprising around one third of the total area of the LGA, while the Yarrowlumla LEP 2002 applies to the remainder of the Queanbeyan LGA with the exception of two portions of land known as Poplars and Jumping Creek which are subject to Queanbeyan LEP 1991. Table 6 below shows the area covered by each zone under the two relevant LEPs.

**Table 6: Area covered by each zone category within the Queanbeyan LGA.**

Zone Category	Area within Queanbeyan LGA (ha)	% of the LGA
Rural Residential	5,637	32.7
Rural	5,020	30
Environmental Protection	3,315	19.2
Residential	1,213	7
National Park	866	5
Open Space	382	2.2
Industrial	161	0.9
Special Uses	137	0.8
Business	28	0.16
Roads	467	2.7
Amendments 23 and 5	17	0.1
<b>Total</b>	<b>16,805</b>	<b>100</b>

The aims and general objectives of the Queanbeyan LEP 1998 include:

- Recognising and protecting Queanbeyan's cultural and archaeological heritage, including environmentally sensitive areas such as Queanbeyan's Native Grasslands, the Queanbeyan Escarpment, the Queanbeyan River and Jerrabomberra Creek;
- Ensuring that development occurs in locations and at scales that are sensitive to environmental and planning constraints; and
- Ensuring that development is well designed and has minimal adverse impact on adjoining natural areas.

Similarly, the Yarrowlumla LEP 2002 aims to:

- Ensure planning controls encourage ecologically sustainable development; and
- Protect and conserve places of natural, historic and cultural significance, while maintaining agricultural productivity and flexibility in residential living styles.

The biodiversity management objectives of the Queanbeyan LEP 1998 and Yarrowlumla LEP 2002 are expressed most explicitly in the:

- National Park Zones – that apply to land which has been reserved or dedicated under the *National Parks and Wildlife Act 1974*; and
- Environmental Protection Zones - that aim to provide for the protection of environmentally sensitive land of visual significance, maintain the intrinsic scientific, scenic, habitat and educational values of natural and semi-natural environments, protect rivers, creeks and gully ecosystems, and protect threatened species.

Whilst these two zones most explicitly express efforts to manage biodiversity within the existing LEPs, they cover less than 25% of the LGA and many of the biodiversity and conservation values of the LGA are currently on lands zoned for other purposes, and primarily for rural or rural residential land-uses.

The interface between the existing zoning and the biodiversity values of the Queanbeyan LGA is reviewed in the following sections. The distribution of the various zoning categories throughout the LGA is shown in Figure 2 (Appendix A).

## **4.2 Existing Zones and Biodiversity**

### **4.2.1 National Park or Nature Reserves**

Areas zoned for National Parks occur predominantly in the northeast of Queanbeyan LGA around Carwoola and protect a substantial proportion of the relatively extensive areas of remnant native vegetation which occur in the locality. Cuumbeun Nature Reserve extends from the Scabbing Flat area to the south of Carwoola over a large corridor of remnant vegetation, predominantly Dry Forest, which connects vegetation in the north of Queanbeyan LGA with the vegetation along the Queanbeyan Escarpment and south along the eastern foreshores of Googong Reservoir. Wanna Wanna Nature Reserve occurs between Cuumbeun Nature Reserve and Stony Creek Nature Reserve and is surrounded by lands that have been developed for or are currently zoned to permit rural residential development. Stony Creek Nature Reserve lies in the northeast extremities of the study area, and is also relatively isolated from large patches of native vegetation nearby by rural lands or existing rural residential areas.

The only other National Parks estate within the LGA is Queanbeyan Nature Reserve which is located west of the suburb of Letchworth in the north-western extremities of the study area.

#### 4.2.2 Environmental Protection Zones

Those areas within the Queanbeyan LGA that are currently zoned for Environmental Protection include:

- Lands to the east of the suburbs of Larmer and Dodsworth and bushlands to the east associated with the Queanbeyan Escarpment and adjoining Cuumbeun Nature Reserve, and lands to the south-west of Cuumbeun Nature Reserve through to the north-eastern parts of Googong, including part of the Queanbeyan River corridor and connecting with the north-western foreshore of Googong Reservoir. These areas are known to support important biodiversity values including EECs, several threatened species, regionally significant vegetation communities and regionally significant flora and fauna species;
- Mount Jerrabomberra and lands to the east and south associated with Barracks Creek and to the east of the suburb of Jerrabomberra, and north and west of the Cooma Road Quarry linking with the Jerrabomberra Creek corridor;
- Remnant Dry Forest and Grassy Woodlands to the south-west of the Pemberton Hills on Tralee Station, and parts of the predominantly cleared lands to the north-east of Tralee Station. These areas link to lands zoned for Environmental Protection associated with the Jerrabomberra Creek corridor and Barracks Creek; and
- Remnant and regrowth Dry Forest, Native Grasslands and Grassy Woodlands associated with the Enchanted Hill area in the south-west of the LGA which is not currently linked with other lands zoned for Environmental Protection or National Parks.

The existing LEPs thus establish a more or less continuous band of lands zoned for Environmental Protection or National Parks stretching from the south-western parts of the LGA through Tralee, the northern parts of the Jerrabomberra Creek corridor, Barracks Creek, the Queanbeyan River Corridor and the Queanbeyan Escarpment. This band of protected lands links to the extensive areas of remnant native vegetation associated with the eastern foreshores of Googong Reservoir, and on lands to the south, and provides an important regional biolink linking many of the larger patches of remnant vegetation within the LGA and surrounds.

#### 4.2.3 Rural Residential Zones

A significant proportion of the Queanbeyan LGA is zoned for rural residential land uses including:

- A large area supporting extensive Dry Forests to the east of Cuumbeun Nature Reserve and surrounding Wanna Wanna Nature Reserve and Stoney Creek Nature Reserve in the Carwoola area;

- Predominantly heavily disturbed lands to the south of Wickerslack Lane and surrounding Tempe Crescent but also extending to partially cleared and grazed Dry Forests immediately to the south and joining the Queanbeyan River to the east; and
- Extensive areas of Grassy Woodlands, Dry Forests and to a lesser extent Native Grasslands which have been disturbed to various degrees in the upper catchments of Jerrabomberra Creek, Four Mile Creek and Guises Creek forming an extensive band from Fernleigh Park south through the Little Burra and Mount Campbell subdivisions and through the Beatty Hill and Enchanted Hill areas, to the southern borders of the LGA.

Whilst the existing rural residential zones include lands of low conservation value they also include extensive areas of remnant native vegetation, including EECs, threatened species habitats, and areas that are known to possess habitat values of conservation significance such as the Jerrabomberra Creek corridor. These lands also include records of threatened fauna species such as threatened reptiles and woodland birds.

In the Carwoola area, the existing rural residential zones are located in between the smaller conservation reserves of Wanna Wanna and Stoney Creek Nature Reserves and the more extensive areas of native vegetation associated with Cuumbeun Nature Reserve, the Queanbeyan Escarpment, Queanbeyan River Corridor and the Googong Foreshores. Thus, irrespective of their conservation values, the rural residential zoned lands in the Carwoola area are critical to the maintenance of biolinks to Wanna Wanna and Stoney Creek Nature Reserves and thus to the security of their conservation values in the long-term. Similarly, the existing rural residential zones in the southern parts of the LGA include a mosaic of remnant native vegetation in various condition states that comprise potential biolinks between that more extensive remnant native vegetation on the western and eastern margins of the southern and central parts of the Queanbeyan LGA.

#### **4.2.4 General Rural Zones**

Lands zoned for general rural land-uses include:

- The predominantly cleared and heavily grazed eastern parts of Tralee Station;
- The predominantly cleared and heavily grazed western foreshores of Googong reservoir;
- Lands to the east of the suburb of Larmer and north of the Kings Highway extending through to Burbong supporting a mix of Dry Forests and Grassy Woodlands in various condition states;
- Land to the south-east of the Gale Precinct on the eastern side of the Queanbeyan River around Valley Creek;

- “Environa”, the Poplars, and undeveloped lands to the south of Queanbeyan Nature Reserve which are known to support NTG, threatened and regionally significant flora species;
- Lands to the north of Fernleigh Park including parts of Cooma Road Quarry which support Box-Gum Woodlands and small areas of NTG;
- Crown Land at Royalla; and
- Forested lands on the eastern extremities of the Queanbeyan LGA south of Burra Road.

As with the rural residential zones lands, general rural zoned lands include areas that are known or likely to support important conservation values. Dependent upon the extent, both temporally and spatially, and nature of historic and ongoing agricultural landuses, general rural zoned lands may continue to support important occurrences of Box-Gum Woodlands or NTGs. These lands were the most sought after for grazing and, if grazing pressure has been relatively light, then these EECs may persist and be in Moderate to Good condition. This is known to be the case in the general rural zoned lands to the north of Fernleigh Park, in places on Tralee, Environa and the Poplars, and in the Royalla Travelling Stock Reserve (TSR) in the extreme south of the LGA.

In those area that are more heavily disturbed, important habitat values may be present in the form of patches of important threatened species habitats such as rock habitats for threatened reptiles, farm dams that provide potentially suitable water habitats for the Green and Golden Bell Frog, or isolated paddock trees that provide hollows for hollow dependent threatened fauna, or are “stepping stones” in local or regional biolinks.

#### **4.2.5 Residential and Other Zones**

Residential and other zones such as Industrial, Business and Open Space are concentrated around the Queanbeyan CBD and areas immediately adjacent. The biodiversity values of these areas are generally limited as a result of the historical and ongoing disturbances associated with the intensive land-uses permitted under these zonings. Notwithstanding this, there are likely to be some limited but significant biodiversity values in places where patches of less disturbed remnant vegetation remain, or where isolated remnant and regrowth trees occur. This is particularly likely to be the case on the fringes of the relatively new suburbs which in places like Jerrabomberra, Dodsworth and the Gale Precinct, abut lands supporting High Conservation Value vegetation.

The biodiversity values of many of these areas are assessed in detail in the Urban Bushland Reserve Survey for Queanbeyan (Barrer 1993).

## 5 DEFINING RELATIVE CONSERVATION VALUE WITHIN THE STUDY AREA

Vegetation of conservation value can be defined generally as vegetation containing important ecological features that make a significant contribution to the maintenance of biodiversity values.

Areas of HCV vegetation support one or more of the following general attributes:

- Over-cleared, poorly conserved or otherwise threatened vegetation communities;
- They area located within over-cleared Mitchell landscapes;
- They are in Moderate to Good condition;
- They provide other important ecological functions such as buffering HCV vegetation, linkages between habitats, creek bank stability and riparian protection.

Given these general attributes, HCV vegetation in the Queanbeyan LGA, can range from large areas of remnant native vegetation, such as those associated with the Queanbeyan Escarpment, to isolated small patches of vegetation *i.e.* small patches of NTG or Box-Gum Woodland.

By defining HCV vegetation, it is implicit that vegetation that is not HCV supports less important biodiversity values. However, these biodiversity values in many instances, whilst not ranking as HCV, may still be critical to the maintenance of biodiversity values within the LGA. As such, in the process of identifying the attributes of HCV vegetation, it is valuable to also identify the attributes of vegetation that supports otherwise important biodiversity values. For the purposes of this report this vegetation is referred to as Medium Conservation Value (MCV) vegetation.

Areas of MCV vegetation support one or more of the following general attributes:

- Important habitat for rare, threatened or migratory species;
- Important or scarce resources or habitats for the maintenance of biodiversity (*eg.* high quality tree hollows, rock or riparian habitats);
- Regionally significant vegetation communities;
- EECs in low condition; or
- Identified or potential local biolinks.

By defining and mapping HCV and MCV vegetation in the Queanbeyan LGA, appropriate management and development provisions can be targeted to support HCV and MCV vegetation and subsequently biodiversity values.

## **5.1 Mapping HCV Vegetation within Murrumbidgee CMA**

Using multi-criteria analysis based on existing regional biodiversity datasets, and with limited field validation, SKM (2007) undertook modelling and mapping of HCV vegetation throughout the upper Murrumbidgee catchment.

SKM (2007) defined HCV vegetation as:

“Specific landscape or ecological attributes defined in the Murrumbidgee Catchment Action Plan, including threatened species, populations and ecological communities, over cleared native vegetation communities or vegetation in over cleared landscapes, old growth forests and corridors, aquatic and riparian areas including wetlands and other areas of biodiversity significance including Aboriginal cultural heritage, habitat for migratory species and habitat for declining species, edge of range species habitat or species rich habitat.”

The model produced by SKM also incorporated parameters such as patch size and shape, proximity and connectivity analysis, the presence of threatened species records and ranked various classes within these parameters.

However, the SKM model was limited by the scale at which it was conducted and the absence of reliable data for important parameters such as vegetation condition, the presence or otherwise of key habitat attributes for threatened species, the presence of local corridors, and the presence or absence of EECs. The modelling by SKM relied on surrogates for these variables which limited the usefulness of the outcomes for strategic planning projects that require reliable data at a finer scale.

The data produced by SKM (2007), as shown in Figure 3, showed areas of HCV vegetation concentrated in the northeast of the Queanbeyan LGA, with additional large areas around Mount Jerrabomberra and scattered patches of HCV vegetation in the western, central and southern parts of the LGA.

Much of the HCV vegetation identified by SKM (2007) in the northeast of the LGA is already contained within Environmental Protection or National Park zones. However a large area contiguous with already protected areas is currently zoned for rural residential and general rural development. Patches of HCV vegetation in the south of the LGA are also zoned for rural development. Scattered areas of potential HCV vegetation were also identified throughout the southern half of the LGA.

## **5.2 Defining Relative Conservation Value within Queanbeyan LGA**

The definition of HCV vegetation for this study is based on similar criteria to the modelling completed for the Murrumbidgee CMA. However, this study also includes additional parameters that are relevant to the specific objectives of the QBS, and which were either beyond the scope of the Murrumbidgee CMA project or for which reliable datasets were not available.

This study included the capturing of datasets that will enable a more comprehensive assessment of the relative conservation values of vegetation within the study area such as:

- Vegetation condition;
- EECs extent and condition;
- Fauna habitat quality; and
- Local biolinks.

The key criteria determining conservation value are briefly described in Sections 5.2.1 – 5.2.8. These values are ranked in Table 7 which identifies the criteria defining HCV within the Queanbeyan LGA. Table 7 also identifies the attributes of MCV vegetation and Low Conservation Value (LCV) vegetation.

The ranking of conservation values recognises that whilst all vegetation supports biodiversity values to some extent, certain attributes increase the ecological importance and thus conservation priority of vegetation and associated habitats.

### **5.2.1 Endangered Ecological Communities**

As previously described, the Queanbeyan LGA supports two EECs, which are each of high conservation value due to the drastic declines in their pre-European extents. The condition of EECs also influences their conservation status with occurrences in Moderate to Good condition comprising HCV vegetation and occurrences that are in low condition or which comprise paddock trees comprising MCV vegetation.

### **5.2.2 Areas Zoned for Environmental Protection or National Parks**

Those areas currently zoned for Environmental Protection or National Parks are known to support biodiversity and other values of conservation significance and consequently are considered HCV vegetation.

### **5.2.3 Native Vegetation on Over-cleared Mitchell Landscapes**

Vegetation communities on Mitchell Landscapes where greater than 70% of vegetation has been cleared are considered to be HCV vegetation.



Within the Queanbeyan LGA, there are three Mitchell Landscapes; Canberra Plains, Upper Murrumbidgee Channels and Floodplains, and Molonglo Ranges. The estimated percentage of the Canberra Plains, Upper Murrumbidgee Channels and Floodplains, and Molonglo Ranges Mitchell Landscapes that are cleared is 83%, 88% and 44% respectively. Under these circumstances, any remnant vegetation on the Canberra Plains or Upper Murrumbidgee Channels and Floodplains Mitchell Landscapes that is not in Low condition, is considered HCV vegetation. These two Mitchell Landscapes cover approximately the northern half of the LGA.

#### **5.2.4 Over-cleared Vegetation Types**

Otherwise over-cleared vegetation types, as per the Murrumbidgee CMA vegetation types, are generally limited to those communities that comprise the Box Gum Woodland and NTG EECs. However the regionally declining vegetation community Eastern Tableland Moist Woodland on High Altitudes (Murrumbidgee CMA Vegetation Types), of which approximately 65% of its pre-European extent is estimated to be cleared, also occurs within the LGA. This community is known locally as Snow Gum Grassy Woodland.

#### **5.2.5 Riparian Corridors**

The riparian corridors of the Queanbeyan LGA, including Jerrabomberra Creek and the Queanbeyan River, comprise particularly important local and regional biolinks supporting a high complexity of landforms and habitats, including water and rock habitats, and a variety of vegetation communities. The riparian corridors within the Queanbeyan LGA support records of threatened flora and fauna species and are likely to be important corridors for the movement of fauna and exchange of genetic material, which is vital for the maintenance of biodiversity within the LGA generally. For these reasons, and for the ecosystem services they provide such as water quality and bank stability, riparian corridors are considered to support HCV vegetation.

#### **5.2.6 Buffers Supporting HCV Vegetation**

Vegetation that does not in itself comprise HCV vegetation, but provides a buffer supporting the long-term viability, recovery, enhancement or expansion of adjacent HCV vegetation is of high conservation value. These areas may mitigate threatening processes that are affecting HCV vegetation and the values they support and may in some instances, provide potential habitats where HCV vegetation, such as EECs or threatened species habitats, may be recovered in the medium to long-term. These areas may also comprise or be part of important local or regional linkages between HCV vegetation.

### **5.2.7 Regional and Local Biolinks**

Vegetation that provides important regional or local linkages between areas of vegetation is considered to be MCV vegetation. These areas include linear stretches of vegetation *i.e.* along roads or watercourses, or small, isolated clumps of trees, which can be utilised as “stepping stones” by mobile fauna species moving between disjunct areas of habitat. In some cases isolated individual trees, which may serve as a refuge for common and threatened species inhabiting or moving through open or highly disturbed areas, may also comprise important components of local biolinks.

### **5.2.8 Other Native Vegetation**

Native vegetation that is not HCV vegetation is considered to be MCV vegetation. Remnant native vegetation within the LGA may include other specific attributes of conservation significance such as:

- Known or potential habitat for threatened, regionally significant or migratory species including critical resources such as important foraging substrates, and sheltering or breeding habitat. This includes resources that may be scattered across landscapes dominated by LCV vegetation such as farm dams that may be important for threatened amphibians or waterbirds, small areas of rock habitats suitable for threatened reptiles, and isolated hollow-bearing trees.
- Vegetation of regional significance because it comprises unusual or rare vegetation assemblages or regional variants of more widespread vegetation communities.

MCV vegetation is also inherently important for the maintenance of biodiversity generally providing important ecosystem services and resources for the myriad of species which are currently considered to be of lower conservation significance, but nonetheless are important components of the characteristic biodiversity values of the Queanbeyan LGA.

**Table 7: Attributes of High, Medium and Low Conservation Value Vegetation within the QLGA**

<b>Parameter</b>	<b>Attributes</b>	<b>Value</b>
<b>Endangered Ecological Communities (Moderate to Good Condition)</b>	Box- Gum Woodland and NTG in Moderate to Good condition.	HCV
<b>Areas Zoned for Environmental Protection or National Parks</b>	Areas currently zoned as Environmental Protection or National Parks under the LEPs applying to the LGA and are known to support important biodiversity values.	HCV
<b>Vegetation on Over-cleared Mitchell Landscapes</b>	Remnant native vegetation not in low condition on the Canberra Plains or Upper Murrumbidgee Channels and Floodplains Mitchell Landscapes.	HCV
<b>Over-cleared Murrumbidgee CMA Vegetation Types</b>	Any Box- Gum Woodland, NTG or Snow Gum Grassy Woodland vegetation.	HCV
<b>Buffers supporting HCV Vegetation</b>	Vegetation supporting HCV, mitigating the effects of threatening processes, or providing other important ecosystem services.	HCV
<b>Riparian Corridors</b>	Riparian corridors supporting important habitats and known populations of threatened species and comprising important corridors for the movement of fauna and the exchange of genetic material. Important riparian corridors within the Queanbeyan LGA include the Queanbeyan River, Molonglo River, Jerrabomberra Creek, and some other creeks such as Four Mile Creek, Church Creek, Barracks Creek and Scabbing Flat Creek.	HCV
<b>Endangered Ecological Communities (Low Condition or Paddock Trees)</b>	Box- Gum Woodland and NTG in low condition or consisting of paddock trees.	MCV
<b>Regional or Local Biolinks between important Habitats</b>	May include vegetation that provides linkages or stepping stones between larger or otherwise important habitats. These areas are likely to be important corridors for the movement of fauna and support important remnant vegetation and habitats for threatened, regionally significant and migratory species.	MCV
<b>Other Native Vegetation</b>	Includes vegetation that is important for the maintenance of biodiversity generally, known and potential habitat for threatened, migratory and regionally or locally significant species, and regionally significant vegetation communities.	MCV
<b>Low Value Vegetation</b>	Areas that do not support native vegetation or habitats or habitats for native fauna.	LCV

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## 6. RESULTS OF FIELDWORK

The results of the vegetation verification and targeted field work undertaken for the study are identified in Section 6. The results are synthesised into a discussion of the distribution of threatened ecological communities, threatened flora, and key fauna habitats within the detailed investigations areas. Key regional and local biolinks are also identified.

The datasets captured during the field work comprise a number of the key criteria for determining relative conservation values across the study area as defined in Section 5. Those key criteria datasets that are not primarily the outcome of the fieldwork undertaken for the study are discussed in Section 7, as is the results of the conservation value mapping.

### ***6.1. Vegetation Verification and Condition Mapping***

The verified and updated vegetation mapping of Fallding (2002) is presented in Figure 4 (Appendix A).

The vegetation mapping verification supported the bulk of the Fallding (2002) mapping in those areas predominately mapped as supporting Dry Forests, such as in the Carwoola area, in the Mount Jerrabomberra and Barracks Creek areas, and on the south-eastern fringes of the study area south of Burra Road. Some changes were made to the boundaries between vegetation communities however the general pattern and location of the communities was confirmed.

The verification resulted in substantial changes to both the broad vegetation community classes and the location of boundaries between vegetation communities in many locations in the central and southern parts of the study area. Generally, it was observed that the mapping of Fallding (2002) over-estimates the extent of Box-Gum Woodlands, which whilst often including Yellow Box and occasionally Blakley's Red Gum, were often found to be dominated by canopy species characteristic of the Dry Forests such as Red Box, Brittle Gum, Scribbly Gum, Mealy Bundy and in the groundcover by species such as Red-anthered Wallaby Grass. Whilst examples of this situation occurred in the Burbong, Carwoola and Mount Jerrabomberra areas, it was more prevalent in the central and southern parts of the study area including:

- In the higher parts of Beatty Hill and Enchanted Hill;
- On the ridge to the north of Burra Road, through east of Mount Campbell Estate north along Old Cooma Road to the Swan Feature;
- In the hills to the east of the Little Burra Estate north to Burra Road;
- To the west and south-west of the Cooma Road Quarry;
- On the northern slopes of Mount Jerrabomberra, and
- To a lesser extent in places in the Burbong and Carwoola areas.

Similarly, Fallding (2002) was found to over-estimate the extent of Native Grasslands on the lower lying areas associated with Jerrabomberra Creek and tributaries south and east of Old Cooma Road, north to Burra Road, and in the catchment of Guises Creek. The Native Grasslands mapped by Fallding (2002) in these areas were found to be generally pasture improved, previously ploughed and cropped, and predominantly dominated by exotic species.

Conversely, Fallding (2002) appears to underestimate the extent of the Grassland Woodland Mosaic vegetation community associated with the lower slopes of Beatty Hill, the western parts of Fernleigh Estate, and the Jerrabomberra Creek and Four Mile Creek corridors. The vegetation in these areas correlates well with the Grassland Woodland Mosaic given the fine scale mosaic of Native Grasslands in various condition states, Snow Gum Grassy Woodlands, Box-Gum Woodlands and small patches of Dry Forest.

The mapping of secondary grasslands and areas dominated by non native vegetation (in all strata) was generally observed to be accurate, however with a few exceptions, the most notable of which included:

- The areas of Native Grassland and Secondary Grasslands to the east and west of Old Cooma Road south of Burra Road. These areas were found to support predominantly exotic pastures or Box- Gum Woodlands in Low condition.
- The Secondary Grasslands in the Guises Creek Catchment to the east of the Cooma Railway Line. These areas were found to support predominantly exotic pastures.

However, there were a number of other examples of native vegetation being mapped by Fallding (2002) as small polygons of non-native vegetation.

Condition classes were mapped consistent with the Biometric vegetation condition classes (Gibbons *et. al.* 2005). As a result most areas mapped as Secondary Grasslands by Fallding (2002) were classified as comprising Moderate to Good occurrences of the particular broad vegetation community. In general, it is only those relatively limited areas within the study area where repeated efforts at pasture improvement or repeated cropping, or where housing, quarrying, roads or other major disturbances to the substrate have occurred, that meet the definition for Low condition vegetation. This is the case as, even where there has been extensive or even total removal of the canopy and long-term heavy grazing, native pastures usually persist, at least to the extent where they comprise more the 50% of the perennial groundcover.

Those areas where Low condition vegetation communities were recorded were limited primarily to a few areas formerly supporting Native Grasslands or Box-Gum Woodlands in low-lying parts of the landscape, predominately in the upper catchments of Jerrabomberra Creek and Guises Creek, as shown in Figure 4 (Appendix A). However, Low condition Box-Gum Woodland also occurs in more undulating conditions where there has been intensive or long-term rural residential subdivision such as in the Gale Precinct south of Wickerslack Lane.

The relative extent of the various vegetation classes of Fallding (2002) and validated for this report are identified in Table 8.

**Table 8: Relative extent of vegetation communities within the study area**

Vegetation Community	Fallding (2002) (ha)	BES 2008 (ha)
Box-Gum Woodland	2730	2807
Dry Forest	2607	5277
Grassland-Woodland Mosaic	1230	1394
Native Grassland	373	132
Secondary Grassland	4450	-
Non Native Vegetation	3659	3681
<b>Total</b>	15049 ha	13291 ha

## 6.2. Endangered Ecological Communities

The mapping of EECs within the detailed investigation areas identified occurrences of the Box-Gum Woodland and NTG as identified in Figure 5 (Appendix A) and discussed below. In some instances, such as along the Jerrabomberra Creek corridor north of Old Cooma Road, there is a fine scale mosaic of small patches of NTG, Snow Gum Grassy Woodlands and Dry Forests, amongst Box-Gum Woodland, such that distinguishing between areas that comprise either EEC or are not the EEC, would be very labour intensive. In this area, only larger patches of Dry Forest were excluded from the EEC mapping. The patches of Snow Gum Grassy Woodlands were generally less than a hectare in size and surrounded by NTG or Box-Gum Woodland such that it was practical to map this area as a mix of the NTG and Box-Gum Woodland EECs. This approach does not affect the conservation value mapping as Snow Gum Grassy Woodlands meet the definition of HCV given that this community is over-cleared in the Molonglo Ranges Mitchell Landscape.

### 6.2.1. Box-Gum Woodland

Notwithstanding the over-estimation of the distribution of Box-Gum Woodland by Fallding (2002) in places, as identified in Section 6.1, the Box-Gum Woodland EEC was found to be present in a number of locations including:

- In the Burbong area in the lower slopes associated with the Molonglo River and some tributaries. These occurrences whilst thinned and grazed were in Moderate to Good condition;
- On the broad valleys associated with the upper catchment of Scabbing Flat Creek predominantly to the south of Captains Flat Road and the east of Wanna Wanna Road. Parts of this occurrence are in Low condition, however the bulk is in Moderate to Good condition;

- In association with the tributary of Valley Creek that runs parallel and north of Wanna Wanna road and through “Frog Hollow”. This occurrence is generally in Moderate to Good condition;
- South of Wickerslack Lane to Tempe Crescent in the Gale Precinct. Much of this occurrence is in Low condition;
- In association with the mid-slopes in the northern parts of Fernleigh Park Estate, the lower slopes in the Mount Campbell Estate and areas associated with Jerrabomberra Creek south to Old Cooma Road, the mid to lower slopes of Beatty Hill, “Pingarra”, and south to the Royalla TSR and Crown Lands. Much of the Box-Gum Woodlands in these areas are in Moderate to Good condition, with some areas such as the Royalla TSR and Crown Lands supporting particularly good condition occurrences both structurally and floristically. In the Fernleigh Park Estate and Beatty Hill areas and along Jerrabomberra Creek south to Old Cooma Road the Box-Gum Woodlands often form a mosaic with patches of NTG, and native pastures derived from NTG, Snow Gum Grassy Woodlands, and Dry Forests. These areas were mapped as the Grassland Woodland Mosaic broad vegetation community.
- In places on the lower and in some instances mid-slopes of the ranges to the east of the Little Burra Estate north to Burra Road. These occurrences are predominately in Moderate to Good condition although on the lower slopes they have been thinned and grazed almost to the point of being in Low condition.

As discussed in Section 6.1 some of the areas mapped by Fallding (2002) as supporting Box-Gum Woodland were found not to comprise the EEC. This was predominantly due to a lack of evidence to support a conclusion that Yellow Box or Blakley’s Red Gum or a combination of both ever dominated the canopy, or were co-dominant. In many instances whilst Yellow Box was present, it was only as a minor component and Blakley’s Red Gum was generally rare within the detailed investigation areas. Similarly, in many instances the understorey was found to be too shrubby and dominated by shrubs more typically associated with Dry Forests rather than the shrubs associated with post disturbance regrowth in the EEC, such as the colonising Wattles *Acacia* spp. and Dogwoods *Cassinia* spp.

### **6.2.1. Natural Temperate Grasslands**

The identification of NTG within the study area was undertaken with reference to both the definition in the NTG recovery plan (Environment ACT 2005) and the NTG assessment method (Version 7 October 2007) produced by Rainer Rehwinkel of DECC.

Areas of NTG were identified at a number of locations within the detailed investigation areas. These areas were:

- In the far north-eastern corner of the study area in the Burbong area in association with the Molonglo River corridor. The NTG in this area was found to be predominately of high conservation value.
- In association with the mid and lower slopes of the south-western, southern and south-eastern slopes of Beatty Hill. The NTG in this area was found to be predominately of high conservation value although areas of moderate and lower conservation value are present predominantly on the margins with areas where grazing or other disturbances have been more intensive.
- In the Fernleigh Park Estate in the mid and lower slopes to Jerrabomberra Creek. There is a fine scale mosaic of NTG in various condition states in this area with some areas of high conservation value persisting on those allotments where there has not been intensive grazing of horses, mowing, landscaping or other disturbances since the subdivision was occupied. Areas of moderate and lower conservation value are present where heavy grazing has continued or has historically been more intensive.
- In patches along Jerrabomberra Creek north of Old Cooma Road, extending to the northern boundary of Fernleigh Park Estate and beyond. These patches of NTG occur in a mosaic of patches of Snow Gum Grassy Woodlands, Box-Gum Woodland and Dry Forests or secondary grasslands derived from these communities.

The Native Grasslands mapped by Falding (2002) in the Royalla and Little Burra area in association with the low lying areas to the east of Jerrabomberra Creek were found to be highly modified having been cropped and or pasture improved over many years. In this area NTG was found to be locally extinct.

### **6.3. Over-cleared Vegetation Communities**

Small patches of the over-cleared vegetation community Snow Gum Grassy Woodland, where identified in the southern parts of the detailed investigation area in association with NTG, Box-Gum Woodlands and mosaics of these communities. Snow Gum Grassy Woodlands were recorded in:

- Small patches on the margins of Box-Gum Woodland and NTG in the Guises Creek catchment in the Royalla area, including on the Royalla TSR and crown lands; and
- Amongst a mosaic of NTG and Box-Gum Woodland along Jerrabomberra Creek mainly north of Old Cooma Road.

The patches of Snow Gum Grassy Woodland were generally less than a hectare in size and as such were not mapped individually where they occurred in a mosaic of EECs.



## **6.4. Threatened Flora**

Two threatened flora species, Silky Swainson-pea *Swainsona sericea* and the Hoary Sunray *Leucochrysum albicans* subsp. *albicans* var. *tricolor*, were detected within detailed investigation areas.

No other threatened flora species were detected during the survey period

### **6.4.1. Silky Swainson-pea**

The Silky Swainson-pea was detected at a number of locations in association with patches of NTG. The species was recorded:

- In NTG adjacent to Jerrabomberra Creek in the Fernleigh Park Estate and south towards Old Cooma Road;
- In NTG on the south-western slopes of Beatty Hill; and
- In grassy woodland in the north of the Royalla Crown Lands.

Where it was recorded, the species was generally in low abundance with usually only two or three, but some times up to ten or so individuals recorded at any one site. This is consistent with other observations of its distribution and abundance within the Southern Tablelands where it is still relatively common although not abundant in less disturbed grassy woodlands and grasslands (Rehwinkel. R. pers. comm., 2007).

### **6.4.2. Hoary Sunray**

The Hoary Sunray is relatively common and even abundant in parts of the Queanbeyan LGA, particularly in the northern and central areas around Barracks Creek, the Gale Precinct and north through Cuumbeun NR, and the Ridgeway Estate. The Hoary Sunray was less abundant in the detailed investigation areas, particularly in the south.

The Hoary Sunray was recorded at a number of locations including:

- In the Carwoola area in road reserves and less heavily grazed areas near the junction of Wanna Wanna Road and Captains Flat Road, to the south of Captains Flat road in the Stony Creek catchment, and adjacent to the Kings Highway, .
- Sporadically throughout the Gale Precinct south of Wickerslack Lane;
- On the lower eastern slopes of Mount Campbell adjacent to Old Cooma Road; and
- In grassy woodland in the north of the Royalla Crown Lands.

Where it was detected the species was generally abundant persisting in areas that are not heavily grazed and as such commonly occurring in road reserves and grassy woodlands and dry forests that have a history of lighter grazing.

## **6.5. Threatened Fauna**

Four threatened fauna species were detected during the survey period, the Eastern bentwing-bat, Greater Broad-nosed Bat, Pink-tailed Worm Lizard and the Speckled Warbler. The targeted fauna surveys also included fauna habitat assessments which identified good quality potential habitat for threatened fauna species in a number of locations within the detailed investigation areas. The following sections described the relative value of the habitats within these areas for specific threatened fauna species in the context of fauna guilds.

### **6.5.1 Microchiropteran Bats**

Two threatened hollow-dependent microchiropteran bat species were recorded during the targeted surveys: the Eastern Bentwing-bat and Greater Broad-nosed Bat. Both species were detected via the analysis of echolocation calls, although the Greater Broad-nosed Bat was only identified to a possible (rather than confident) level. Suitable foraging habitat is present throughout the study area for both species, and scattered roosting resources exist for the Greater Broad-nosed Bat, although this species is not regularly recorded in the Queanbeyan area.

The targeted surveys and habitat assessments suggest that the detailed investigation areas generally do not provide higher quality habitats for threatened microchiropteran bat species given the general paucity of potential winter roosting and breeding habitat even where there are patches of remnant forest and woodland. However, the mosaic of remnant Dry Forest in the Carwoola area provides a greater abundance of potential winter roosting and breeding habitat, as do the adjacent Nature Reserves. These areas also provide reasonable foraging habitat, given the relatively good condition and connectivity of the remnant and regrowth vegetation in this area. Both Eastern Bentwing-bat and Greater Broad-nosed Bat were detected in the Carwoola area. As such the remnant forest and woodland on private property in the Carwoola area is likely to be important foraging habitat for any local populations that may be centred around the better quality roosting and breeding habitats associated with the Nature Reserves.

There is some better quality foraging habitats in the more heavily wooded areas in the central and southern parts of the study area in the Mount Campbell area, where the Eastern Bentwing-bat was detected, and to the east of Little Burra and Royalla. These areas also support a number of hollow bearing trees so there is also potential winter roosting and breeding habitat.

### **6.5.2 Other Mammals**

No other threatened mammals were recorded during the targeted surveys however potential habitat for the Koala, and to a lesser extent the Spotted-tailed Quoll, is present within the detailed investigation areas, particularly in the Carwoola area. The Carwoola area is characterised by a mosaic of regrowth and remnant vegetation which provides quite extensive areas of habitat similar to the Queanbeyan Escarpment and eastern foreshores of Googong Reservoir, where there is a recent Koala record, and records of the Spotted-tailed Quoll. The

native vegetation on private land in the Carwoola area also continues to provide connectivity between habitats in Cuumbeun NR and potential habitat in the Stony Creek and Wanna Wanna Nature Reserves.

Habitat for the Spotted-tailed Quoll in the Carwoola area may be limited to some extent by a low abundance of hollow-bearing trees in places. However, hollow-bearing trees are present on the private property in the Carwoola area, and are in reasonable abundance within the Stony Creek Nature Reserve.

Habitat for the Koala and Spotted-tailed Quoll elsewhere in detailed investigation areas is generally limited to:

- The Jerrabomberra Creek corridor north of Old Cooma Road through to Mount Campbell where the mosaic of remnant woodlands and grasslands provide some marginal habitat for the Koala. However there are reasonable linkages to more extensive areas of potential habitat associated with the remnant vegetation in the Mount Jerrabomberra – Barracks Creek area and on the Maclean, Robin and Talpa properties;
- The remnant vegetation in the eastern extremities of the Royalla – Little Burra – through to Burra Road areas which are contiguous with extensive areas of potential habitat associated with the hills in the Mount Butler area.

Elsewhere the habitats for the Koala and Spotted-tailed Quoll are limited by the general absence or limited extent of suitable foraging habitats and/or fragmentation as a result of extensive clearing and existing rural residential development.

### **6.5.3 Woodland Birds**

Only one threatened woodland bird was recorded during the survey period, the Speckled Warbler, which was detected adjacent to Jerrabomberra Creek in the Fernleigh Estate. However the detailed investigation areas support areas of potentially suitable habitat for threatened woodland birds such as the Brown Treecreeper, Diamond Firetail, and Hooded Robin which are all known from the Queanbeyan LGA. Again, the relatively extensive remnant and regrowth vegetation in the Carwoola area, remnant vegetation in the eastern extremities of the Royalla – Little Burra – through to Burra Road areas, and the Jerrabomberra Creek corridor north of Old Cooma Road, appear to provide the most extensive areas of potential habitat given their connectivity with larger areas of potential habitat. Elsewhere, patches of suitable habitat are generally more fragmented and are more likely to be used more irregularly or when individuals are dispersing.

Potential habitats for the Superb Parrot, Swift Parrot and Regent Honeyeater are reasonably widespread within detailed investigation areas although none of these species has been recorded within the Queanbeyan LGA, and were not detected during the survey period. Even in highly modified areas, there is generally some potential breeding habitat for the Superb Parrot in the hollow-bearing remnant trees and stags that occur sporadically throughout the landscape.

#### **6.5.4 Threatened Cockatoos**

The detailed investigation areas do not support good quality habitats for either the Glossy Black-cockatoo or the Gang-gang Cockatoo. There are only very limited stands of She-oak feeding resources for the Glossy Black-cockatoo with a few She-oak individuals occurring to the east of Tempe Crescent in the Gale area, on the upper eastern slopes of Beatty Hill, and in the hills to the east of the Royalla and Little Burra Estates. No evidence of feeding activity was observed and these resources are so limited that they are unlikely to be utilised by the species. Given the limited extent of foraging resources it is considered unlikely that the species would breed in the detailed investigation areas.

There is far more potential foraging habitat for the Gang-gang Cockatoo and the species is likely to forage from time to time in the more heavily wooded parts of the detailed investigation areas. It is possible that the species may also breed there, given that there are some hollow-bearing trees, however the species is thought to prefer taller forests with an abundance of old growth attributes. The higher quality potential breeding habitat is likely to be associated with the more heavily wooded areas such as those in the Carwoola area, to the south of Captains Flat Road, around Mount Campbell, and in the hills to the east of Royalla and Little Burra Estates.

#### **6.5.5 Owls**

No evidence of threatened owls such as the Masked Owl, Powerful Owl or Barking Owl was found in the study area, and with the possible exception of the Barking Owl, the habitats within the study area are of relatively poor quality for threatened owls. The poor quality of the habitats for threatened owls in the detailed investigation areas generally relates to the scarcity of suitable breeding and sheltering habitat and limited prey availability. The habitats in the remnant forests and woodlands in the Carwoola area and in association with the extensive areas of remnant vegetation in association with the Queanbeyan Escarpment and areas to the south, appear more suitable for the Barking Owl, however these habitats are also only likely to be marginal for the species.

#### **6.5.6 Reptiles**

The detailed investigation areas were found to support known habitat for the Pink-tailed Worm Lizard, and good quality potential habitat for the Rosenberg's Goanna. Potential habitat for the Grassland Earless Dragon, Striped Legless Lizard, and Little Whip Snake was also recorded in a number of locations.

### ***Pink-tailed Worm Lizard***

The Pink-tailed Worm Lizard was detected in three locations:

- In association with the high quality NTG on the south-western parts of Beatty Hill;
- In heavily grazed regrowth Dry Forest dominated by Red Box on a spur leading down to the Queanbeyan River to the east of Tempe Crescent in the Gale Precinct; and
- In high quality Grassland Woodland Mosaic on the northern margins of Fernleigh Estate.

The presence of the Pink-tailed Worm Lizard in habitats that have been subject to heavy historic and ongoing grazing such as the site in the Gale Precinct, suggests that potential habitat for the species occurs wherever suitable rock habitats are present within the detailed investigation area. Field observations during the survey period suggest that suitable rock habitats are widespread within the detailed investigation area, but may often be limited to small patches of less than half a hectare, amongst larger areas where suitable rock habitats are absent.

However the most extensive areas of potential habitat for the species in the detailed investigation areas are:

- In association with Beatty Hill;
- In the Burbong area in association with the NTG and Box-Gum Woodlands associated with the Molonglo River and the mosaic of Dry Forests and Box-Gum Woodlands north and south of the Kings Highway;
- In the grasslands and grassy woodlands in Fernleigh Estate and south along the Jerrabomberra Creek corridor to Old Cooma Road; and
- On the slopes to the Queanbeyan River south of Wickerslack Lane and east of Tempe Crescent.

These locations all retain connectivity with known or potential habitat for the species.

### ***Rosenberg's Goanna***

Good quality potential habitat for Rosenberg's Goanna occurs in two locations within the detailed investigation areas:

- In the Carwoola area where the mosaic of regrowth and remnant Dry Forests on private property provide extensive areas of habitat similar to those associated with the Queanbeyan Escarpment and Mount Jerrabomberra, where there are recent records of the species. The Carwoola area also supports many termite mounds which are required by the species for breeding; and

- The remnant vegetation in the eastern extremities of the Royalla – Little Burra – through to Burra Road area, which is contiguous with extensive areas of potential habitat associated with the ranges to the north and south of Mount Butler. This area supports extensive Dry Forests, generally with good sheltering habitats amongst the groundcover and abundance of fallen timber, and also supports a relative abundance of termite mounds.

Whilst no direct evidence of the species was observed in either of these areas, both support an abundance of suitable habitat and retain connectivity with habitats where the species has been recorded. Elsewhere, the detailed investigation areas generally support vegetation communities lacking suitable sheltering and nesting habitats.

### ***Grassland Earless Dragon, Striped Legless Lizard, and Little Whip Snake***

These species are associated primarily with NTG and Box-Gum Woodlands with sheltering habitats such as tussocky grasses, partially imbedded rocks and timber, cracking soils and arthropod holes. Each species has been found in habitats that have been modified to some extent such as secondary grasslands and areas that have been invaded by exotic groundcovers.

The most extensive areas of potential habitat for the Grassland Earless Dragon, Striped Legless Lizard, and Little Whip Snake are present primarily in the same areas as the better quality habitats for the Pink-tailed Worm Lizard. However, none of these species were detected during the survey period and, with the exception of the Grassland Earless Dragon, there are few records from the Queanbeyan LGA. Habitats for these species elsewhere within the detailed investigation areas appear to be marginal.

### **6.5.7 Amphibians**

Targeted surveys during the survey period did not result in the detection of any threatened amphibians in the detailed investigation areas, however potentially suitable habitat for the Green and Golden Bell Frog was found in the following locations:

- Along Jerrabomberra Creek and tributaries south of Fernleigh Estate to the southern boundary of the study area;
- In the lower parts of Guises Creek;
- In association with the Molonglo river in the extreme north-east of the study area; and
- In farm dams throughout the study area.

This species has undergone a well documented drastic range reduction in recent decades and was thought to be extinct in the southern tablelands prior to the recent discovery of a population in the Captains Flat area. In the absence of intensive targeted surveys it is difficult to

unequivocally rule out the presence of the species within the study area. This is particularly the case given the large numbers of potentially suitable waterbodies within the detailed investigation areas, particularly the many dams supporting emergent vegetation and suitable refugia. Many of these dams are close to watercourses such as Jerrabomberra Creek and Guises Creek, that also support potential habitat for the species. As such, whilst it is unlikely that the detailed investigation areas support large populations of threatened amphibians, it is possible that species such as the Green and Golden Bell Frog and Southern Bell Frog may continue to persist in localised areas of suitable habitat associated with Jerrabomberra Creek, Guises Creek and the Molonglo River, and wherever there are farm dams supporting preferred habitats.

### **6.5.8 Golden Sun Moth**

Targeted surveys for the Golden Sun Moth did not result in the detection of any individuals during the survey period. However, weather conditions during the survey period were generally marginal or unsuitable owing to rain or cloud during the optimal midday survey conditions.

However the detailed investigation areas were found to support good quality potential habitat for the Golden Sun Moth:

- In association with NTG and secondary grasslands on Beatty Hill;
- In the Burbong area in the NTG and Box-Gum Woodlands associated with the Molonglo River and the Box-Gum Woodlands to the immediate north and south of the Kings Highway; and
- In the grasslands and grassy woodlands in Fernleigh Estate and south along the Jerrabomberra Creek corridor to Old Cooma Road.

The potential habitat on Beatty Hill is approximately 100 m above the elevation of the highest known site of the Golden Sun Moth (Thompson and Mullins 2004), however the slightly higher elevation is not considered sufficient to discount the species given the presence of suitable habitat, and the presence of known populations to the north on the Robin property.

## **6.6 Migratory Species**

Only one listed migratory species was detected during the survey period, the Painted Snipe, with one individual being flushed from a small disturbed wetland dominated by tussock grasses in the lower parts of Guises Creek, in the extreme south-west of the study area. The individual is likely to have been using this small wetland area temporarily on route to more extensive habitats elsewhere. Within the detailed investigation areas similar tussocky wetlands were not observed elsewhere, however the species could potentially occur at least temporarily in the river corridors and in some of the larger dams within the study area where a suitable cover of emergent and fringing vegetation is present.

## **6.7. Fauna Habitat Assessments**

The targeted fauna surveys and habitat assessments enabled an assessment of the relative value of the fauna habitats across the detailed investigation areas. On the basis of this assessment, and an analysis of the existing biodiversity data identified in the background research, those areas supporting higher quality fauna habitats were identified and mapped as shown in Figure 6 and described below.

**Carwoola – Burbong** - The remnant native vegetation communities on private property in the Carwoola - Burbong area support a relatively extensive area of potential habitat for threatened microchiropteran bats, Koala, threatened woodland birds, the Gang-gang Cockatoo and Rosenberg's Goanna. There are also less extensive potential habitats for other threatened reptiles such as the Pink-tailed Worm Lizard, and in the Burbong area, some potential habitat for the Golden Sun Moth.

These habitats retain good connectivity to the extensive areas of remnant native vegetation in Cuumbeun NR and are characterised by a predominance of native vegetation in Moderate to Good condition. Whilst there is much post clearing regrowth, there is a reasonable abundance of older hollow-bearing trees in the landscape, generally good sheltering opportunities in dense groundcover and understorey vegetation, a reasonable abundance of fallen timber and rock habitats, and an abundance of termite mounds. As such this area in addition to supporting extensive areas of potential foraging habitat also supports potential breeding and sheltering habitat for a range of threatened fauna.

**Fernleigh Estate – Mount Campbell Estate** – The mosaic of Native Grasslands, grassy woodlands and Dry Forests in Fernleigh Estate and south to the Mount Campbell Estate provide known habitat for the Pink-tailed Worm Lizard and potential habitat for Golden Sun Moth. There is also potential habitat for threatened woodland birds such as the Speckled Warbler which was recorded during the survey period in Jerrabomberra Creek immediately to the east of Fernleigh Estate. The Fernleigh Estate is characterised by a mosaic of remnant native vegetation in Moderate to Good condition, including high conservation value NTG, and areas that have been highly modified, primarily in association with existing rural residential development. However there is generally reasonable connectivity between the better quality habitats and connectivity to the high quality habitats along Jerrabomberra Creek and the remnant vegetation on Maclean and Robin Properties and lands to the north.

**Jerrabomberra Creek Corridor** – The corridor of Jerrabomberra Creek south of Fernleigh Estate and north of Old Cooma Road supports a mosaic of remnant native vegetation in Moderate to Good condition, including high conservation value NTG, Box-Gum woodlands, Snow Gum Grassy Woodland, Dry Forests and to a lesser extent, areas that have been highly modified through heavy grazing, cropping and pasture improvement. This area includes potential habitats for the Pink-tailed Worm Lizard, Golden Sun Moth, and a range of woodland



birds and microchiropteran bats. There is also potential habitat for threatened amphibians such as the Green and Golden Bell Frog in places in Jerrabomberra Creek. The habitats within the Jerrabomberra Creek Corridor are well connected to high quality fauna habitats associated with Fernleigh Estate, Mount Campbell Estate, Beatty Hill and, beyond the detailed investigation areas, areas to the north of Fernleigh Estate along Jerrabomberra Creek and on the Maclean and Robin properties.

**Beatty Hill** – Beatty Hill supports relatively extensive areas of high conservation value NTG and a mosaic of Box-Gum Woodlands and Dry Forests. These include known habitat for the Pink-tailed Worm Lizard and potential habitat for Golden Sun Moth. This area also provides potential habitat for other threatened reptiles such as the Grassland Earless Dragon, Striped Legless Lizard, Little Whip Snake and some threatened woodland birds.

The habitats associated with Beatty Hill retain good connectivity to the north along the riparian corridors of Jerrabomberra Creek and Four Mile Creek and to a lesser extent to the south through the existing rural residential development and adjacent properties to Royalla TSR and crown lands. There is also some connectivity across secondary grasslands to the extensive areas of remnant vegetation associated with Enchanted Hill.

**Royalla TSR and Crown Lands** – Royalla TSR and adjacent crown lands support the best condition Box-Gum Woodland in the study area. However, this area supports only a relatively low abundance of hollow-bearing trees, and provides mainly foraging habitat for threatened woodland birds and microchiropteran bats.

**East of Royalla and Little Burra** – A band of remnant and regrowth Box-Gum Woodland and Dry Forests characterise the eastern extremities of the detailed investigation areas south of Burra Road. These communities are associated with the ranges and foot-slopes north of Mount Butler and include habitats for a range of threatened fauna species and in particular potential habitat for threatened microchiropteran bats, Koala, threatened woodland birds, the Gang-gang Cockatoo, and Rosenberg's Goanna.

These areas include some hollow-bearing trees, good sheltering habitats amongst the dense groundcover and fallen timber that occurs particularly on the eastern margins, rocky outcrops and many termite mounds. The Box-Gum Woodlands on the lower slopes generally do not support a particularly diverse groundcover flora however there is a high cover of Wallaby Grass indicating potential habitat for the Golden Sun Moth.

The habitats in this area are contiguous with the extensive areas of remnant native vegetation to the east but are separated from better condition fauna habitats to the west by the extensive areas of predominantly exotic pasture east of Jerrabomberra Creek and Old Cooma Road south of Burra Road.

**Queanbeyan River Corridor** – The Queanbeyan River corridor and areas immediate adjacent to the south of the Wickerslack Lane and east of Tempe Crescent support predominantly regrowth Dry Forests that provide some potential foraging habitats for threatened

microchiropteran bats, Koala, threatened woodland birds, the Gang-gang Cockatoo, and Rosenberg's Goanna, but also known habitat for the Pink-tailed Worm Lizard. This area is part of the regional biolink along the Queanbeyan River and part of the local biolink linking the Queanbeyan River to Jerrabomberra Creek through the properties north of Googong *i.e.* Talpa and west of Old Cooma Road *i.e.* Maclean and Robin.

## **6.8. Biolinks**

The field work and desktop analyses identified a number of important local and regional biolinks. These biolinks are important because they provide linkages between larger or important areas of habitat, and thus provide opportunities for animals and plants, to disperse to access resources or to exchange genetic material.

In general the biolinks identified are characterised by mostly continuous links of remnant native vegetation in Moderate to Good condition. However some biolinks currently have substantial disruptions to connectivity which would require changes to current land management practices and, in some cases, active revegetation to realise their potential as biolinks.

### **6.8.1 Regional Biolinks**

Important regional biolinks identified during this study are described below and identified in Figure 7 (Appendix A):

- The extensive area of remnant native vegetation extending from the Molonglo River, south along the Queanbeyan Escarpment, Queanbeyan River corridor, eastern foreshores of Googong Reservoir and south along the ranges in the south-eastern extremities of the Queanbeyan LGA.
- The remnant vegetation along Barracks Creek linking the Queanbeyan Escarpment, Queanbeyan River corridor and contiguous vegetation to the south with remnant vegetation and associated habitats in the Mount Jerrabomberra and Jerrabomberra Creek corridor.
- The remnant vegetation and associated habitats along Jerrabomberra Creek south to Beatty Hill and south through the Beatty Hill Estate and Little Burra Estate to the remnant Box-Gum Woodlands and habitats in the extreme south of the Queanbeyan LGA on Royalla TSR and the Royalla Crown Lands; and
- The patches of remnant Dry Forest and Grassy Woodlands to the south-west of Pemberton Hills on Tralee Station and the more disturbed vegetation through to the north-east of Tralee Station linking with the lower parts of the Jerrabomberra Creek corridor and Barracks Creek.

## 6.8.2 Local Biolinks

A number of local biolinks were identified as shown in Figure 7 and described below. These biolinks provide linkages between the regional biolinks and/or linkages to otherwise isolated patches of remnant native vegetation and associated habitats:

- The linkage from the Jerrabomberra Creek corridor, east through the remnant vegetation to the north of the Mount Campbell Estate and east of Old Cooma Road through the band of remnant native vegetation north of Burra Road and east to the remnant vegetation associated with the hills in the eastern extremities of the LGA. This biolink is disrupted by some areas in the extreme east that have been heavily cleared and grazed. However the disruptions are relatively minor and could be mitigated by strategic plantings and/or lighter grazing. This local biolink provides the only remaining linkage south of Googong between the habitats along Jerrabomberra Creek and the extensive areas of remnant vegetation in the eastern extremities of Queanbeyan LGA and beyond.
- The linkage north of Fernleigh Estate from the Jerrabomberra Creek corridor through the Maclean, Robin and Talpa properties and east to the Queanbeyan River Corridor. This linkage, whilst more tenuous than the link to the north through Barracks Creek and the remnant vegetation north of Wickerslack Lane, includes extensive areas of Box-Gum Woodland in Moderate to Good condition, Dry Forests in the east and known habitats for the Golden Sun Moth, Pink-tailed Worm Lizard and threatened woodland birds such as the Brown Treecreeper.
- The linkage from Cuumbeun NR through the currently zoned rural residential lands to the east and north to Stony Creek and Wanna Wanna Nature Reserves. Given the extent of regrowth and remnant native vegetation in this area, this linkage is relatively broad with few obvious areas that retain greater connectivity between habitats. However the more extensively cleared and pasture improved lands immediately to the south of Captains Flat Road and east of Wanna Wanna Road generally comprise an obvious disruption to the biolink. This linkage is critical to the maintenance and enhancement of the conservation values of Stony Creek and Wanna Wanna Nature Reserves in the long-term.
- The linkage north from Stony Creek NR north along the Molonglo River corridor and to those areas north of the Kings Highway that continue to support relatively extensive areas of remnant native vegetation in Moderate to Good condition.
- The linkage from the south-western slopes of Beatty Hill to the slopes of Enchanted Hill providing connectivity between two regional biolinks and the remnant extensive areas of remnant native vegetation associated with both these sites. This linkage

requires sympathetic management and recovery strategies to realise its potential. However it is located strategically where there is a narrowing of the gap between two north-south aligned regional biolinks.

- The linkage from Royalla crown lands across Jerrabomberra Creek to the ranges on the eastern margins of the study area. This linkage also requires sympathetic management and recovery strategies to realise its potential. However it is similarly located strategically where there is a narrowing of the gap between two north-south aligned regional biolinks.

## 7. Mapping Relative Conservation Value

Section 6 identified the results of the fieldwork undertaken for the study. As discussed in Section 5.2 the datasets captured during the fieldwork, including vegetation type and condition, EEC extent and condition, fauna habitat quality, and the identification of regional and local biolinks, are critical to a robust analysis of the relative conservation values of remnant vegetation and associated habitats within the Queanbeyan LGA. These datasets are the basis of a number of the key criteria for determining conservation value as defined in Table 7. Section 7 identifies the results of the mapping of relative conservation value within the Queanbeyan LGA. However, before presenting and analysing these results, Sections 7.1-7.3 discuss the datasets that are the basis of key criteria for determining conservation value, but which are not primarily the outcome of the fieldwork, and were consequently not discussed in Section 6. These datasets are over-cleared Mitchell Landscapes, riparian and HCV vegetation buffers, and non-HCV native vegetation.

### 7.1. Over-cleared Mitchell Landscapes

As identified in Section 5.2.3 and Table 7 any remnant vegetation on the Canberra Plains or Upper Murrumbidgee Channels and Floodplains Mitchell Landscapes that is not in Low condition, is considered HCV. As these two Mitchell Landscapes cover approximately the northern half of the LGA and support only very limited areas of non-native vegetation or native vegetation in Low condition, this criteria contributes significantly to the extent of HCV vegetation within the study area as identified in Figure 8 (Appendix A). This is particularly the case given that much of the northern parts of the study area are dominated by Dry Forests that do not comprise EECs or over-cleared vegetation types and would thus not otherwise be considered HCV.

### 7.2. Riparian and HCV Buffers

Riparian buffer widths were determined consistent with the Biometric Tool (Gibbons *et. al.* 2005). The relative riparian buffer widths of watercourses within the study area are identified in Table 9.

**Table 9: Riparian buffers dimensions within the study area**

Watercourse Size	Buffer <sup>1</sup>	Example
Major Rivers	40 m	Queanbeyan and Molonglo Rivers
Minor Rivers, Wetlands and Major Creeks	30 m	Perennial parts of Jerrabomberra Ck, Barrack Ck, and Scabbing Flat Creek
Minor Creeks	20 m	Named and other larger creeks <i>i.e.</i> Four Mile Ck, Church Ck, Guises Ck, Valley Ck, Deep Ck, Stoney Ck
Minor Watercourses	10 m	All other ephemeral creeks and watercourses

<sup>1</sup> Buffers are either side of the watercourse centreline

Notwithstanding the important ecosystem services provided by riparian areas, the contribution of riparian buffers to HCV vegetation is relatively limited within the study area given the absence of any large wetlands.

A standard 50 m buffer zone was adopted to all other HCV vegetation. Whilst the appropriate buffer width at any particular site depends upon a range of site specific factors including the nature of the conservation values, landforms, development, and associated direct and indirect impacts, in most situations, a 50 m buffer provides sufficient opportunity to successfully protect conservation values and mitigate against adverse impacts. A 50 m buffer width is also consistent with other buffer widths adopted for other strategic planning studies completed recently elsewhere within the Queanbeyan LGA.

### **7.3. Other Native Vegetation**

As discussed in Section 6.1 the vast majority of the study area continues to support native vegetation in Moderate to Good condition. Whilst much of the vegetation within the study area has been cleared and grazed for more than a century, the study area has not been subject to widespread cropping and repeated pasture improvement, and the perennial vegetation continues to be predominantly native.

The criteria for establishing the conservation value of vegetation within the study area classifies any non-HCV native vegetation as MCV. As such, remnant native vegetation contributes substantially to the extent of the MCV vegetation within the study area. However much of this vegetation also contributes to regional or local biolinks, which also comprise MCV vegetation.

### **7.4. Mapping Results**

Applying the conservation value criteria identified in Section 5 illustrates the extent of HCV vegetation within the study area, as identified in Figure 9 (Appendix A). HCV vegetation overwhelmingly dominates the northern half of the study area and whilst less widespread in the southern half, still predominates.

MCV vegetation is less widespread and is concentrated in the small patches of Low condition EEC in the Carwoola areas, Jumping Creek, and in the Gale precinct, and in the bands of Dry Forest associated with the central southern and eastern extremities of the study area. These areas are mapped as MCV vegetation as they support remnant native vegetation and contribute to or comprise regional or local biolinks.

LCV vegetation is limited primarily to an extensive band mainly east of Jerrabomberra Creek south of Mount Campbell extending almost to the southern extremities of the study area, and two smaller patches in the Guises Creek catchment. There are also many smaller areas of LCV vegetation scattered throughout the study area in association with localised areas of heavy disturbance.

The extent of each conservation value class within the detailed investigation areas and the study area as a whole is identified in Table 10. Table 10 identifies the predominance of HCV vegetation within both the detailed investigation areas and the study area as a whole with roughly four times as much HCV vegetation as LCV vegetation within the detailed investigations areas, and three times within the study area.

**Table 10: Relative extent of HCV, MCV, & LCV vegetation within the study area**

Conservation Value	Detailed Investigation Areas (ha)	Study Area (ha)
HCV	3703 (66%)	8861 (66%)
MCV	999 (18%)	1816 (14%)
LCV	888 (16%)	2606 (20%)
<b>Total</b>	5590 ha	13283 ha

As discussed in Section 7.1, the predominance of HCV vegetation in the northern parts of the study area derives primarily from the limited extent of non-native vegetation or native vegetation in Low condition on over-cleared Mitchell Landscapes. It is also an artefact of the extent of lands currently zoned for Environmental Protection or as National Parks.

The extent of HCV vegetation in the southern parts of the study area is an artefact primarily of the extent of EECs in Moderate to Good condition.

Figure 9 includes HCV vegetation resulting from Environmental Protection or as National Parks in those areas excluded from the study area. These areas have been included to identify the continuity of known HCV vegetation into those areas excluded from the study area. However it is likely that HCV vegetation is more widespread in areas excluded from the study area in association with other conservation values and particularly the presence of EECs in Moderate to Good condition. For instance, areas of Box-Gum Woodland in Moderate to Good condition were confirmed in the Grassland Woodland Mosaic in the Four Mile Creek catchment between Beatty Hill and Enchanted Hill, however the extent of Box-Gum Woodland was not mapped as this area was beyond the detailed investigations areas.

The conservation value mapping produced in this report correlates reasonably well within the mapping of HCV vegetation in the upper Murrumbidgee catchment (SKM 2007), in that all the areas identified as of potential or high conservation value in that study are confirmed as being either MCV or HCV vegetation in this study. However the analysis undertaken for this study identifies substantial additional areas of HCV and MCV vegetation throughout the study area, and particularly in the southern half.

## **7.5. Areas More or Less Suitable for Development**

The outcome of the relative conservation value mapping has broadly identified those areas within the study area that are more or less suitable for development or environmental protection. Those areas more suitable for development are primarily those areas that have been identified as supporting low conservation value vegetation. However some of those areas identified as supporting MCV and HCV vegetation, such as the extensive Dry Forests in the northern parts of the LGA, may be able to support lower intensity development such as larger lot subdivision, without significantly compromising biodiversity values. However, this will only be the case where development can be limited to heavily disturbed sites, avoid key habitat resources *i.e.* hollow-bearing trees, does not compromise regional or local biolinks, and can appropriately offset impacts on biodiversity values. Development that meets these criteria may be appropriate in areas mapped as HCV or MCV vegetation, particularly where biodiversity values are improved through mechanisms such as protective covenants and BioBanking agreements, which protect and enhance biodiversity values over larger areas or in strategic locations *i.e.* local biolinks.

Notwithstanding the potential for some types of lower intensity development in areas mapped as HCV or MCV vegetation, in instances where small areas suitable or potentially suitable for development occur within extensive areas not suitable for development, the scope for appropriate development is likely to be very limited. The main areas identified as more or less suitable for development are identified in Figure 10 and discussed below.

### **7.5.1. Areas More Suitable for Development.**

The areas more suitable for intensive types of development are those areas identified as supporting LCV vegetation and in some instances, areas supporting MCV vegetation, which comprises vegetation in Low condition as described below:

**Jerrabomberra Creek Corridor South of Mount Campbell** – The band of LCV vegetation primarily east of Jerrabomberra Creek south of Mount Campbell extending almost to the southern extremities of the study area is suitable for intensive types of development. This area is the most extensive contiguous area of land suitable for development within the study area.

**Western Parts of Guises Creek Catchment** – The patch of LCV in the Guises Creek catchment in the south-western extremities of the study area is suitable for intensive types of development. However any development in this area would need to appropriately protect the population of *Swainsona recta* in the railway easement on its western boundary.

**Gale Precinct** – The mix of non-native vegetation and Box-Gum Woodland in Low condition in the Gale Precinct is more suitable for higher intensity development than the existing rural residential development.

**Low Condition EECs in Carwoola** – Those areas of Box-Gum Woodland in Low condition in the Carwoola area are suitable for intensive types of development.



**Eastern extremities of Googong** – This area was beyond the detailed investigation area and vegetation was verified remotely due to access limitations. However on the basis of the available data it would appear that much of this area is suitable for development, notwithstanding limitations associated with impacts on water quality to Googong Reservoir. Further investigations on biodiversity constraints would be necessary.

**Lower Valley Creek** – The heavily disturbed vegetation that characterises much of the lower parts of the Valley Creek catchment are suitable for intensive types of development.

### **7.5.2. Areas Where Some Forms of Development May Be Suitable.**

Parts of the lands identified as supporting MCV and HCV vegetation may be suitable for development where developments are designed to limit impacts on biodiversity and appropriately offset any unavoidable impacts. Development may be suitable in these areas where development can be limited to heavily disturbed sites, avoid key habitat resources *i.e.* hollow-bearing trees, and does not compromise regional or local biolinks.

Those areas potentially suitable for development as identified in Figure 10 comprise those areas:

- Which are not EECs or an over-cleared vegetation type (*i.e.* Snow Gum Grassy Woodland) in Moderate to Good condition.
- that support Dry Forests or Grassy Woodland Mosaic that has not been identified as an EEC or over-cleared vegetation type.
- Which are not riparian corridors or existing National Parks or Environmental Protection Zones.
- Which are not buffers to EECs, over-cleared vegetation types, riparian corridors, National Parks or Environmental Protection Zones.

The main areas where some low impact forms of development *i.e.* limited residential development, may potentially be suitable include:

**Carwoola Lands** – Low impact types of development may be suitable in heavily disturbed areas within the Dry Forests in the Carwoola area. The key criteria for development in this area will be avoiding impacts on key habitat resources such as hollow-bearing trees and improving the condition and security of local biolinks.

**Lands South and East of Googong and Eastern Parts of Fernleigh Estate** – These lands predominantly support Dry Forest within localised areas or non native vegetation. There would appear to be a capacity for these lands to support more intensive types of development if significant impacts on threatened species could be avoided and impacts on native vegetation appropriately offset.

**High Parts of Beatty Hill and ridgeline to the north**– Notwithstanding the potential impacts on visual amenity, low impact types of development may be suitable in the non-native vegetation and heavily disturbed Dry Forests in the higher parts of Beatty Hill. The key criteria for development in this area would be avoiding impacts on potential habitat for threatened fauna such as the Pink-tailed Worm Lizard and Golden Sun Moth and avoiding adverse impacts on the HCV vegetation that occurs on the mid and lower slopes of Beatty Hill.

**Lands South of the Gale Precinct** – Low impact development may be suitable in the lands to the immediate south of the Gale Precinct which support Dry Forests. The key criteria for development in this area will be avoiding impacts on potential habitat for threatened fauna such as the Pink-tailed Worm Lizard and improving the condition and security of local biolinks.

**Four Mile Creek Catchment** – Some development may be suitable in this area however the biodiversity values of the area have not been sufficiently assessed to determine where development may be more suitable or at what intensity. The area is known to support some Box Gum Woodland in Moderate to Good condition and supports potential habitat for the Pink-tailed Worm Lizard, Grassland Earless Dragon, and Golden Sun Moth. The key criteria for development in this area will be avoiding impacts on potential habitat for threatened fauna, retaining HCV vegetation, and improving the condition and security of local biolinks.

**Eastern Parts of Guises Creek Catchment** – Some further more intensive development may be suitable in this area which is characterised by a mosaic of Grassland Woodland Mosaic vegetation in both Moderate to Good and Low Condition. Much of the area has already been developed for rural residential development. The key criteria for development in this area will be avoiding impacts on potential habitat for threatened fauna, retaining HCV vegetation, and improving the condition and security of local biolinks.

There are a number of smaller isolated areas that fit the criteria to be potentially suitable for some limited low impact types of development. In most instances the small size of these areas and their location within areas more suited to environmental protection significantly limits their development potential.

### **7.5.3. Areas More Suitable for Environmental Protection.**

Those areas more suitable for Environmental Protection generally comprise the areas identified as supporting EECs in Moderate to Good condition, and areas within existing National Park or Environmental Protection Zones. These areas generally coincide with and support the regional biolinks that have been identified in Figure 7.

## 8. RECOMENDATIONS

Section 8 provides recommendations pertaining to the zoning of lands within the study area within the new LEP and the use of environmental layers and planning provisions. These recommendations are based on the findings of the research and analysis identified in previous sections of this report. They are also presented in the context of the objectives and development expectations of the existing zoning under the three LEPs which pertain to the study area. Other factors affecting zonings, such as social, economic and servicing, have not been considered as they are beyond the scope of this study.

Environmental zones (E zones) have been recommended in all areas supporting remnant native vegetation in Moderate to Good condition, which comprises a significant proportion of the study area. The general objectives of the E zones are described below:

- E2 (Environmental Conservation) zones are recommended to be applied to those areas where conservation of natural environmental or protection of cultural heritage is the primary if not the sole land use. Any uses not consistent with environmental conservation should be prohibited from E2 zones.
- E3 (Environmental Management) zones are recommended to be applied to those areas where protection and management of biodiversity values is a key objective but in the context of multiple landuses. Intensive agriculture should be prohibited within E3 zones however extensive agricultural activities such as grazing would be provided for as an existing use. Other extensive agricultural activities should be permitted only with consent.
- E4 (Environmental Living) zones are recommended to be applied to those areas supporting MCV vegetation but where there is some expectation of further multiple-lot development under the existing LEP. Notwithstanding the development expectations implied by the E4 Zone, the objective of the zone is to facilitate development whilst protecting important conservation values.

Those parts of the detailed investigation areas that support HCV vegetation are recommended to be zoned as E3 (Environmental Management) in recognition of the fact that whilst these areas support identified high conservation values, the existing rural residential zoning has created a mix of existing uses and development expectations that are inconsistent with the objectives of a E2 (Environmental Conservation) zone. Areas of MCV vegetation within the detailed investigation areas have been recommended to be zoned E4 (Environmental Living) using a similar logic and in recognition of the lower relative conservation value of these lands.

Areas of HCV and MCV vegetation beyond the detailed investigation areas zoned Rural under the existing LEPs, have been recommended to be zoned E3, given the lower development expectation associated with Rural zones.

Notwithstanding the zone objectives under the Standard Instrument (LEP) Order (2006), the protection of the identified conservation values within the study area and their consideration in the strategic planning and development assessment process is recommended to be facilitated primarily through the use of a number of Environmental Layers. An Environmental Layer is recommended for riparian corridors as opposed to zoning given their narrow linear nature.

A number of recommendations are also made in relation to Planning Provisions and a Development Control Plan (DCP) pertaining to E zones or areas covered by Environmental Layers. In addition recommendations are made in relation to facilitating the appropriate the consideration of conservation values in the development assessment process.

### **8.1. Zones**

The following recommendations are made with respect to the zoning of lands within the Study Area. The zones are consistent with those identified under the Standard Instrument (LEP) Order (2006).

1. Retention of current environmental provisions. All lands currently zoned for Environmental Protection should be zoned E2 – Environmental Conservation. This is consistent with the Department of Planning's Section 117 Direction: 2.1 Environmental Protection Zones, which applies to land within an existing environmental protection zone or land otherwise identified for environmental protection purposes, to ensure no reduction in the level of environmental protection for that land.
2. All HCV vegetation within lands covered by a registered on-title agreement for conservation should be zoned to reflect the objectives of the agreement to promote biodiversity conservation, and should thus generally be zoned E2 – Environmental Conservation.
3. Identified LCV vegetation should be zoned, where necessary, so as to enable higher intensity types of development *i.e.* R, B and I Zones.
4. All HCV and MCV vegetation in areas currently zoned for rural residential development should be zoned E4 Environmental Living or as a zone with higher environmental conservation objectives *i.e.* E3-E2 except where the existing zoning under the existing LEPs has created inconsistent development expectations. However higher intensity types of development may be considered where biodiversity values are not compromised or are appropriately offset as discussed in Section 7.5.
5. Zones enabling higher intensity development types should only be considered in areas of EECs, where they are in Low condition which are classified by this study as MCV.
6. In addition to the objectives of the E zones identified in the Standard Instrument (LEP) Order (2006), E zones should include an objective requiring any development requiring consent to demonstrate that biodiversity values are being maintained or improved.

## **8.2 Environmental layers**

The following recommendations are made with respect to environmental layers that should be incorporated into the new LEP.

1. All HCV and MCV vegetation should be identified in the LEP as an environmental overlay.
2. Identified local and regional biolinks should be identified in the LEP as an environmental overlay.
3. The identified riparian buffer layers should be identified in the LEP as an environmental overlay.
4. A 100 m buffer surrounding known threatened flora species records should be identified in the LEP as an environmental overlay.
5. Any activities that involve vegetation clearing, including Routine Agricultural Management Activities (RAMAs), should only be permissible with Council consent in areas affected by environmental overlays *i.e.* HCV and MCV vegetation, biolinks, riparian corridors and buffers, and areas surrounding known threatened flora species records.
6. Areas affected by environmental overlays should be identified as priority areas for detailed assessment of impacts in association with any development applications.
7. The regional and local biolinks layer and EECs and over-cleared vegetation types layers (in Moderate to Good condition) should be used to identify priority areas for enhancement and restoration actions. These areas should be priorities for offsets.

## **8.3 Planning Provisions**

The following recommendations are made with respect to planning provisions that should be incorporated into the new LEP.

1. Any developments that have the potential to affect any of the numerous small dams within the LGA should be subject to specific assessment of the potential impacts on threatened amphibians and particularly the Green and Golden Bell Frog as per the requirements of the *Environmental Planning and Assessment Act 1979*.
2. Any developments within E or RU zones should require detailed assessment of the potential impacts on threatened species and regional or local biolinks as per the requirements of the *Environmental Planning and Assessment Act 1979*.
3. Any activities that involve vegetation clearing, including RAMAs, should only be permissible with Council consent in E zones.

4. Any activities that involve vegetation clearing, including RAMAs, should only be permissible with Council consent in areas affected by environmental overlays *i.e.* HCV vegetation and buffers, MCV vegetation, local or regional corridors, riparian corridors, and areas surrounding known threatened flora species records.
5. Extensive agriculture should generally be excluded from E2 zones. E3 can support occasional grazing, beekeeping *etc.*
6. A biodiversity clause should be adopted which applies to all identified HCV and MCV vegetation. Recommended wording of this clause is as follows:
  - (1) The objective of this clause is to protect maintain and improve the biodiversity of landscapes including:
    - a. protecting biological diversity, native fauna and flora, and
    - b. protecting ecological processes necessary for their continued existence, and
    - c. encouraging the recovery of threatened species, communities, populations and their habitats.
  - (2) This clause applies to development on land identified as *Environmentally Sensitive Areas - Biodiversity on the Environmentally Sensitive Areas – Biodiversity Map*.
  - (3) For the purpose of this clause the *Environmentally Sensitive Areas - Biodiversity Map means the Queanbeyan Local Environmental Plan [year] Environmentally Sensitive Areas - Biodiversity Map*.
  - (4) Development consent must not be granted to development unless the applicant has submitted a report with the development application that addresses, to the satisfaction of the consent authority, the following matters:
    - a. identification of any potential adverse impact on;
      - i. a native vegetation community, and
      - ii. the habitat of any threatened species, populations or ecological communities, and
      - iii. a regionally significant species of plant, animal or habitat, and
      - iv. a habitat corridor, and
      - v. a wetland, and
      - vi. the biodiversity values within a reserve, including a road reserve or a stock route; and
    - b. a description of any proposed measures to be undertaken to ameliorate any potential adverse impact.
  - (5) Where the consent authority is of the opinion that the development will cause a potential adverse impact the consent authority shall not grant development consent unless it is satisfied that;
    - a. the development meets the objectives of this clause, and
    - b. the development is designed, sited and managed to avoid the potential adverse environmental impact, or
    - c. in circumstances where a potential adverse impact cannot be avoided, the development:
      - i. is designed and sited so as to have minimum adverse impact, and
      - ii. incorporates effective measures so as to have minimal adverse impact, and
      - iii. mitigates any residual adverse impact through the restoration of any existing disturbed area on the site.

## **8.4 Principles for Inclusion in DCP**

The following recommendations are made with respect to the principles that should be included in any DCP that covers areas identified as E zones or affected by environmental overlays:

1. All native vegetation in Moderate to Good condition should be retained and protected.
2. Hollow-bearing trees and other important habitat resources should be retained and protected, *i.e.* rock habitats for threatened reptiles, termite mounds, known or potential feed trees for Glossy Black Cockatoos.
3. Conservation reserves, native vegetation and important habitat resources should be appropriately buffered from development and associated activities.
4. Guidelines should be developed for the management of landuses/activities in areas identified as supporting HCV or MCV vegetation.
5. Environmental weeds, as part of landscape and rehabilitation plans, should not be permitted in any lands that are known to support HCV or MCV vegetation.
6. A list of environmental weeds within the Queanbeyan LGA should be developed.
7. The keeping of cats should be prohibited within new developments within E zones.
8. Fencing of lot boundaries should be restricted where it encroaches on remnant native vegetation (so as to minimise clearing of native vegetation) or otherwise designed to minimise adverse impacts on biodiversity values.
9. The collection of timber should be regulated within new developments within E zones to promote the retention of fallen and dead standing timber and associated fauna habitats.
10. Ensuring proposal design rationalises the extent of infrastructure such as roads, fire-trails, asset protection zones and services such that adverse impacts on biodiversity are avoided or minimised.
11. Minimum average lot sizes should be applied in E zones rather than minimum lot sizes to enable cluster development which enables the retention and protection of biodiversity values and concentrates development in areas with low conservation value.
12. Wherever possible development and activities should be designed to achieve net improvements in biodiversity values *i.e.* through the protection and enhancement of MCV and HCV vegetation, and the enhancement of local and regional corridors, through the use of registered on-title agreements for conservation such as BioBanking agreements and Property Vegetation Plans (PVPs).

## **8.5 Principles for use by Council in the Assessment of Development**

### **Applications**

The following recommendations are made with respect to the principles that should underpin Council's development assessment process:

1. Ensure biodiversity issues are appropriately considered at all stages of the site based activity and development assessment process.
2. Any activities requiring consent in areas affected by environmental overlays, or within 100 m of these areas, should require a detailed assessment of the potential impacts on biodiversity.
3. Where HCV and MCV vegetation or areas otherwise affected by environmental overlays are potentially affected by a development or activity requiring consent, then a detailed assessment of the potential impacts on matters of national, state, regional and local significance should be undertaken including an assessment on relevant threatened species, endangered populations and endangered ecological communities. These assessments should have regard to relevant guidelines *i.e.* Threatened Species Assessment Guidelines (DECC 2005), and where appropriate include targeted survey for relevant threatened entities during appropriate seasons.
4. Clearing of native vegetation should be avoided. No clearing of native vegetation should be permitted where there will be any significant impacts on threatened species, endangered populations, or endangered ecological communities. If avoiding clearing of native vegetation is not possible, it should be mitigated against. If it cannot be mitigated against, then clearing of native vegetation should only be permitted where appropriate offsets can be achieved and where there will not be any significant impacts on threatened species, endangered populations, or endangered ecological communities.
5. The definition of native vegetation clearing should also include the clearing of secondary grasslands derived from native woodland and forest communities.
6. Given the absence of comprehensive threatened species information within the study area, any development applications that involve impacts on native vegetation will require an assessment of the impacts on threatened species and their habitats as per the requirements of the *Environmental Planning and Assessment Act 1979*.
7. Hollow bearing trees should not be cleared if they provide key habitat values for threatened species, or if there is a potential for significant impacts on threatened fauna. No further loss of hollow-bearing trees should be permitted without appropriate offsets.
8. Opportunities should be explored where assessing development applications to enhance the management of identified HCV or MCV vegetation *i.e.* through the exclusion or relaxing of grazing or other threatening processes.



9. Opportunities should be explored where assessing development applications to enhance local and regional corridors. *i.e.* through the recovery of vegetation that comprises part of local or regional corridors.
10. Assessment guidelines should be developed to ensure biodiversity issues are considered early in the development assessment and planning process *i.e.* through the use of conservation value mapping and GIS analysis.
11. Model development consent conditions should be prepared that address protection, maintenance and improvement of biodiversity values.
12. A policy and procedure should be developed for managing clearing consents in situations where both Council and the CMA are consent authorities.
13. Tree planting should be discouraged in NTG.

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### **Personal Communications**

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## **APPENDIX A: FIGURES**

Figure 1: Extent of study area and detailed investigation areas

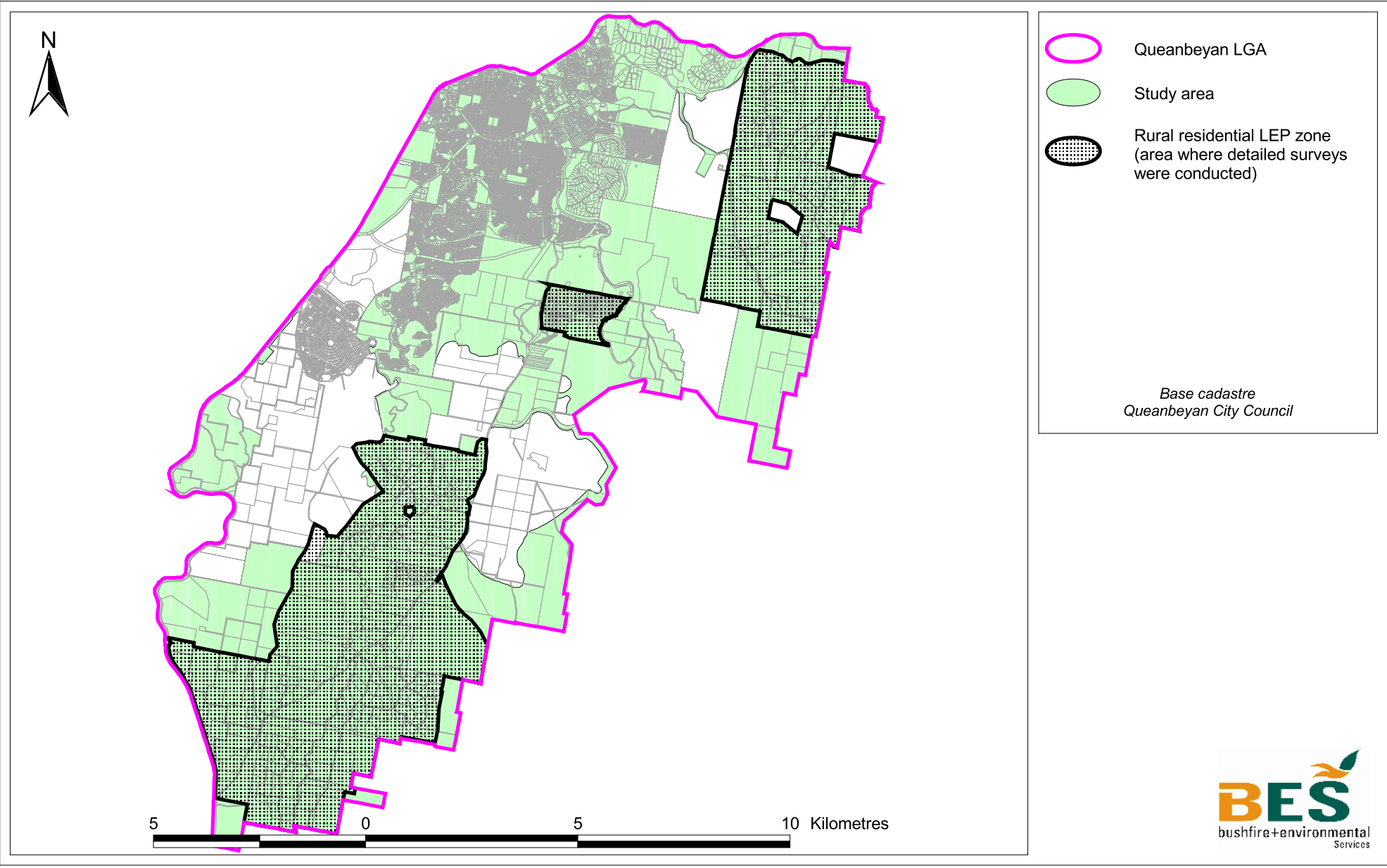




Figure 2: Distribution of existing zoning categories throughout Queanbeyan LGA

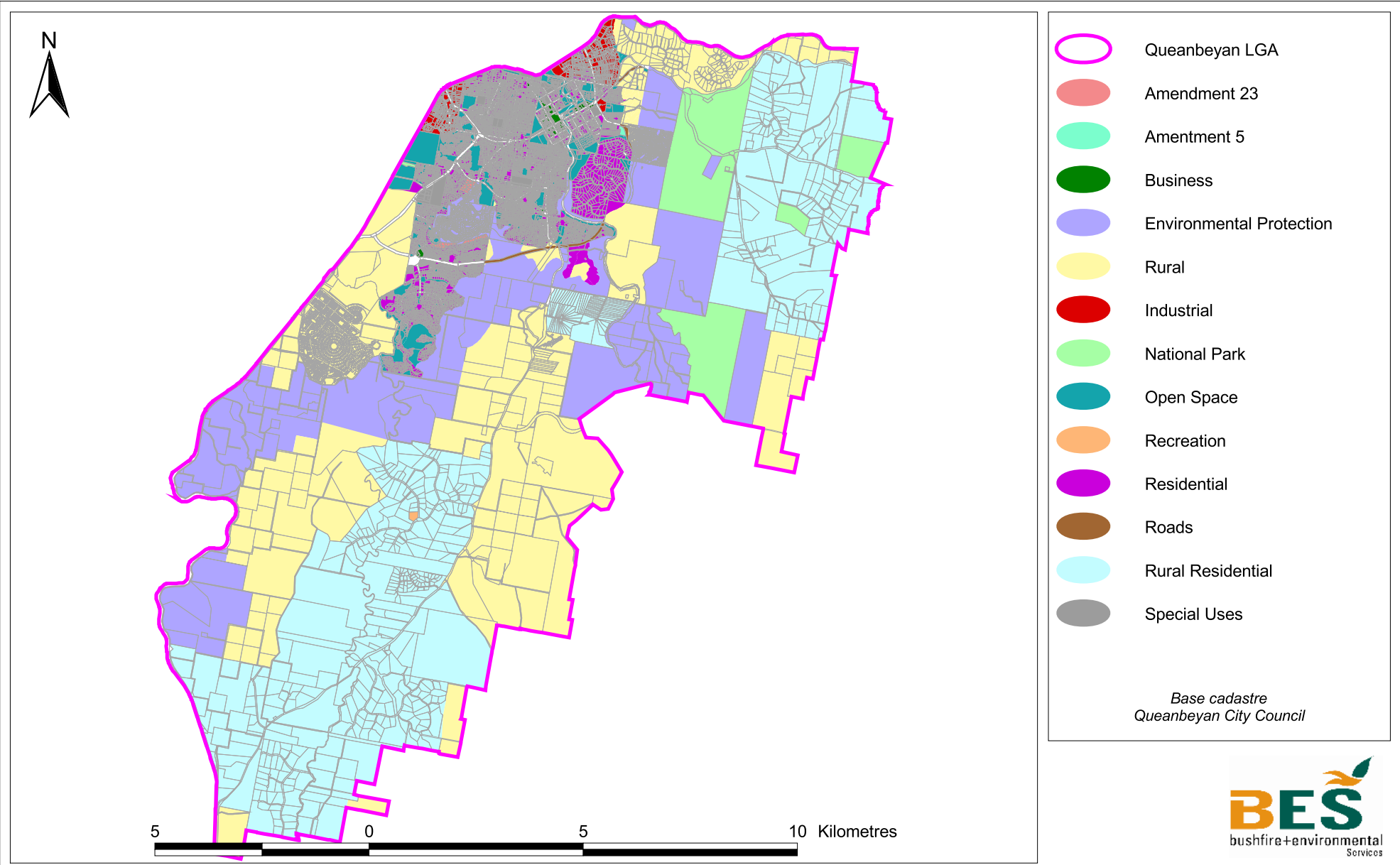


Figure 3: High conservation value vegetation within the Queanbeyan LGA as modelled by SKM (2007)

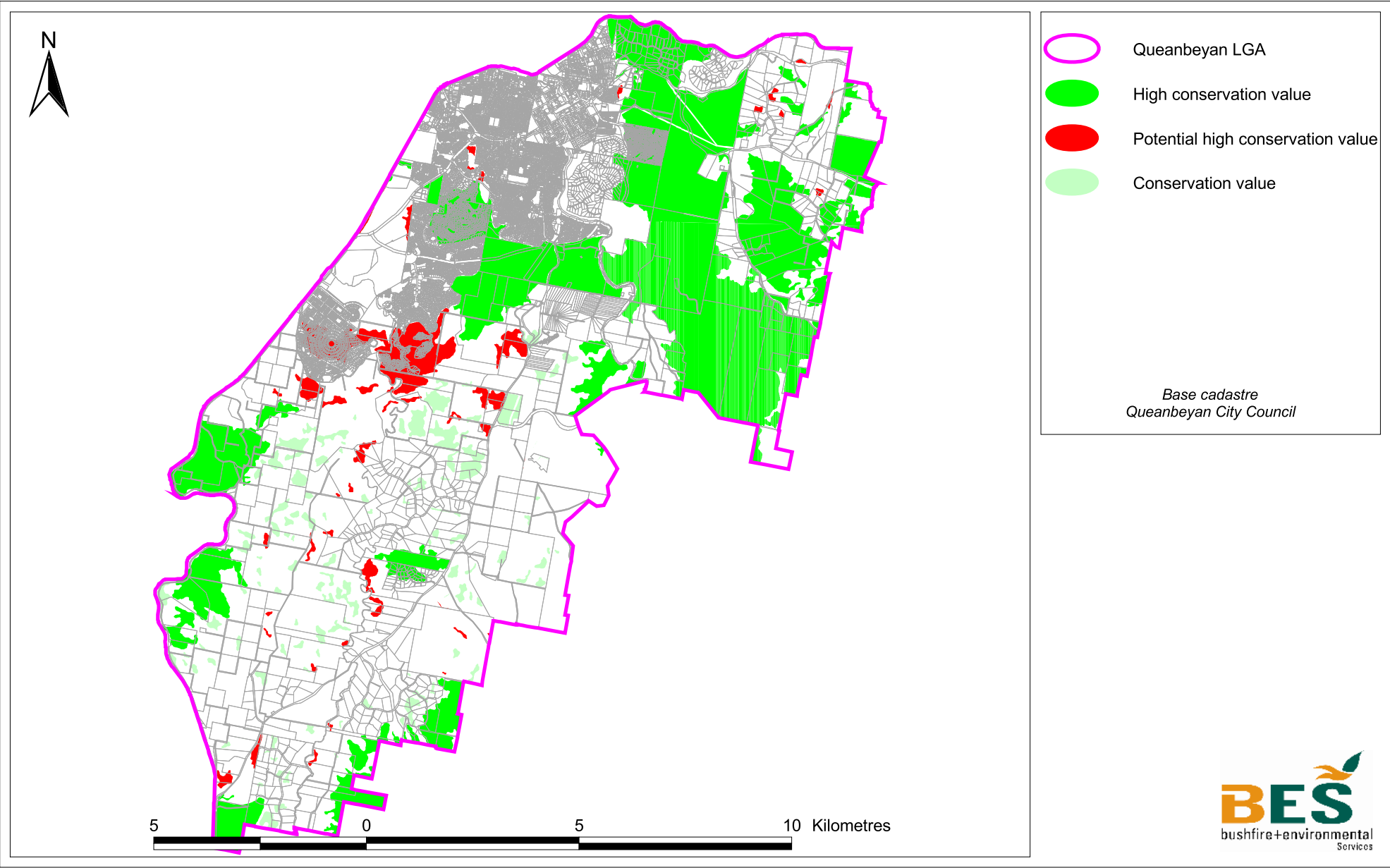


Figure 4: Validated vegetation mapping within the study area

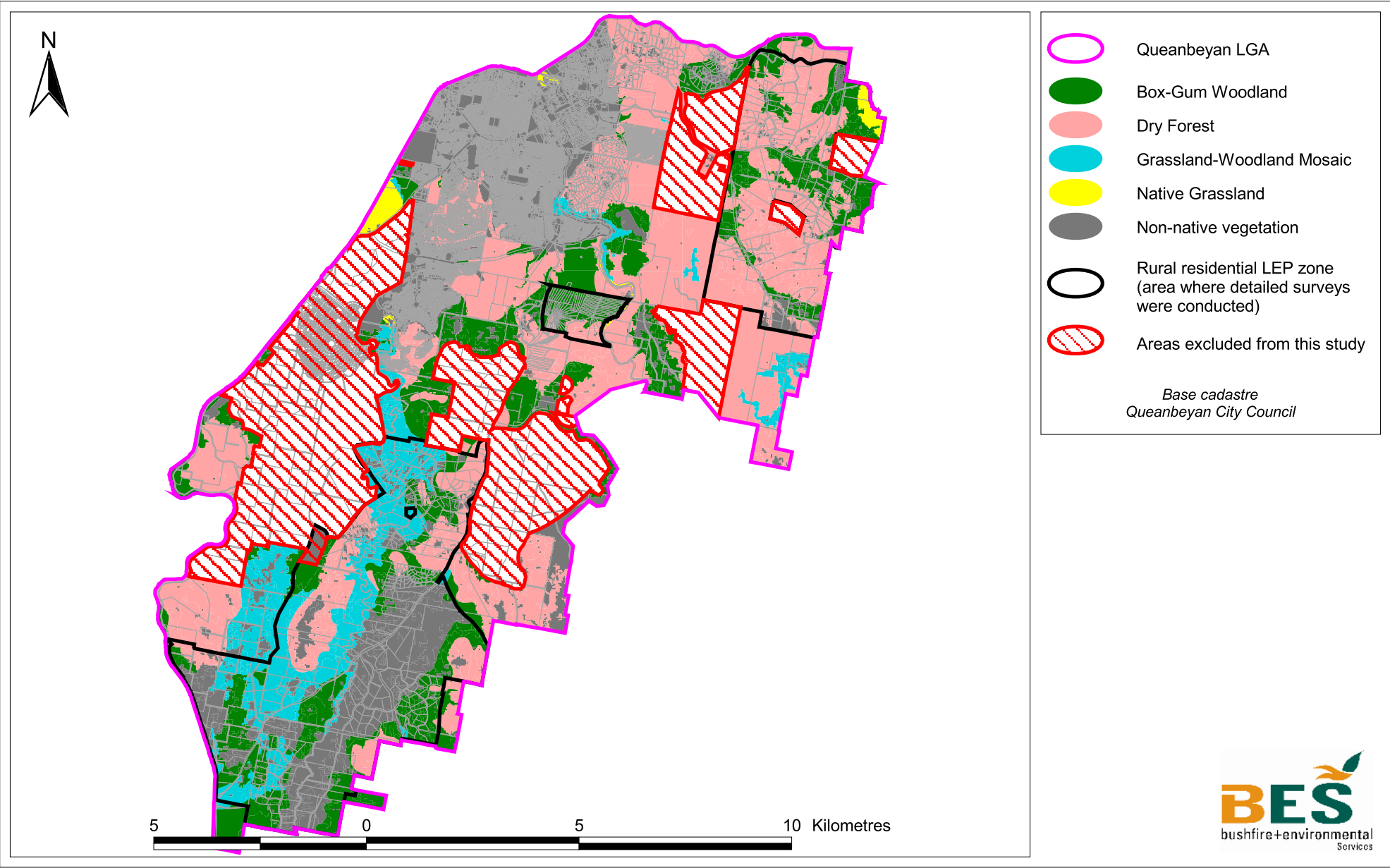


Figure 5: EECs and over-cleared vegetation communities within the study area

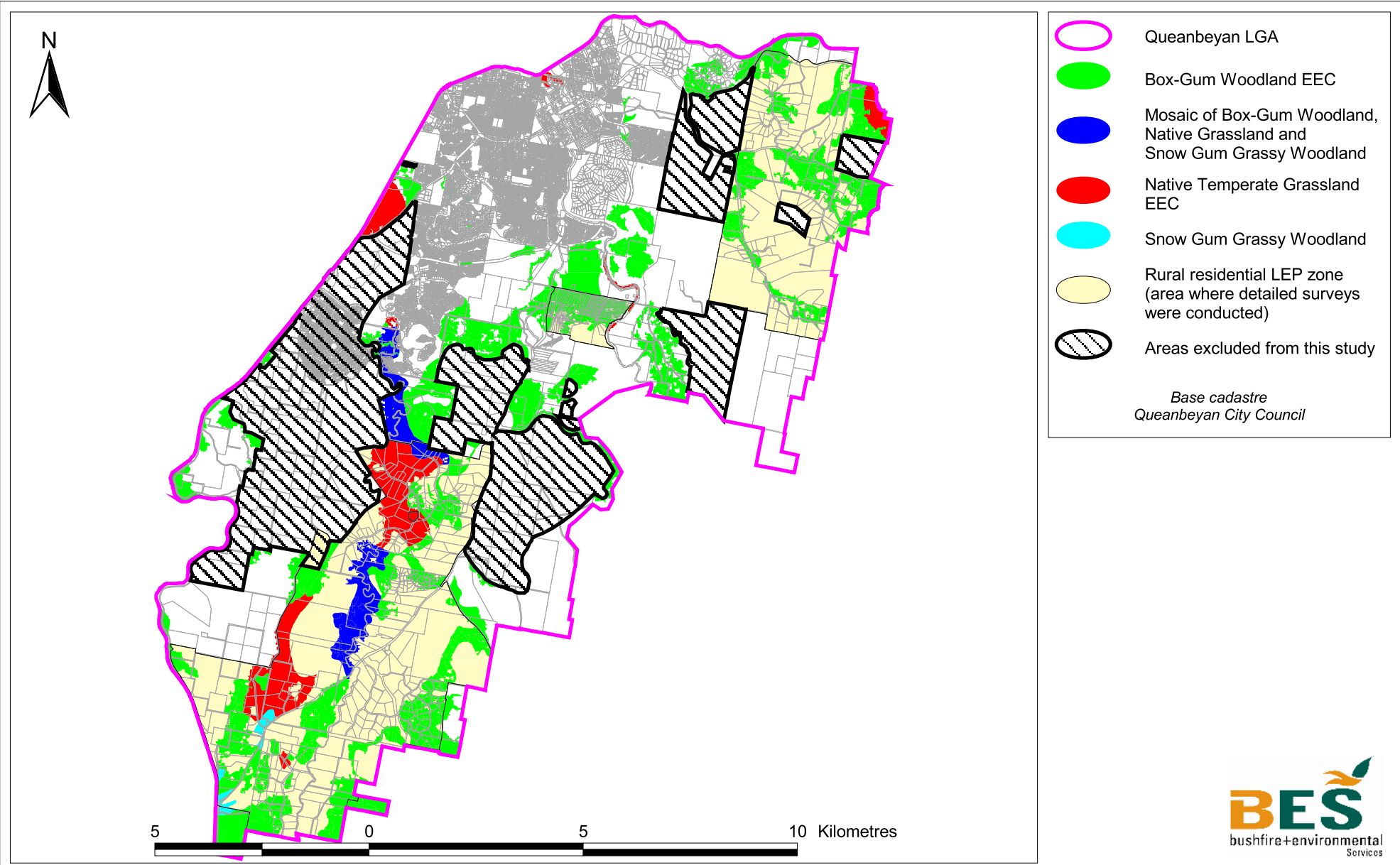


Figure 6: Relative quality of fauna habitats within the detailed investigation areas

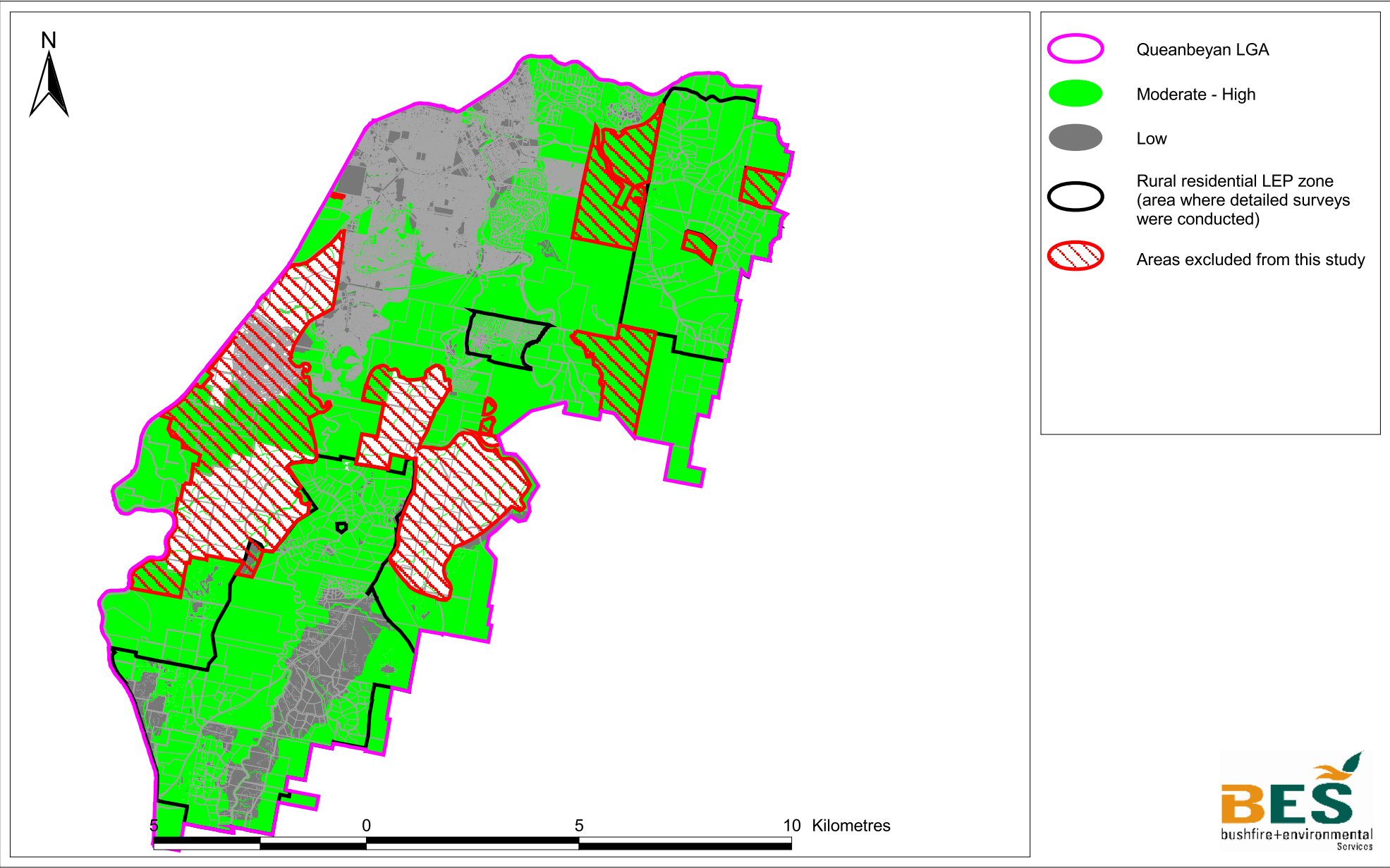




Figure 7: Regional and local biolinks within the Queanbeyan LGA

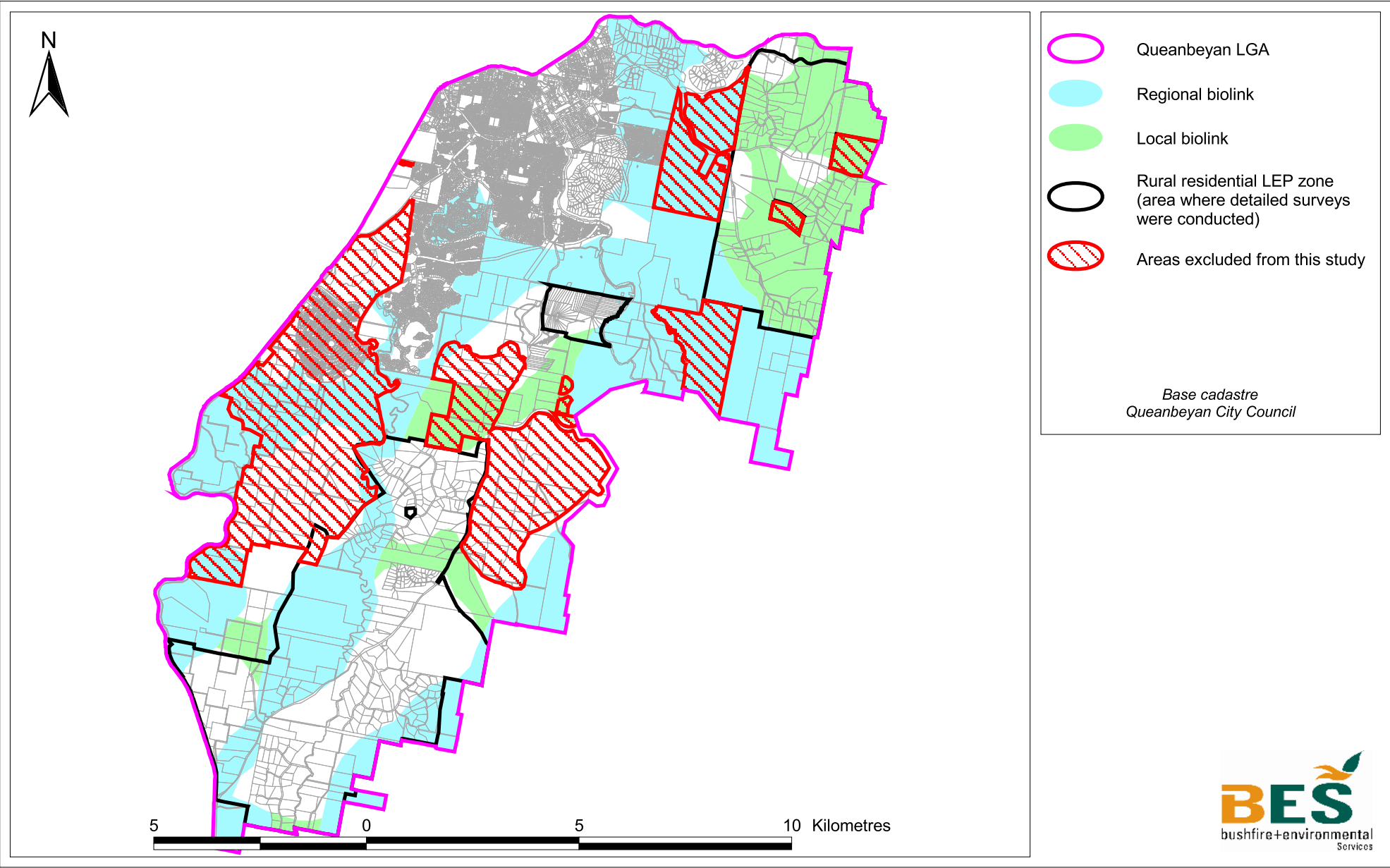


Figure 8: Native vegetation on over-cleared Mitchell Landscapes within the study area

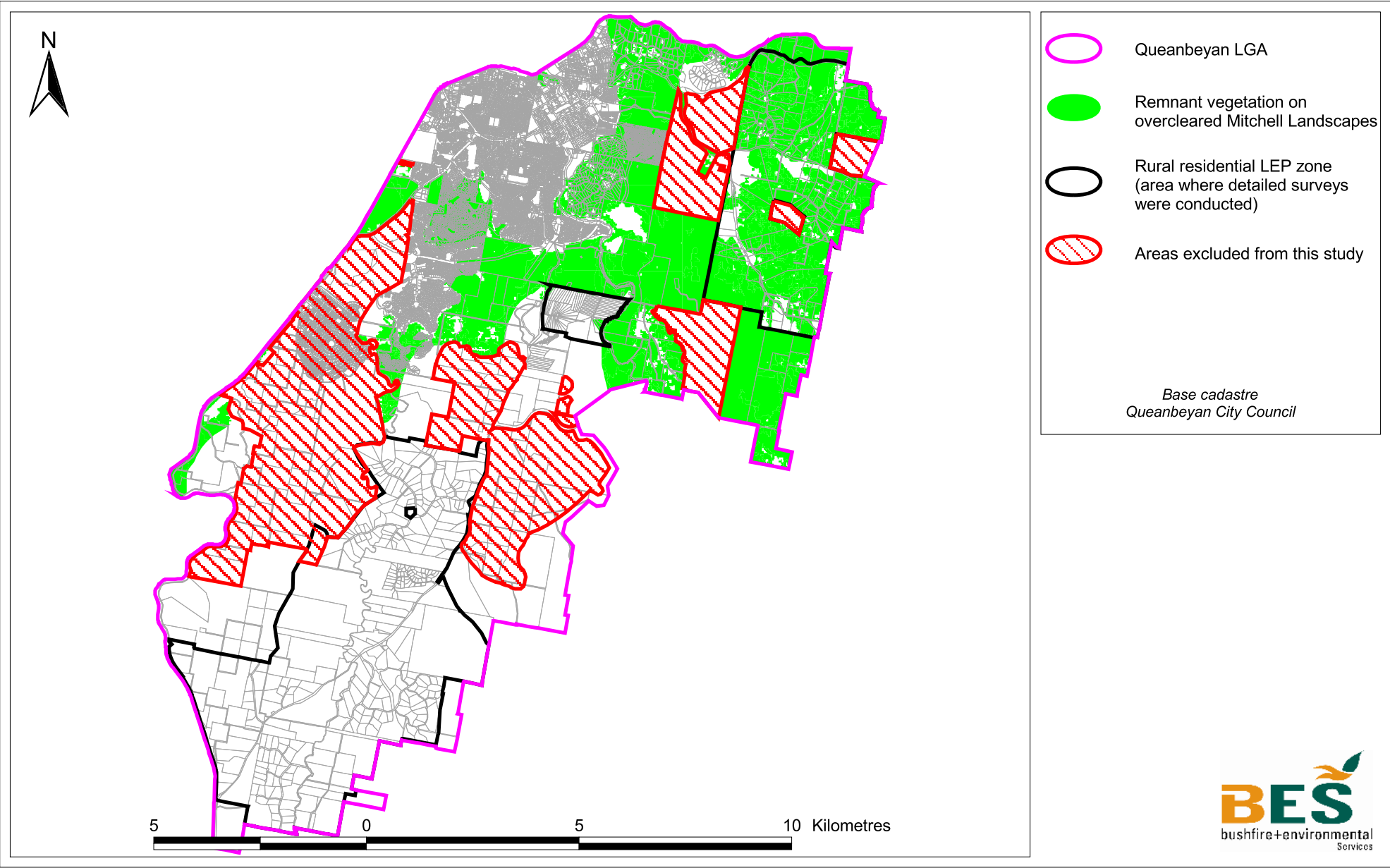


Figure 9: Distribution of HCV, MCV and LCV vegetation within the Queanbeyan LGA

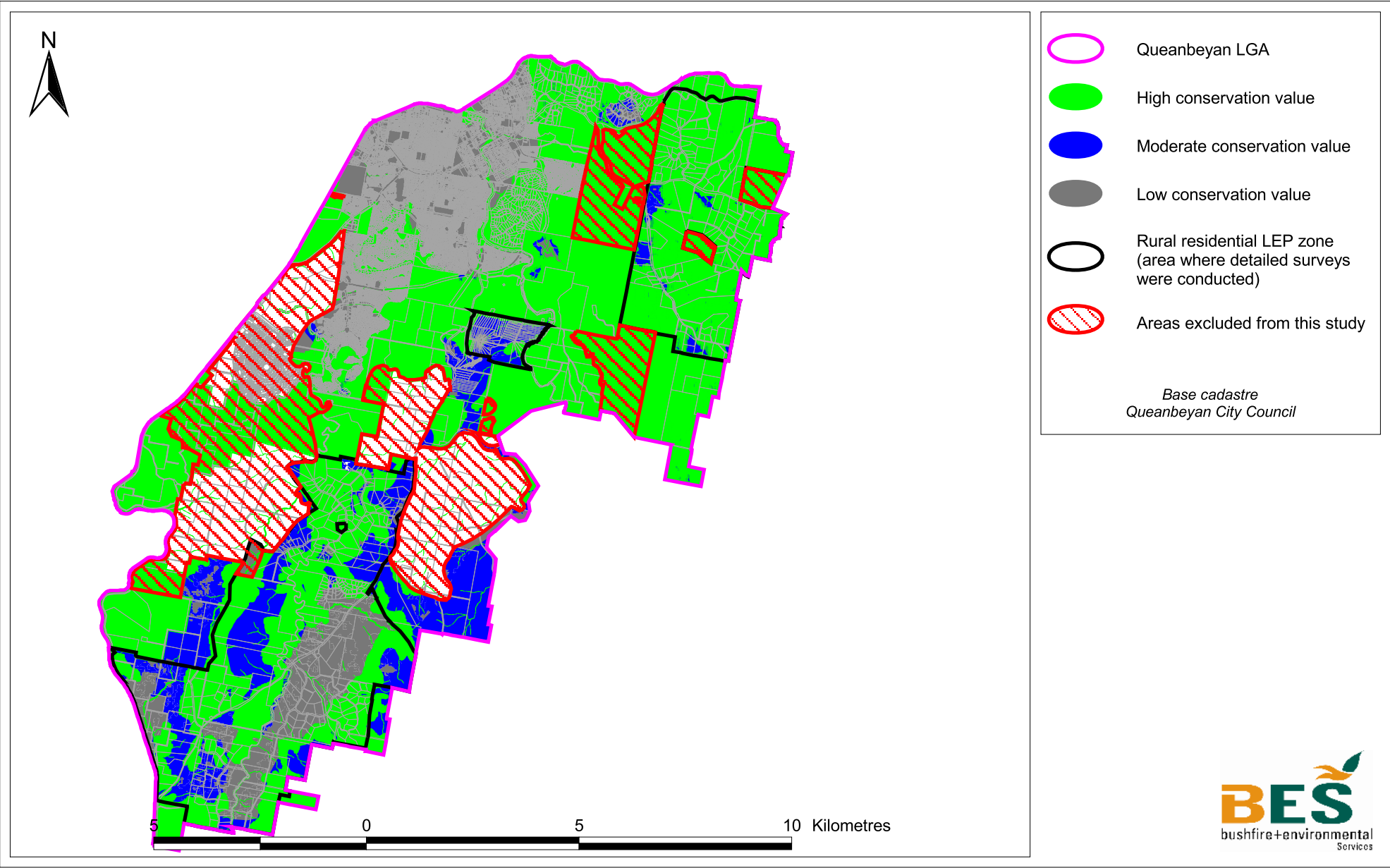




Figure 10: Areas more or less suitable for development within the Queanbeyan LGA

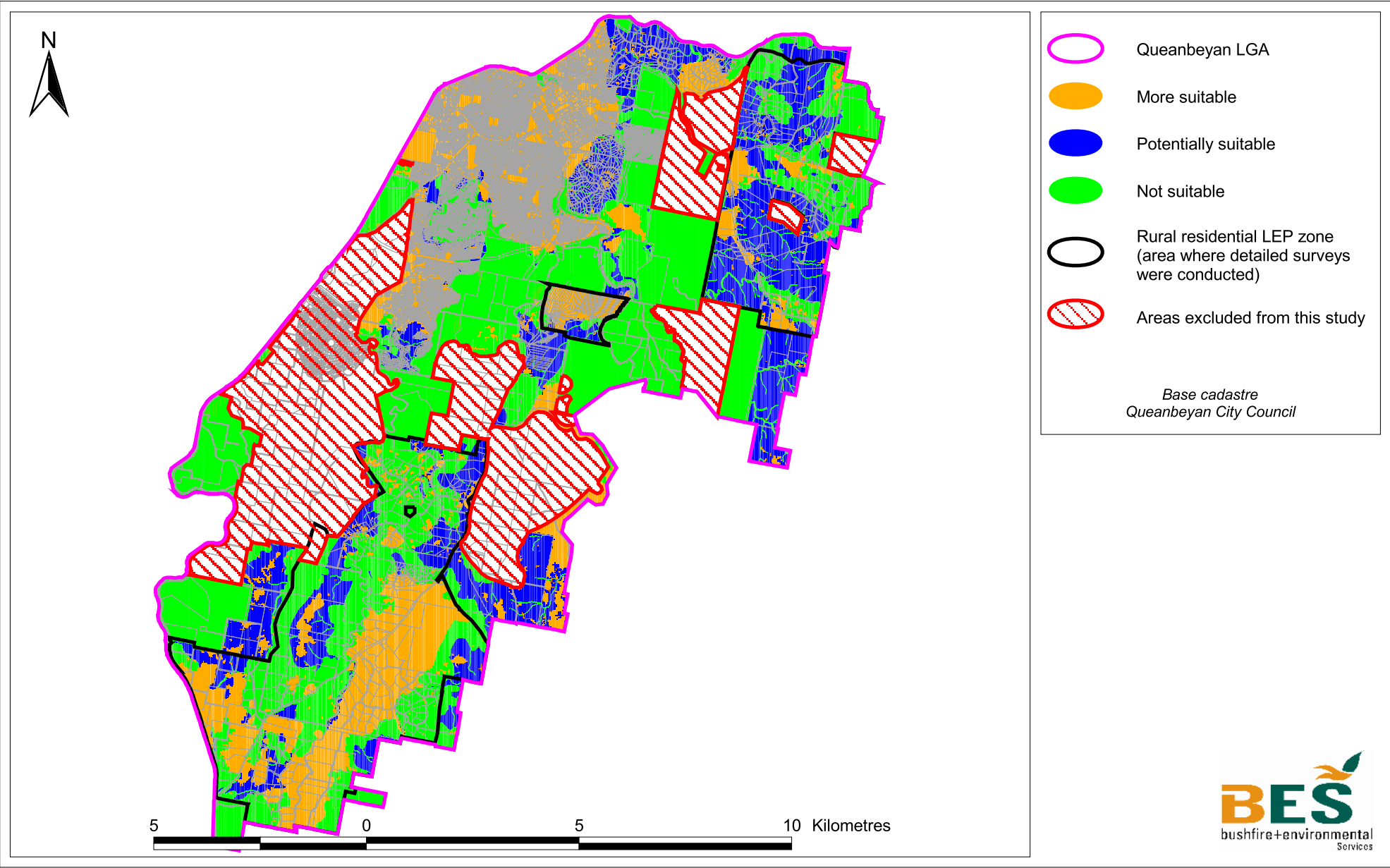
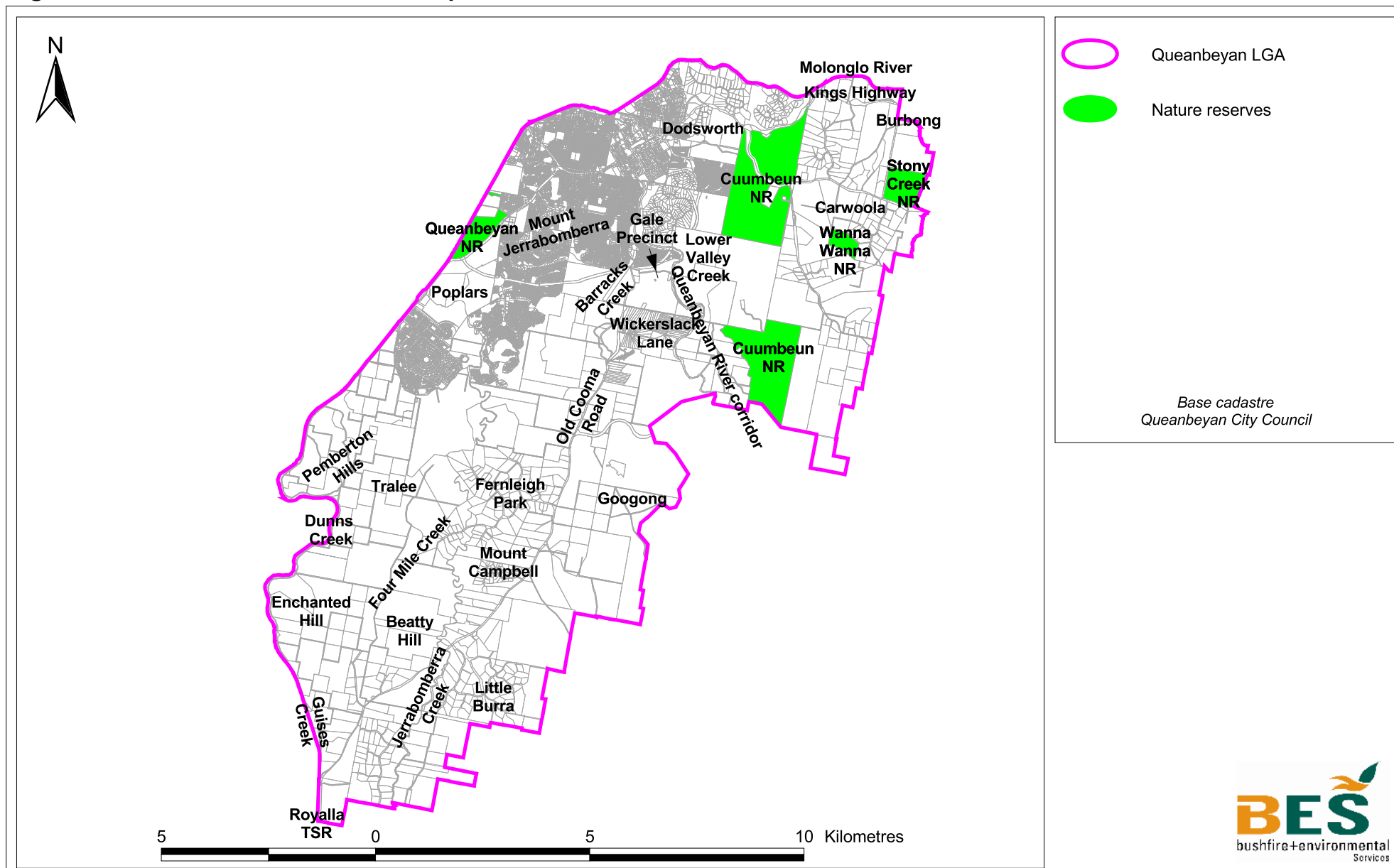


Figure 11: Localities referred to in the report



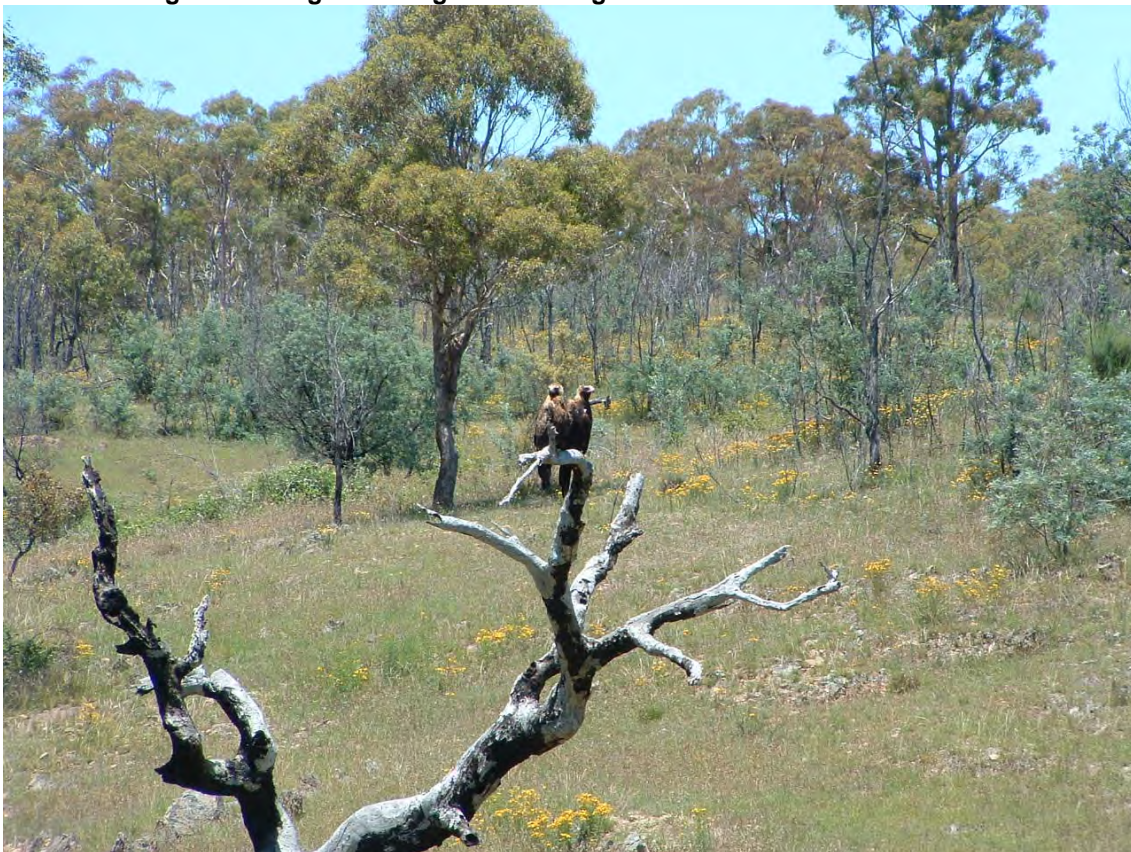
## **APPENDIX B: PHOTOS**



**Photo 1: Pink-tailed Worm Lizard at Beatty Hill.**



**Photo 2: Wedge-tailed Eagles amongst recovering Box-Gum Woodland at Carwoola.**





**Photo 3: Box-Gum Woodland at Royalla with good canopy cover but highly modified groundcover as a result of pasture improvement.**



**Photo 4: Box-Gum Woodland at Royalla with diverse native groundcover and canopy recruitment. This vegetation is recovering as a result of reduced grazing pressures.**





**Photo 5: Dry Forest in the south-eastern margins of the study area with groundcover dominated by Black-anthered Wallaby Grass**



**Photo 6: NTG remnant within existing rural residential subdivision at Little Burra.**





**Photo 7: High quality NTG on lower western slopes of Beatty Hill with more heavily disturbed habitats on the upper slopes**



**Photo 8: Grassland-Woodland Mosaic on the eastern slopes of Beatty Hill overlooking Jerrabomberra Creek and the rural residential development along Old Cooma Road.**





**Photo 9: High quality Grassland-Woodland Mosaic on eastern slopes of Beatty Hill**



**Photo 10: A large patch of high quality Wet Themeda NTG on the lower south-western slopes of Beatty Hill.**





**Photo 11: Intermediate Dry Forest and Box-Gum Woodland on the south-eastern margins of the study area with important fallen timber habitats as a result of historic clearing**



**Photo 12: Moderate Condition Box-Gum Woodland with Pink-tailed Worm Lizard potential habitat.**

