

**LISMORE LOCAL GOVERNMENT AREA**  
**KEY HABITATS AND CORRIDORS SYSTEM**



**DEVELOPMENT AND APPLICATION OF A METHODOLOGY  
TO IDENTIFY KEY HABITATS AND CORRIDORS FOR  
TERRESTRIAL VERTEBRATE SPECIES TO INFORM  
PLANNING FOR BIODIVERSITY CONSERVATION IN THE  
LISMORE LOCAL GOVERNMENT AREA**

**D.R. Milledge**

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**LANDMARK**  
Ecological Services Pty Ltd

PO Box 100 Suffolk Park NSW 2481 Australia  
(02) 66808889 [landmark@landmarkonline.com.au](mailto:landmark@landmarkonline.com.au)  
ABN 29 064 548 876

**cover photo:** the Endangered Giant Barred Frog *Mixophyes iteratus*, a Priority Assemblage 1.1 species



The conservation-priority Southern Leaf-tailed Gecko *Saltuarius swainii*, a Priority Assemblage 2.1 species.

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## SUMMARY

A methodology was developed to identify Key Habitats and Corridors in the Lismore City Council Local Government Area (LGA) and applied to produce a system to inform planning and assist regeneration actions for biodiversity conservation across the LGA.

Terrestrial vertebrate species were adopted as a surrogate for biodiversity and a sub-set of conservation-priority vertebrates was determined, comprising Threatened species (listed under the NSW *TSC Act 1995*) together with other eligible species. Patterns of distributions of these species within the LGA were examined to identify important blocks of habitat representing refuges, and previous habitats and corridors systems covering the Lismore LGA were considered.

A further sub-set of conservation-priority species with core habitat in the LGA was analysed to derive a series of assemblages of species considered most at risk from habitat fragmentation, isolation and degradation and other landscape-scale threatening processes such as climate change. The assemblages were then ranked in order of perceived risk from the threatening processes to enable their preferred habitats to be identified as a set of ranked key habitats.

The occurrence of key habitats across the LGA was determined from previous LGA-wide vegetation mapping and ground-truthed by limited field inspections. Large habitat blocks and linking corridors incorporating key habitats were identified, together with additional links from riparian corridors, to define a Key Habitats and Corridors system designed to maintain and enhance biodiversity throughout the Lismore LGA, with connections to other important habitats and links in adjoining LGAs.

The Key Habitats and Corridors system contains 26 sectors, comprising five blocks and 21 connectors or corridors, together with riparian links. Sectors are ranked in order of significance according to conformity with the regional system proposed by Scotts (2003), suitability as habitat for the highest ranked assemblages and the connectors on the basis of their provision of links to significant habitat blocks.

The system is compared with the previous habitats and corridors systems covering the Lismore LGA and prioritised for rehabilitation and restoration actions based on significance, linkage value and provision of habitat for the highest priority assemblages. Recommendations are provided on refining the Key Habitats and Corridors system and on mechanisms for rehabilitating and restoring gaps and degraded sections of linkages.

## 1.0 INTRODUCTION

### 1.1 *Project brief*

In August 2010 Lismore City Council (LCC) engaged Landmark Ecological Services to develop and apply a methodology to identify a system of key habitats and corridors for the Lismore Local Government Area (LGA).

Vertebrate fauna and their habitats were to be used as surrogates for overall biodiversity values in identifying and ranking the key habitats and corridors system.

The project was to use detailed vegetation mapping recently completed for two of three LCC vegetation mapping zones (**Fig. 1**) within the LGA (grey and blue zones, Stage 1 mapping, Landmark Ecological Services 2011), and existing CMA vegetation mapping (held in Council's GIS) for the remainder of the Shire (green zone) to provide information to identify key habitats.

Other data to be used in identifying the system comprised watercourse and soil mapping (held in LCC's GIS), vertebrate records from the NSW Office of Environment and Heritage's (OEH) Atlas of NSW Wildlife, and previous wildlife corridor mapping undertaken for the LGA (Scotts 2003, DECC 2007, LCC 2010 Draft LEP – Natural Resources Sensitivity Overlay Map).

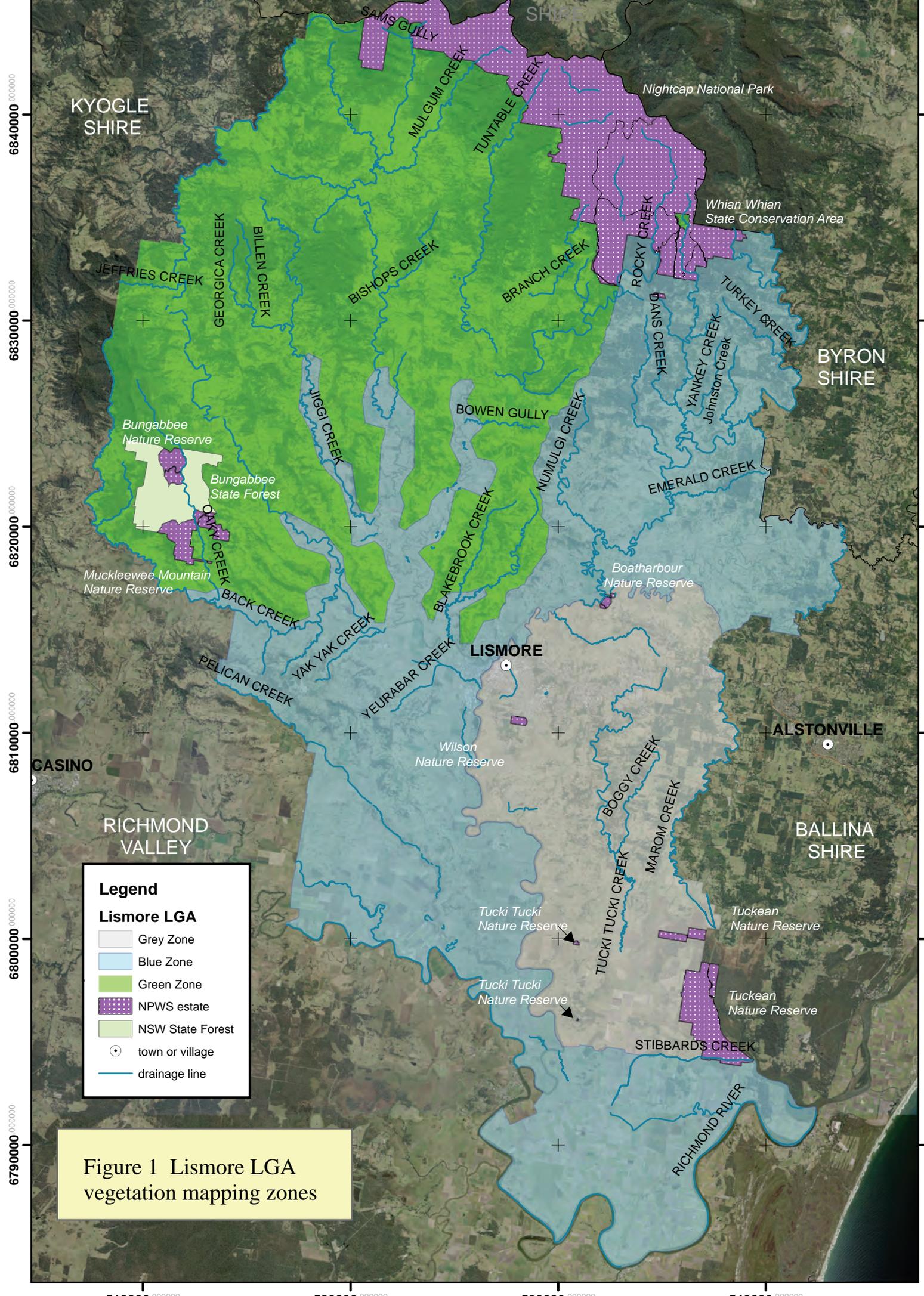
Key habitats were to be identified and ranked on the basis of their known/potential value as habitat for Threatened terrestrial vertebrate species (as listed under the NSW *Threatened Species Conservation Act 1995 (TSC Act)*) and for other conservation-priority terrestrial vertebrate species with core habitat in the Lismore LGA.

Corridors incorporating and linking the key habitats were to be identified and ranked in value for conservation-priority vertebrates and prioritised to inform planning decisions and to direct vegetation rehabilitation and restoration projects to achieve the most effective outcomes for biodiversity conservation across the LGA, particularly in relation to landscape-scale threats such as climate change.

### 1.2 *Additional aims*

Additional aims of the project incorporated after its inception were:

- i) to check the accuracy of the extent and floristics of vegetation polygons located in the green zone (not covered by the recent Landmark Ecological Services 2011 mapping); and
- ii) to prioritise the restoration and rehabilitation of habitat links in the system providing connectivity with significant areas of key habitats in adjoining shires; these include Boorabee State Forest adjacent to the north western boundary of the LGA, Andrew Johnston Big Scrub Nature Reserve and Booyong Flora Reserve on the LGA's eastern boundary, and Victoria Park Nature Reserve, the Blackwall Range and Broadwater National Park adjacent to the south eastern boundary of the LGA.



### 1.3 Values of wildlife corridors

The value of wildlife corridors as a mechanism to assist in preventing biodiversity loss resulting from the isolation, fragmentation and degradation of wildlife habitats has been widely accepted in Australia (Recher *et al.* 1987, Bennett 1990, Saunders and Hobbs 1991, Hobbs 1997, Burgman and Lindenmayer 1998, Scotts 2003, Scotts and Drielsma 2003, Mackey *et al.* 2010, National Wildlife Corridors Plan Advisory Group 2012). Isolated, fragmented and degraded habitats lose species progressively over time through genetic impoverishment, perturbations and extreme events. These losses have a cascading effect, leading to further losses and breakdowns in ecosystem functioning. The provision of corridors facilitates gene flow, the maintenance and re-establishment of ecological processes and recolonisation, enabling populations to remain viable rather than decline to extinction.

Corridors can function as movement corridors, allowing species to move through sub-optimal to optimal habitats, or as habitat corridors, supporting populations of species in optimal habitats. In the former case, the locations of corridors in the landscape can be critical, such as connecting ridge, slope and riparian habitats or catering for particular assemblages or target species. In the latter case, the habitat quality and widths of corridors become crucial.

Some adverse effects of establishing corridors have been suggested, including providing access and habitat for introduced plant and animal species and increasing the risk of disease and fire (Hobbs 1997, Burgman and Lindenmayer 1998). However, the benefits of providing corridors can be considered to largely outweigh any undesirable effects, particularly if networks are designed to connect key habitats in good condition with corridors of adequate width, and ridge, slope and riparian habitats are linked at frequent intervals (Burgman and Lindenmayer 1998, Scotts 2003, Coffs Harbour City Council NSW 2009)

## 2.0 BACKGROUND

Initial tasks in gathering data to inform the identification of key habitats and the selection of corridors comprised:

- searching the OEH Atlas of NSW Wildlife database for records of Threatened (*TSC Act*) and other conservation-priority terrestrial vertebrate species in the Lismore LGA, and sourcing additional records from local observers
- comparing mapping units (vegetation types) used in the Landmark Ecological Services vegetation mapping (Landmark mapping, 2011) of the grey and blue zones and the CMA vegetation mapping (CMA mapping) of the green zone for occurrence and similarity
- sourcing and comparing previous key habitats and corridors mapping for the LGA
- undertaking field inspections throughout the LGA to establish familiarity with the vegetation types used in the Landmark and CMA mapping

## 2.1 *Conservation-priority terrestrial vertebrates in the Lismore LGA*

### 2.1.1 **Threatened species**

Searches of the OEH Atlas of NSW Wildlife database and records supplied by several local observers (see Acknowledgements) found that a total of 51 Threatened (TSC Act) terrestrial vertebrate species have been recorded in the Lismore LGA (Table 1). OEH records were edited to exclude seabird and shorebird species and species not dependent on woody vegetation communities, and vetted to exclude species apparently extinct or erroneously recorded in the LGA (Table 1).

The total comprises five frog species, three reptile species, 21 bird species and 22 mammal species (Table 1). Eight of the species, consisting of two frog, two bird and four mammal species are also listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (*EPBC Act*, Table 1).

### 2.1.2 **Other (non-Threatened) conservation-priority species**

Searches of the OEH Atlas of NSW Wildlife database and records supplied by local observers provided records of 31 additional conservation-priority species from the LGA, comprising three frog, 14 reptile, six bird and eight mammal species (Table 1). These species were accorded conservation-priority status on the basis of their meeting one or both of two criteria: i) north-eastern NSW represented a significant part of their range, and ii) they were considered to be susceptible to one or more Key Threatening Processes (TSC Act). Their status had previously been established using these criteria by a number of regional assessment projects (Gilmore and Parnaby 1994, NSW National Parks and Wildlife Service 1995, Scotts 1996) and accepted in recent biodiversity conservation plans for the region (DECCW 2010a, b).

## 2.2 *Distribution of records of conservation-priority vertebrates in the Lismore LGA*

As expected from the confinement of large blocks of remnant and regenerated vegetation in the LGA to the north and south-east, the majority of records of most conservation-priority vertebrate species are clustered in these areas (Fig. 2). Many of these records were generated by past systematic surveys undertaken for the purposes of regional assessment (NSW National Parks and Wildlife Service 1994, 1995, CSIRO Division of Wildlife and Ecology 1996). Other clusters of records occur in areas with high densities of the Koala *Phascolarctos cinereus* (Fig. 3), a species with an exceptionally high reporting rate in the LGA (Biolink 2011) and consequent strong influence on the overall pattern of records. Smaller clusters of records of mostly the more mobile species occur in remnants of the former Big Scrub rainforest (Frith 1977, Holmes 1987) such as Wilson and Boatharbour Nature Reserves, Rotary Park and the Brockley area, or where other systematic surveys have been conducted, such as about the lower reaches of Rocky Creek (SMEC 2011) and where local observers have been active (Appendix 1).

An analysis of the number of records of conservation-priority species from the LGA compared with their relative abundance elsewhere in the region (OEH

**TABLE 1 CONSERVATION-PRIORITY TERRESTRIAL VERTEBRATE SPECIES RECORDED IN THE LISMORE LGA**

with conservation status, zoogeographical origin, and dispersal capability, and the presence of core habitat in the LGA

Records from OEH Atlas of NSW Wildlife database extracted 11 November 2010 and 13 September 2011 (edited to exclude seabird species, shorebird species and species not dependent on woody vegetation communities<sup>1</sup>, and vetted to exclude species apparently extinct in the LGA<sup>2</sup> or recorded in error<sup>3</sup>) and supplemented by records from local observers.

\* species also listed under the Commonwealth *EPBC Act* (1999)

**Species with core habitat in Lismore LGA** (compared with relative abundance elsewhere in the region).

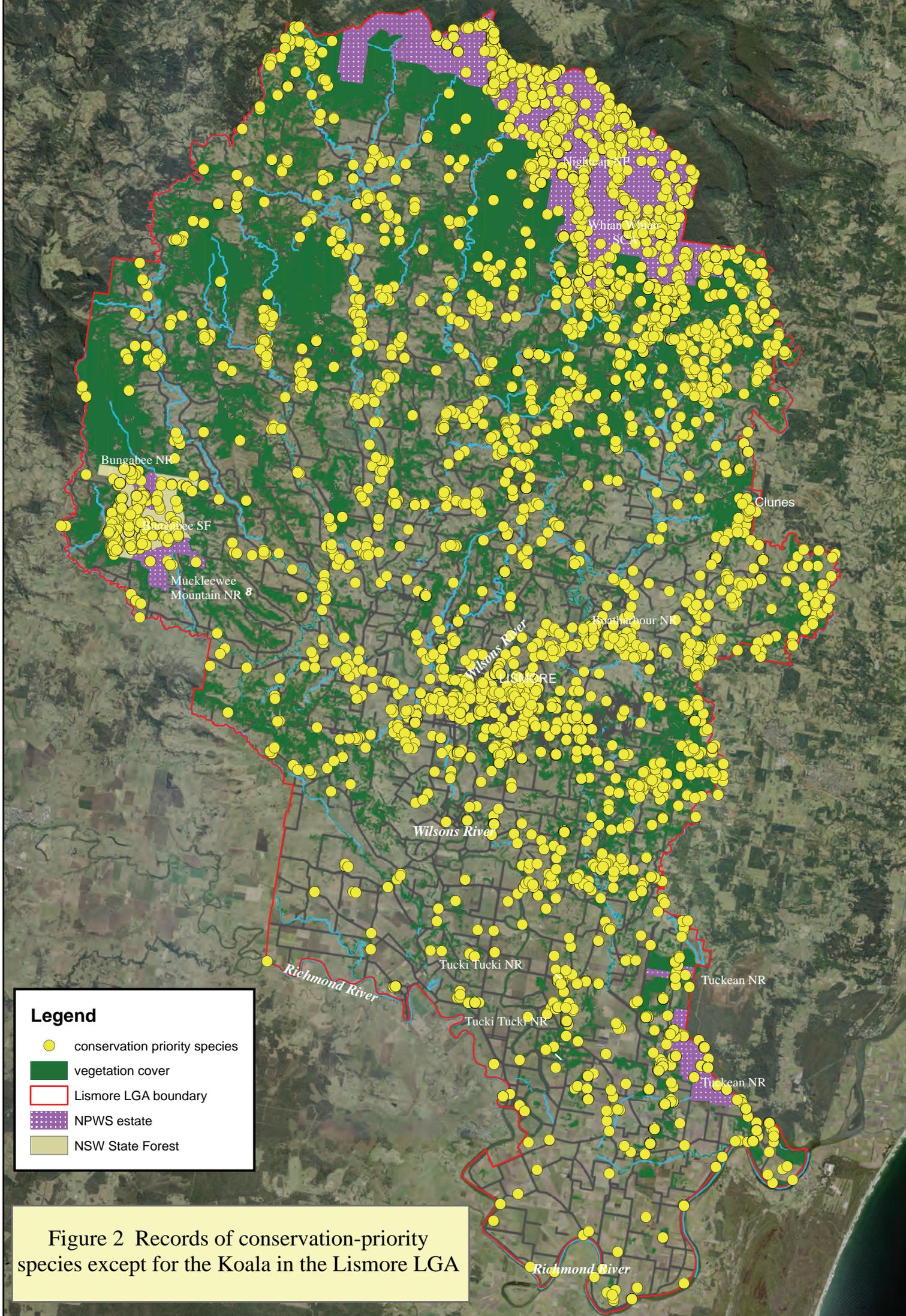
species	TSC Act status	zoogeographical origin	dispersal capability
	E - endangered V - vulnerable	TU - Tumbunan B - Bassian TO - Torresian I - Irian	
<b>amphibians</b>			
Green-thighed Frog <i>Litoria brevipalmata</i>	V	TU	low
Pearson's Tree Frog <i>Litoria pearsoniana</i>		TU	low
Whirring Tree Frog <i>Litoria revelata</i>		TU	low-moderate
Pouched Frog <i>Assa darlingtoni</i>	V	TU	low
Fletcher's Frog <i>Lechriodus fletcheri</i>		TU	low
*Fleay's Barred Frog <i>Mixophyes fleayi</i>	E	TU	low
*Giant Barred Frog <i>Mixophyes iterates</i>	E	TU	low
Loveridge's Frog <i>Phyllorhina loveridgei</i>	E	TU	low
<b>reptiles</b>			
Southern Leaf-tailed Gecko <i>Saltuarius swainii</i>		TU	low
Scute-snouted Calyptotis <i>Calyptotis scutirostrum</i>		TU	low
Three-toed Snake-toothed Skink <i>Coeranoscincus reticulatus</i>	V	TU	low
Major Skink <i>Bellatorius frerei</i>		TO	low-moderate
Land Mullet <i>Bellatorius major</i>		TU	low-moderate
McPhee's Skink <i>Bellatorius mcpheei</i>		TU	low-moderate
Martin's Skink <i>Eulamprus martini</i>		TU	low-moderate
Blue-speckled Forest-skink <i>Eulamprus murrayi</i>		TU	low-moderate
Short-limbed Snake-skink <i>Ophioscincus truncatus</i>		TU	low
Orange-tailed Shadenskink <i>Saproscincus challengerii</i>		TU	low
Rose's Skink <i>Saproscincus rosei</i>		TU	low
Gully Shadenskink <i>Saproscincus spectabilis</i>		TU	low
Southern Angle-headed Dragon <i>Hypsilurus spinipes</i>		TU	low
White Crowned Snake <i>Cacophis harriettae</i>	V	TO	moderate
Dwarf Crowned Snake <i>Cacophis krefftii</i>		TU	low-moderate
Stephen's Banded Snake <i>Hoplocephalus stephensi</i>	V	TU	moderate
Rough-scaled Snake <i>Tropidechis carinatus</i>		TU	moderate
<b>birds</b>			
Wompoo Fruit-dove <i>Ptilinopus magnificus</i>	V	I	high

cont. Table 1 Conservation-priority terrestrial vertebrates in the Lismore LGA

Superb Fruit-dove <i>Ptilinopus superbus</i>	V	I	high
Rose-crowned Fruit-dove <i>Ptilinopus regina</i>	V	I	high
Top-knot Pigeon <i>Lopholaimus antarcticus</i>		TU	high
Marbled Frogmouth <i>Podargus ocellatus</i>	V	I	moderate
Black Bittern <i>Ixobrychus flavicollis</i>	V	I	high
Little Eagle <i>Hieraaetus morphnoides</i>	V	TO	high
Pale-vented Bush-hen <i>Amaurornis moluccana</i>	V	I	moderate-high
Glossy Black-cockatoo <i>Calyptorhynchus lathami</i>	V	B	high
Little Lorikeet <i>Glossopsitta pusilla</i>	V	B	high
Little Bronze-cuckoo <i>Chalcites minutillus</i>		I	high
Powerful Owl <i>Ninox strenua</i>	V	B	high
Barking Owl <i>Ninox connivens</i>	V	TO	high
Sooty Owl <i>Tyto tenebricosa</i>	V	TU	moderate-high
Masked Owl <i>Tyto novaehollandiae</i>	V	B	high
Albert's Lyrebird <i>Menura alberti</i>	V	TU	moderate
Regent Bowerbird <i>Sericulus chrysocephalus</i>		TU	high
*Eastern Bristlebird <i>Dasyornis brachypterus</i>	E	B	moderate
*Regent Honeyeater <i>Anthochaera phrygia</i>	E	B	high
Little Shrike-thrush <i>Colluricincla megarhyncha</i>		I	moderate-high
Paradise Riflebird <i>Ptiloris paradiseus</i>		TU	moderate
Pale-yellow Robin <i>Tregellasia capito</i>		TU	moderate
Grey-crowned Babbler <i>Pomatostomus temporalis</i>	V	B	moderate-high
Varied Sittella <i>Daphoenositta chrysoptera</i>	V	B	moderate-high
Barred Cuckoo-shrike <i>Coracina lineata</i>	V	TU	high
Olive Whistler <i>Pachycephala olivacea</i>	V	B	moderate
White-eared Monarch <i>Carterornis leucotis</i>	V	I	moderate-high
<b>mammals</b>			
*Spotted-tailed Quoll <i>Dasyurus maculatus</i>	V	B	moderate-high
Subtropical Antechinus <i>Antechinus subtropicus</i>		TU	low-moderate
Common Planigale <i>Planigale maculata</i>	V	TO	low-moderate
Koala <i>Phascolarctos cinereus</i>	V	B	moderate-high
Yellow-bellied Glider <i>Petaurus australis</i>	V	B	moderate-high
Squirrel Glider <i>Petaurus norfolkensis</i>	V	TO	moderate-high
Greater Glider <i>Petauroides volans</i>		B	moderate
* Long-nosed Potoroo <i>Potorous tridactylus</i>	V	B	moderate
Parma Wallaby <i>Macropus parma</i>	V	TU	moderate
Red-legged Pademelon <i>Thylogale stigmatica</i>	V	TU	moderate
Red-necked Pademelon <i>Thylogale thetis</i>		TU	moderate
Eastern Blossom-bat <i>Syconycteris australis</i>	V	I	moderate-high
Eastern Tube-nosed Bat <i>Nyctimene robinsoni</i>	V	I	moderate
Black Flying-fox <i>Pteropus alecto</i>		I	high
*Grey-headed Flying-fox <i>Pteropus poliocephalus</i>	V	I	high
Eastern Horseshoe Bat <i>Rhinolophus megaphyllus</i>		TU	moderate-high
Yellow-bellied Sheath-tailed Bat <i>Saccolaimus flaviventris</i>	V	TO	high
Beccari's Free-tailed Bat <i>Mormopterus beccarii</i>	V	TO	high
East-coast Free-tailed Bat <i>Mormopterus norfolkensis</i>	V	B	high
Little Bent-winged Bat <i>Miniopterus australis</i>	V	TU	high
Eastern Bent-winged Bat <i>Miniopterus schreibersii</i>	V	TO	high
Golden-tipped Bat <i>Kerivoula papuensis</i>	V	TU	moderate

cont. **Table 1 Conservation-priority terrestrial vertebrates in the Lismore LGA**

Eastern Long-eared Bat <i>Nyctophilus bifax</i>	V	TU	moderate
*Large-eared Pied Bat <i>Chalinolobus dwyeri</i>	V	TU	moderate-high
Eastern False Pipistrelle <i>Falsistrellus tasmaniensis</i>	V	B	high
Southern Myotis <i>Myotis adversus</i>	V	B	high
Greater Broad-nosed Bat <i>Scoteanax rueppellii</i>	V	TU	high
Central-eastern Broad-nosed Bat <i>Scotorepens</i> sp. 1		TO	high
Eastern Forest Bat <i>Vespadelus pumilus</i>		TU	moderate-high
Fawn-footed Melomys <i>Melomys cervinipes</i>		TU	low-moderate
<b>Total 82 species</b>			
<b>Summary</b>			
<b>TSC Act</b>			
Total endangered species	5	(6% of conservation-priority species)	
Total vulnerable species	46	(56% of conservation-priority species)	
Total TSC Act species	51	(62% of conservation-priority species)	
Total non- TSC Act species	31	(38% of conservation-priority species)	
<b>Zoogeographical origin</b>			
Total Tumbunan species	42	(51%)	
Total Bassian species	17	(21%)	
Total Torresian species	10	(12%)	
Total Irian species	13	(16%)	
<b>Dispersal capability</b>			
low	15	(18%)	
low-moderate	10	(12%)	
moderate	17	(21%)	
moderate-high	14	(17%)	
high	26	(32%)	
<b>Total species with core habitat in the LGA</b>	50	(56%)	
<b><sup>1</sup>species not dependent on woody vegetation communities</b>			
Magpie Goose <i>Anseranus semipalmata</i>			
Freckled Duck <i>Stictonetta naevosa</i>			
Blue-billed Duck <i>Oxyura australis</i>			
Black-necked Stork <i>Ephippiorhynchus asiaticus</i>			
Eastern Osprey <i>Pandion haliaetus</i>			
Spotted Harrier <i>Circus assimilis</i>			
Brolga <i>Grus rubicunda</i>			
Comb-crested Jacana <i>Irediparra gallinacea</i>			
<b><sup>2</sup>species probably extinct in Lismore LGA</b>			
Red Goshawk <i>Erythrorhynchus radiatus</i>			
Black-breasted Button-quail <i>Turnix melanogaster</i>			
Double-eyed Fig-parrot <i>Cyclopsitta diophthalma coxeni</i>			
Rufous Scrub-bird <i>Atrichornis rufescens</i>			
<b><sup>3</sup>species apparently erroneously listed as present in Lismore LGA</b>			
Red-tailed Black-cockatoo <i>Calyptorhynchus banksii</i>			
Brush-tailed Phascogale <i>Phascogale tapoatafa</i>			
Rufous Bettong <i>Aepyprymnus rufescens</i>			



**Legend**

- conservation priority species
- vegetation cover
- Lismore LGA boundary
- NPWS estate
- NSW State Forest

Figure 2 Records of conservation-priority species except for the Koala in the Lismore LGA

Atlas of NSW Wildlife) indicates that 49 (60%) of the 82 species occurring in the LGA can be regarded as having core habitat there (**Table 1**). This assemblage is dominated by Tumbunan species (51%) with smaller numbers of Irian (13%), Bassian (17%) and Torresian species (10%)(**Table 1**). Tumbunan species represent the “old” rainforest biota, relicts or directly descended from the fauna of the Gondwanan rainforests that covered the continent during the mid to late Tertiary Period (Schodde and Calaby 1972, Schodde and Faith 1991, CSIRO Division of Wildlife and Ecology 1996). Similarly, Irian species represent the New Guinean rainforest fauna, “new” or more recent arrivals from when land bridges linked New Guinea to the Australian mainland. Torresian species represent the fauna of the hot, dry savannah woodlands of northern Australia and Bassian species the fauna of the tall, wet forests of south-eastern Australia.

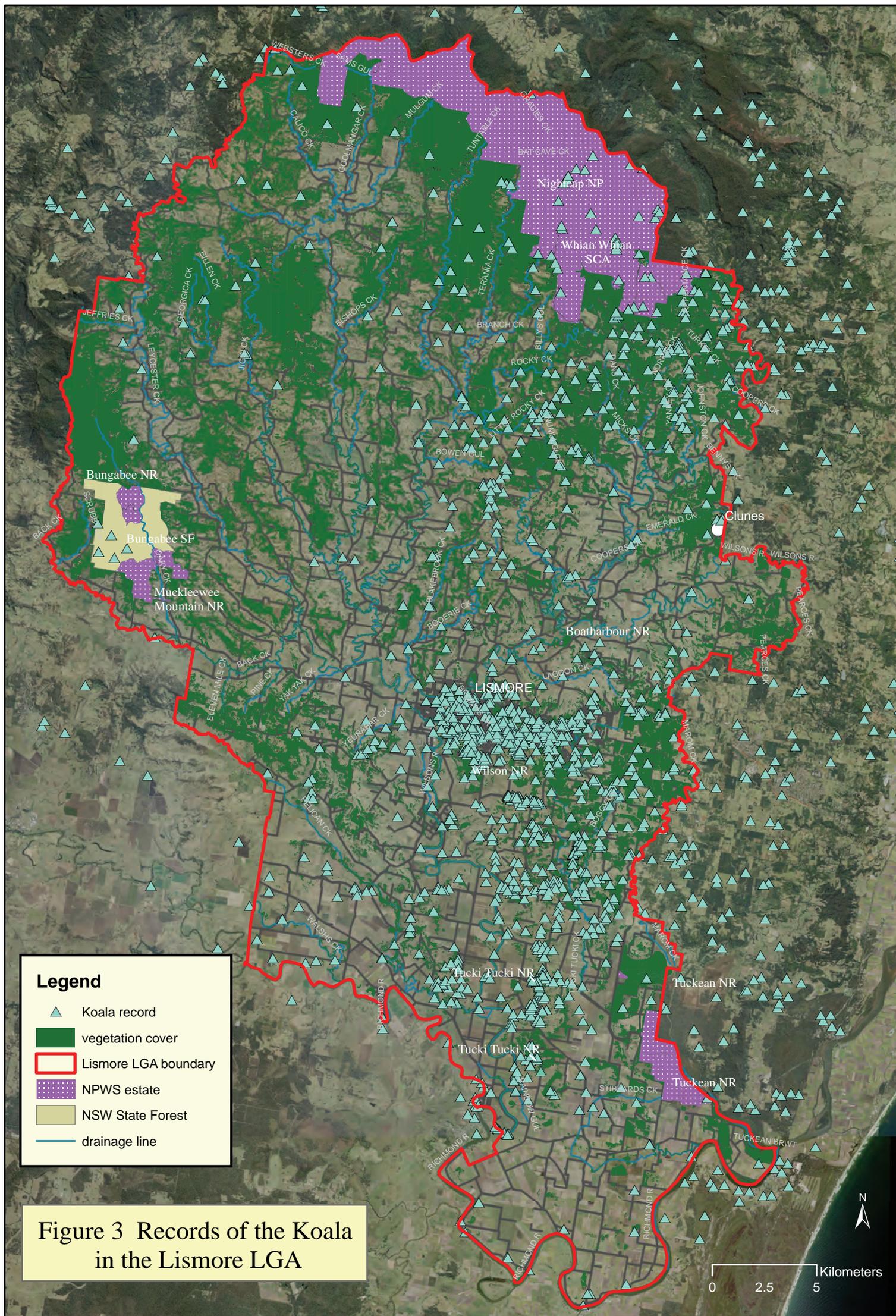
Several additional conservation-priority species not provided with substantial areas of core habitat in the LGA but which nevertheless maintain small populations there are also probably important in terms of sustaining population viability at a sub-regional level. These species include the Southern Angle-headed Dragon *Hypsilurus spinipes*, White Crowned Snake *Cacophis harriettae*, Glossy Black-cockatoo *Calyptorhynchus lathami*, Powerful Owl *Ninox strenua*, Masked Owl *Tyto novaehollandiae*, Spotted-tailed Quoll *Dasyurus maculatus*, Yellow-bellied Glider *Petaurus australis*, Squirrel Glider *Petaurus norfolcensis*, Greater Glider *Petauroides volans*, Eastern Blossom-bat *Syconycteris australis* and Eastern Bent-winged Bat *Miniopterus schreibersii*. However, these species have not been included for the purpose of identifying key habitats.

### 2.3 *Habitat for conservation-priority vertebrates in the Lismore LGA*

An examination of the records of conservation-priority vertebrate species overlaid on vegetation mapping for the three LGA zones (**Fig. 4**) indicates that all native woody vegetation cover in the LGA provides potential habitat for these species.

As noted in s.2.2, habitats supporting conservation-priority terrestrial vertebrate species are concentrated in the north and south-east, where three large un-fragmented blocks of native vegetation provide refuges for fauna in the Nightcap and Mackellar Ranges and in the Tuckean Swamp area (**Fig. 3**). A high proportion of these blocks are protected in public reserves comprising the Nightcap National Park, Nightcap State Recreation Area and Bungabee, Muckleewee Mountain and Tuckean Nature Reserves.

Other smaller and generally fragmented refuges are located in the Mount Billen and Nimbin Rocks areas, on the ridges running north-south between Leycester, Jiggi, Goolmangar and Koonorigan Creeks, about the lower reaches of Rocky Creek and the middle reaches of Dan’s Creek (Doroughby), on the ridge running east-west north of Pelican Creek, about the upper and middle reaches of Tucki Tucki Creek and on the Tuckirimba Ridge.

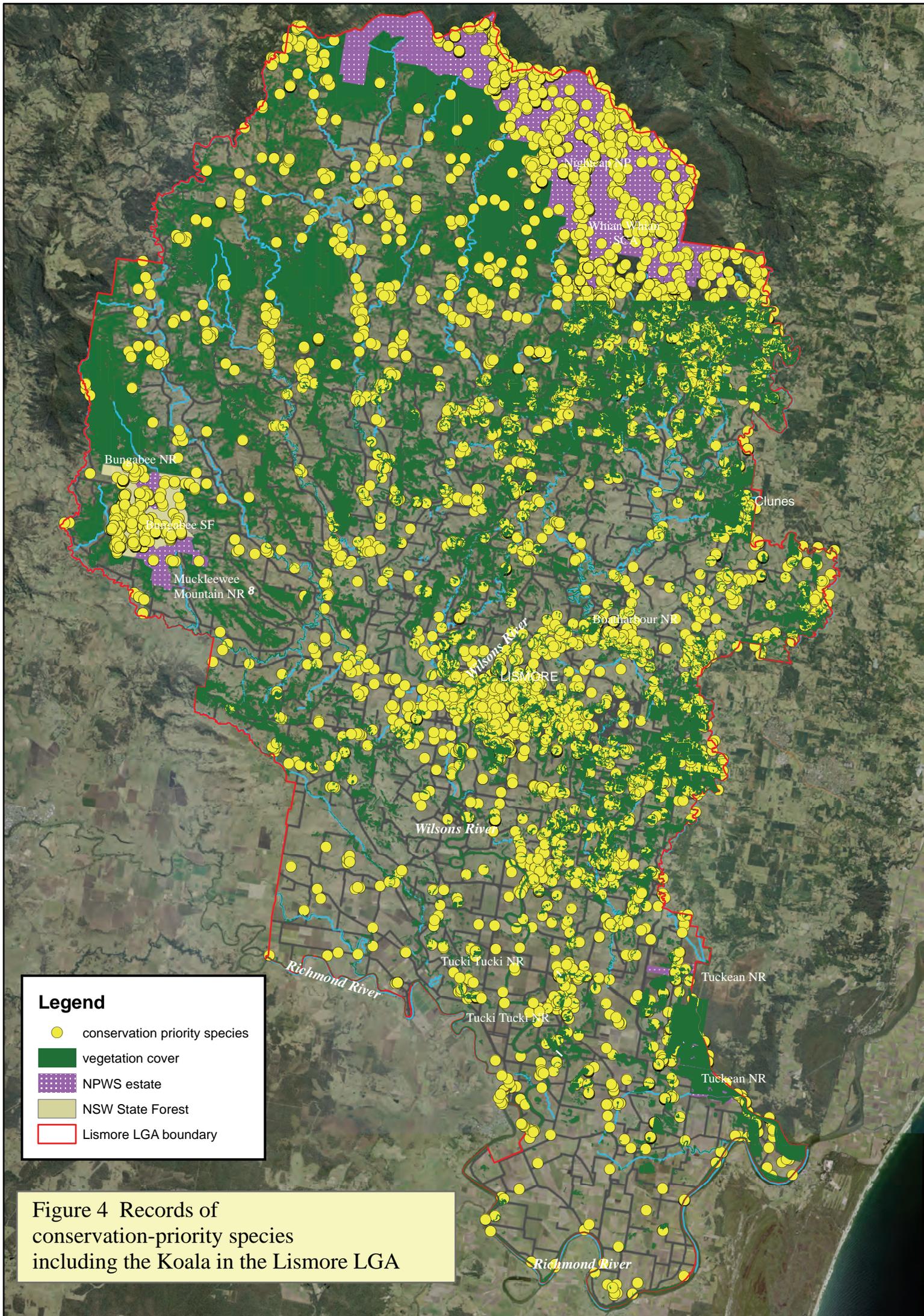


**Legend**

-  Koala record
-  vegetation cover
-  Lismore LGA boundary
-  NPWS estate
-  NSW State Forest
-  drainage line

**Figure 3** Records of the Koala in the Lismore LGA

0 2.5 5 Kilometers



**Legend**

- conservation priority species
- vegetation cover
- NPWS estate
- NSW State Forest
- Lismore LGA boundary

**Figure 4** Records of conservation-priority species including the Koala in the Lismore LGA

Some even smaller refuges of original forest occur as remnants of the former Big Scrub rainforest, including the Wilson and Boatharbour Nature Reserves, Rotary Park and at Brockley.

Lists of conservation-priority species for major and some minor refuges are provided in **Appendix 1**.

The three main fauna refuges represent three different broad vegetation communities, with the Nightcap Range block dominated by rainforest and wet sclerophyll forest, the Mackellar Range block dominated by moist and drier eucalypt forests and the Tuckean Swamp block dominated by swamp forests. As a consequence, their vertebrate assemblages are typified by species dependent on these vegetation communities. Species characteristic of the Nightcap Range include Fleay's Barred Frog *Mixophyes fleayi*, Loveridge's Frog *Phyllorhina loveridgei*, the Southern Leaf-tailed Gecko *Saltuarius swainii*, Orange-tailed Shadescink *Saproscincus challengerii*, Stephen's Banded Snake *Hoplocephalus stephensi*, Superb Fruit-dove *Ptilinopus superbus*, Marbled Frogmouth *Podargus ocellatus*, Paradise Riflebird *Ptiloris paradiseus*, Red-legged Pademelon *Thylogale stigmatica* and Golden-tipped Bat *Kerivoula papuensis*; species characteristic of the Mackellar Range include Martin's Skink *Eulamprus martini*, the Glossy Black-cockatoo, Varied Sittella *Daphoenositta chrysoptera*, Yellow-bellied Glider and Squirrel Glider; and species characteristic of the Tuckean Swamp area include the Black Bittern *Ixobrychus flavicollis*, Pale-vented Bush-hen *Amaurornis moluccana*, Common Planigale *Planigale maculata*, Beccari's Free-tail Bat *Mormopterus beccarii* and Eastern Long-eared Bat *Nyctophilus bifax*.

In terms of importance for biodiversity conservation, the Nightcap Range block stands out as of major significance as it is the centre of distribution of the Tumbunan vertebrate fauna in the LGA and supports the main populations of relictual species such as the Pouched Frog, Fleay's Barred Frog, Loveridge's Frog, Southern Leaf-tailed Gecko, Stephen's Banded Snake, Sooty Owl *Tyto tenebricosa*, Albert's Lyrebird *Menura alberti* and Red-legged Pademelon. Many of these species are also of conservation and scientific significance as regional endemics, such as Fleay's Barred Frog, and as species representing basal lineages, such as Albert's Lyrebird.

#### 2.4 *Previously identified key habitats and corridors in the Lismore LGA*

Three key habitats and corridors systems covering the LGA have previously been described. These comprise:

- the LGA component of the National Parks and Wildlife Service (NPWS, now OEH) key habitats and corridors system developed for the north eastern NSW region (Scotts 2003, **Appendix 2**)
- the LGA component of a system of climate change corridors designed to direct strategic conservation efforts in the Northern Rivers Catchment Management Authority area (DECC 2007, **Appendix 3**)
- the LCC 2010 Draft LEP – Natural Resources Sensitivity Overlay Map (LCCDLEP-OM), incorporating the NPWS key habitats and corridors

(Scotts 2003) and adding larger adjacent vegetation blocks (**Appendix 4**)

Features of the NPWS key habitats and corridors system and of the LCCDLEP-OM (which is based on the former) are the absence of identified key habitats and a lack of connectivity through the central and south western sections of the LGA. This appears to be a result of the scarcity of large blocks of key habitats in these areas, resulting from extensive clearing at the time of European settlement. The lack of identified corridors through the centre and south west of the LGA has been perpetuated in later biodiversity conservation planning for the region, for example in the Northern Rivers Regional Biodiversity Management Plan (DECCW 2010b). In contrast, the DECC climate change corridors system incorporates broad linkages focused more on providing suitable potential (theoretical) corridors rather than on existing stands of vegetation or key habitats. This corridor system is also included in current biodiversity conservation planning for the region (DECCW 2010b).

#### **2.4.1 NPWS key habitats and corridors system**

The NPWS key habitats and corridors system is designed primarily to link NPWS estate and incorporates the three main refuges or large un-fragmented key habitats blocks (s.2.3, including Nightcap National Park, Nightcap State Recreation Area and Bungabee, Mucklewee Mountain and Tuckean Nature Reserves) in regional corridors that fall largely outside the LGA. However, the Nightcap and Mackellar Ranges are linked within the LGA by the Nimbin regional corridor encompassing key habitats across the upper reaches of Terania, Tuntable, Goolmangar, Jiggi and Leycester Creeks. Several sub-regional corridors incorporating key habitats link to the Nimbin regional corridor and to the Nightcap Range, but these are mostly truncated and do not provide continuous linkages for fauna movements.

Another feature of the NPWS system is that it largely excludes riparian corridors, particularly along the Richmond and Wilson's Rivers, which again reflects the absence of substantial areas of key habitats associated with these watercourses.

A number of "reference" conservation-priority vertebrate species, representing modelled vertebrate assemblages for the north eastern NSW region, are listed for the various regional and sub-regional corridors, although in some cases these appear inaccurate. For example, while the Nimbin regional corridor linking the Nightcap and Mackellar Range refuges contains suitable habitat for listed species such as Stephen's Banded Snake and Albert's Lyrebird, it includes little suitable habitat for the Yellow-bellied Glider and Rufous Bettong *Aepyprymnus rufescens*, with no verified records of the latter species in the LGA. One cause for this is likely to be the inadequacy of the CMA mapping in the green zone (as discussed in **s.3.4**) that was used to predict the occurrence of the modelled vertebrate assemblages.

#### **2.4.2 DECC climate change corridors system**

The DECC Climate Change Corridors System provides links across the landscape that cater for three broad groupings of the NPWS vertebrate

assemblages, combined on the basis of perceived risk from climate change impacts into moist, dry and coastal complex assemblages. Within the LGA, the three major refuges containing National Park estate are linked by wide corridors catering for moist and coastal vertebrate assemblages that broadly follow the NPWS system but incorporate two additional linkages across the central and south western sections of the LGA. The latter link the southern foothills of the Mackellar Range with the south eastern foothills of the Nightcap Range and the eastern extremity of the Blackwall Range (Alstonville Plateau Link).

This system provides improved spatial connectivity within the LGA compared with the NPWS system although it generally ignores the distribution pattern of NPWS key habitats and contains numerous wide gaps. In addition, the selection of some reference species to characterise links in the LGA appears inappropriate. For example, little suitable habitat is present or is likely to be restored in the southern Mackellar Range to eastern Blackwall Range link and in the southern Mackellar Range to south eastern Nightcap Range link for the Pouched Frog *Assa darlingtoni*, a reference species for these corridors. Further, the Rose-crowned Fruit-dove *Ptilinopus regina*, a reference species for most corridors in the LGA has a high dispersal capability and is unlikely to be as severely affected by climate change impacts and lack of connectivity as many other conservation-priority vertebrates with lower dispersal capabilities that are known or potential inhabitants of these corridors.

#### **2.4.3 LCC 2010 Draft LEP – Natural Resources Sensitivity Overlay Map**

As noted above, the LCCDLEP-OM is based on the NPWS system with additional habitat added to the Nightcap and Bungabee blocks and the Konoorigan and Rocky Creek (Terania Creek) truncated corridors. Habitat has also been added as a further truncated corridor between Leycester and Jiggi Creeks and as an isolated block in the southern foothills of the Mackellar Range north of Pelican Creek. This improves the coverage of key habitats but retains the lack of connectivity that characterises the NPWS system at the local level.

#### *2.5 Field inspections*

Field inspections were undertaken throughout the LGA from May to October 2011 (**Appendices 5 and 6**), which assisted in determining the suitability of mapped vegetation types as preferred habitat for conservation-priority vertebrates and gauging the accuracy of the CMA mapping in the green zone (the latter is discussed in **s.3.4**). Field inspections amounted to 16 person days and resulted in records of nine conservation-priority species, in particular a number of records of the Koala (**Appendix 5**).

### **3.0 METHODOLOGY**

The process followed in developing a methodology for the selection of key habitats and corridors to benefit biodiversity conservation in the LGA consisted of:

- selecting the set of conservation-priority vertebrate species with core habitat in the LGA and grouping these into assemblages ranked on the basis of perceived risk from current and potential threats
- identifying and ranking key habitats, as represented by the mapped vegetation types, as preferred habitats for the prioritised vertebrate assemblages

### 3.1 *Selection and prioritisation of vertebrate assemblages*

Vertebrates with core habitat in the LGA (**Table 1**) were assessed and grouped into assemblages (**Table 2**) that reflected common attributes based on zoogeographical origin and habitat preference, conservation status (*TSC Act* listing) and dispersal capability.

The assemblages were ranked on the basis of perceived level of risk from threatening processes (**Table 2**), particularly from climate change and other impacts resulting in habitat isolation, fragmentation and degradation.

Species formally listed as Threatened were considered at higher risk than non-Threatened species, and species with low dispersal capability were expected to be at greater risk from climate change and other impacts resulting in habitat isolation and fragmentation than species with moderate or high dispersal capability.

Species of Tumbunan origin were considered more at risk than species of other zoogeographical origin as they are typically either relictual species or species with restricted ranges and dependent on rainforest or rainforest/wet sclerophyll forest habitats. Such species are likely to be at high risk from climate change because of the predicted contraction and fragmentation of rainforests. Similarly, Irian and some Bassian species are also likely to be at risk from the loss of rainforest and wet sclerophyll forest, but not to the same extent as Tumbunan species. Irian species, being relatively recent colonisers of subtropical Australia may have a greater ability to adapt to climate change effects and changes to habitats, and Bassian species may be more resilient to impacts because of their wider niche breadths. Other Bassian and Torresian species were considered the least at risk because of the drier, more open nature of their preferred habitats, with a lower level of predicted climate change impacts on these habitats

The dispersal capability of species was assessed and ranked in five categories (low, low-moderate, moderate, moderate-high and high) from known behavioural characteristics including overall mobility, ranging from widely dispersing migratory or nomadic (“stepping-stone”) birds and flying-foxes to small, sedentary terrestrial frogs and reptiles with restricted movement ability, and the capacity to cross habitat gaps.

The criteria used to group species resulted in several species being included in two or more assemblages (**Table 2**). These are typically altitudinal migrants using hinterland and coastal habitats in different seasons, such as the Wompoo Fruit-dove *Ptilinopus magnificus*, Rose-crowned Fruit-dove, Top-knot Pigeon *Lopholaimus antarcticus*, Black Flying-fox *Pteropus alecto* and

**TABLE 2 PRIORITISED VERTEBRATE ASSEMBLAGES DERIVED FOR SPECIES WITH CORE HABITAT IN THE LISMORE LGA**

Derived from species' attributes listed in **Table 1**.

\* species included in two or more assemblages

assemblage	species
<b>Priority 1 assemblages</b>	
1.1 Tumbunan – rainforest/wet sclerophyll forest dependent Threatened low dispersal capability	Pouched Frog <i>Assa darlingtoni</i> Fleay's Barred Frog <i>Mixophyes fleayi</i> Giant Barred Frog <i>Mixophyes iteratus</i> Loveridge's Frog <i>Philoria loveridgei</i>
1.2 Tumbunan – rainforest/wet sclerophyll forest dependent Threatened moderate dispersal capability	Stephen's Banded Snake <i>Hoplocephalus stephensi</i> Albert's Lyrebird <i>Menura alberti</i> Red-legged Pademelon <i>Thylogale stigmatica</i> Golden-tipped Bat <i>Kerivoula papuensis</i> *Eastern Long-eared Bat <i>Nyctophilus bifax</i>
1.3 Tumbunan – rainforest/wet sclerophyll forest dependent Threatened moderate-high/high dispersal capability	Sooty Owl <i>Tyto tenebricosa</i> Barred Cuckoo-shrike <i>Coracina lineata</i> *Little Bent-winged Bat <i>Miniopterus australis</i> Large-eared Pied Bat <i>Chalinolobus dwyeri</i> *Greater Broad-nosed Bat <i>Scoteanax rueppellii</i>
1.4 Irian – rainforest dependent Threatened moderate dispersal capability	Marbled Frogmouth <i>Podargus ocellatus</i> Eastern Tube-nosed Bat <i>Nyctimene robinsoni</i>
<b>Priority 2 assemblages</b>	
2.1 Tumbunan – rainforest/wet sclerophyll forest dependent non-Threatened low dispersal capability	Pearson's Tree Frog <i>Litoria pearsoniana</i> Fletcher's Frog <i>Lechriodus fletcheri</i> Southern Leaf-tailed Gecko <i>Saltuarius swainii</i> Short-limbed Snake-skink <i>Ophioscincus truncatus</i> Orange-tailed Shadeskink <i>Saproscincus challengeri</i> Rose's Skink <i>Saproscincus rosei</i>
2.2 Tumbunan – rainforest/wet sclerophyll forest dependent non-Threatened low-moderate/moderate dispersal capability	Whirring Tree Frog <i>Litoria revelata</i> Land Mullet <i>Bellatorius major</i> *McPhee's Skink <i>Bellatorius mcpheeii</i> Blue-speckled Forest-skink <i>Eulamprus murrayi</i> Dwarf Crowned Snake <i>Cacophis krefftii</i> Rough-scaled Snake <i>Tropidechis carinatus</i> Paradise Riflebird <i>Ptiloris paradiseus</i> Pale-yellow Robin <i>Tregellasia capito</i> Subtropical Antechinus <i>Antechinus subtropicus</i> Red-necked Pademelon <i>Thylogale thetis</i> Fawn-footed Melomys <i>Melomys cervinipes</i>
2.3 Tumbunan – rainforest/wet sclerophyll forest dependent non-Threatened moderate-high/high dispersal capability	*Top-knot Pigeon <i>Lopholaimus antarcticus</i> Regent Bowerbird <i>Sericulus chrysocephalus</i> Eastern Horseshoe Bat <i>Rhinolophus megaphyllus</i> *Eastern Forest Bat <i>Vespadelus pumilus</i>
2.4 Irian – rainforest/wet sclerophyll forest dependent Threatened/ non-Threatened moderate-high/high dispersal capability	*Wompoo Fruit-dove <i>Ptilinopus magnificus</i> Superb Fruit-dove <i>Ptilinopus superbus</i> *Rose-crowned Fruit-dove <i>Ptilinopus regina</i> *Little Shrike-thrush <i>Colluricincla megarhyncha</i> White-eared Monarch <i>Carterornis leucotis</i> *Black Flying-fox <i>Pteropus alecto</i> *Grey-headed Flying-fox <i>Pteropus poliocephalus</i>
<b>Priority 3 assemblages</b>	
3.1 Bassian - rainforest/wet sclerophyll/ riparian forest dependent Threatened moderate/moderate-high/high dispersal capability	*Koala <i>Phascolarctos cinereus</i> Long-nosed Potoroo <i>Potorous tridactylus</i> *Southern Myotis <i>Myotis adversus</i>

cont. **Table 2** Prioritised vertebrate assemblages derived for species with core habitat in the Lismore LGA

assemblage	species
3.2 Tumbunan/[Torresian] - dry/moist sclerophyll forest dependent non- Threatened low-moderate dispersal capability	Major Skink <i>Bellatorius frerei</i> *McPhee's Skink <i>Bellatorius mcpheeii</i> Martin's Skink <i>Eulamprus martini</i>
3.3 Irian/Tumbunan/[Bassian] – swamp forest/ riparian forest dependent Threatened/non-Threatened moderate-high/high dispersal capability	*Wompoo Fruit-dove <i>Ptilinopus magnificus</i> *Rose-crowned Fruit-dove <i>Ptilinopus regina</i> *Top-knot Pigeon <i>Lopholaimus antarcticus</i> Black Bittern <i>Ixobrychus flavicollis</i> Pale-vented Bush-hen <i>Amauornis moluccana</i> *Little Shrike-thrush <i>Colluricincla megarhyncha</i> *Koala <i>Phascolarctos cinereus</i> *Black Flying-fox <i>Pteropus alecto</i> *Grey-headed Flying-fox <i>Pteropus poliocephalus</i> *Little Bent-winged Bat <i>Miniopterus australis</i> *Eastern Long-eared Bat <i>Nyctophilus bifax</i> *Southern Myotis <i>Myotis adversus</i> *Greater Broad-nosed Bat <i>Scoteanax rueppellii</i>
3.4 Bassian/Torresian/Tumbunan/Irian - dry/moist sclerophyll forest dependent Threatened/non-Threatened moderate-high/high dispersal capability	*Top-knot Pigeon <i>Lopholaimus antarcticus</i> *Koala <i>Phascolarctos cinereus</i> *Grey-headed Flying-fox <i>Pteropus poliocephalus</i> *Little Bent-winged Bat <i>Miniopterus australis</i> *Greater Broad-nosed Bat <i>Scoteanax rueppellii</i> *Eastern Forest Bat <i>Vespadelus pumilus</i>

Grey-headed Flying-fox *Pteropus poliocephalus*, or species with populations in both the hinterland and coast, such as the Little Shrike-thrush *Colluricincla megarhyncha*, Koala, Eastern Long-eared Bat, Greater Broad-nosed Bat *Scoteanax rueppellii* and Eastern Forest Bat *Vespadelus pumilus*.

Assemblages were then ranked and prioritised to inform an assessment of the relative values of key habitats and to direct regeneration programs. Three categories of assemblages, prioritised from highest to lowest level of risk (termed Priority 1, Priority 2 and Priority 3 assemblages) were recognised and assemblages were further ranked within categories in descending order of risk (**Table 2**).

### 3.2 Identification and ranking of key habitats for assemblages

Key habitats or the preferred habitats of the assemblages' constituent species were assigned from the mapped vegetation types for the LGA (Landmark and CMA mapping, **Table 3**), based on the assemblages' broad habitat preferences and expert knowledge of species' habitat preferences in the LGA. These key habitats were then assessed and ranked for significance in supporting the prioritised assemblages across the LGA (**Tables 4 and 5**) to provide the basis for corridor selection.

### 3.3 Corridor selection rationale and decision rules

The selection of corridors initially focused on the occurrence of the largest blocks of native vegetation containing the key habitats of highest significance for the highest ranked assemblages (**Tables 4 and 5**) in establishing hubs for

**TABLE 3 KEY HABITATS FOR PRIORISED VERTEBRATE ASSEMBLAGES IN THE LISMORE LGA**

Derived from broad habitat preferences of assemblages listed in **Table 2** and expert knowledge of species' local habitat preferences and informed by known records.

\*Landmark mapping refers to vegetation types in the grey and blue zones (Landmark Ecological Services 2011) and CMA mapping to vegetation types in the green zone (CMA mapping held in LCC's GIS).

<b>assemblage</b>		<b>key habitat</b>
<b>Priority 1.1</b> Pouched Frog Fleay's Barred Frog Giant Barred Frog Loveridge's Frog	<u>Landmark mapping*</u> Brush Box tall moist forest Flooded Gum-Tallowwood-Brush Box Subtropical Rainforest	<u>CMA mapping*</u> Coastal Flooded Gum Northern Wet Tallowwood-Blue Gum Sub-Tropical and Warm Temperate Rainforest Sub-Tropical Rainforest Warm Temperate Rainforest Wet Bangalow-Brushbox Wet Flooded Gum-Tallowwood
<b>Priority 1.2</b> Stephen's Banded Snake Albert's Lyrebird Red-legged Pademelon Golden-tipped Bat Eastern Long-eared Bat	<u>Landmark mapping*</u> Blackbutt-Tallowwood Brush Box tall moist forest Flooded Gum-Tallowwood-Brush Box Subtropical Rainforest	<u>CMA mapping*</u> Coastal Flooded Gum Northern Moist Blackbutt Northern Wet Tallowwood-Blue Gum Sub-Tropical and Warm Temperate Rainforest Sub-Tropical Rainforest Turpentine Warm Temperate Rainforest Wet Bangalow-Brushbox Wet Flooded Gum-Tallowwood
<b>Priority 1.3</b> Sooty Owl Barred Cuckoo-shrike Little Bent-winged Bat Large-eared Pied Bat Greater Broad-nosed Bat	<u>Landmark mapping*</u> Blackbutt-Tallowwood Brush Box tall moist forest Flooded Gum-Tallowwood-Brush Box Dry Rainforest Riparian rainforest-lower reaches Riparian rainforest-mid reaches Subtropical Rainforest	<u>CMA mapping*</u> Coastal Flooded Gum Northern Moist Blackbutt Northern Wet Tallowwood-Blue Gum Sub-Tropical and Warm Temperate Rainforest Sub-Tropical Rainforest Turpentine Warm Temperate Rainforest Wet Bangalow-Brushbox Wet Flooded Gum-Tallowwood
<b>Priority 1.4</b> Marbled Frogmouth Eastern Tube-nosed Bat	<u>Landmark mapping*</u> Brush Box tall moist forest Flooded Gum-Tallowwood-Brush Box Subtropical Rainforest	<u>CMA mapping*</u> Coastal Flooded Gum Northern Moist Blackbutt Northern Wet Tallowwood-Blue Gum Sub-Tropical and Warm Temperate Rainforest Sub-Tropical Rainforest Wet Bangalow-Brushbox Wet Flooded Gum-Tallowwood
<b>Priority 2.1</b> Pearson's Tree Frog Fletcher's Frog Southern Leaf-tailed Gecko Short-limbed Snake-skink Orange-tailed Shadskink Rose's Skink	<u>Landmark mapping*</u> Brush Box tall moist forest Flooded Gum-Tallowwood-Brush Box Subtropical Rainforest	<u>CMA mapping*</u> Coastal Flooded Gum Northern Moist Blackbutt Northern Wet Tallowwood-Blue Gum Sub-Tropical and Warm Temperate Rainforest Sub-Tropical Rainforest Turpentine Wet Bangalow-Brushbox Wet Flooded Gum-Tallowwood

cont. **Table 3 Key habitats for prioritised vertebrate assemblages in the Lismore LGA**

<p><b>Priority 2.2</b> Whirring Tree Frog Land Mullet McPhee's Skink Martin's Skink Blue-speckled Forest-skink Dwarf Crowned Snake Rough-scaled Snake Paradise Riflebird Pale-yellow Robin Subtropical Antechinus Red-necked Pademelon Fawn-footed Melomys</p>	<p><u>Landmark mapping*</u> Blackbutt-Tallowwood Brush Box tall moist forest Flooded Gum-Tallowwood-Brush Box Subtropical Rainforest</p>	<p><u>CMA mapping*</u> Coastal Flooded Gum Northern Moist Blackbutt Northern Wet Tallowwood-Blue Gum Sub-Tropical and Warm Temperate Rainforest Sub-Tropical Rainforest Turpentine Warm Temperate Rainforest Wet Bangalow-Brushbox Wet Flooded Gum-Tallowwood</p>
<p><b>Priority 2.3</b> Top-knot Pigeon Regent Bowerbird Eastern Horseshoe Bat Eastern Forest Bat</p>	<p><u>Landmark mapping*</u> Blackbutt-Tallowwood Brush Box tall moist forest Flooded Gum-Tallowwood-Brush Box Dry Rainforest Riparian rainforest-lower reaches Riparian rainforest-mid reaches Subtropical Rainforest</p>	<p><u>CMA mapping*</u> Coastal Flooded Gum Northern Moist Blackbutt Northern Wet Tallowwood-Blue Gum Sub-Tropical and Warm Temperate Rainforest Sub-Tropical Rainforest Turpentine Warm Temperate Rainforest Wet Bangalow-Brushbox Wet Flooded Gum-Tallowwood</p>
<p><b>Priority 2.4</b> Wompoo Fruit-dove Superb Fruit-dove Rose-crowned Fruit-dove Little Shrike-thrush White-eared Monarch Black Flying-fox Grey-headed Flying-fox</p>	<p><u>Landmark mapping*</u> Brush Box tall moist forest Flooded Gum-Tallowwood-Brush Box Dry Rainforest Riparian rainforest-lower reaches Riparian rainforest-mid reaches <u>Subtropical Rainforest</u></p>	<p><u>CMA mapping*</u> Coastal Flooded Gum Sub-Tropical and Warm Temperate Rainforest Sub-Tropical Rainforest Wet Bangalow-Brushbox Wet Flooded Gum-Tallowwood</p>
<p><b>Priority 3.1</b> Koala Long-nosed Potoroo Southern Myotis</p>	<p><u>Landmark mapping*</u> Blackbutt-Tallowwood Brush Box tall moist forest Flooded Gum-Tallowwood-Brush Box Riparian rainforest-lower reaches Riparian rainforest-mid reaches <u>Subtropical Rainforest</u></p>	<p><u>CMA mapping*</u> Coastal Flooded Gum Northern Moist Blackbutt Northern Wet Tallowwood-Blue Gum Sub-Tropical and Warm Temperate Rainforest Sub-Tropical Rainforest Wet Flooded Gum-Tallowwood</p>
<p><b>Priority 3.2</b> Major Skink McPhee's Skink</p>	<p><u>Landmark mapping*</u> Blackbutt-Tallowwood Forest Red Gum grassy open forest Forest Red Gum-Tallowwood</p>	<p><u>CMA mapping*</u> Escarpment Redgum Grey Box-Northern Grey Gum Northern Grassy Sydney Blue Gum Northern Moist Blackbutt Northern Ranges Dry Tallowwood Open Shrubby Brushbox-Tallowwood</p>
<p><b>Priority 3.3</b> Wompoo Fruit-dove Rose-crowned Fruit-dove Top-knot Pigeon Black Bittern Pale-vented Bush-hen Little Shrike-thrush Koala Black Flying-fox Grey-headed Flying-fox Little Bent-winged Bat Eastern Long-eared Bat Southern Myotis Greater Broad-nosed Bat</p>	<p><u>Landmark mapping*</u> Flooded Gum-Tallowwood-Brush Box Forest Red Gum-River Oak Forest Red Gum-Swamp Box Paperbark Paperbark-Swamp Oak Riparian rainforest-lower reaches Riparian rainforest-mid reaches River Oak Swamp Oak Swamp Oak-River Oak</p>	

cont. **Table 3 Key habitats for prioritised vertebrate assemblages in the Lismore LGA**

Priority 3.4	Landmark mapping*	CMA mapping*
Top-knot Pigeon	Blackbutt-Tallowwood	Escarpment Redgum
Koala	Forest Red Gum grassy open forest	Grey Box-Northern Grey Gum
Grey-headed Flying-fox	Forest Red Gum-Swamp Box	Northern Ranges Dry Tallowwood
Little Bent-winged Bat	Forest Red Gum-Tallowwood	Open Shrubby Brushbox-Tallowwood
Greater Broad-nosed Bat		River Oak
Eastern Forest Bat		Wet Bloodwood-Tallowwood

connection in a corridor matrix. As a first cut, these hubs were incorporated into corridors encompassing the widths of the blocks and linked via the closest patches of vegetation cover providing the least fragmented connections. Corridors were then refined to widths reflecting the occurrence of key habitats of highest significance, but adopting minimum widths following the NPWS system (Scotts 2003) of 500m for regional corridors and 300m for sub-regional and local corridors.

Large gaps lacking extant vegetation were avoided where possible, but in some cases this was unavoidable in maintaining the continuity of corridors. In other cases it was necessary to include areas of settlement including houses and plantations within corridors to avoid falling below the adopted minimum widths. However, this was not considered detrimental to overall corridor function as such areas can provide movement habitat for a number of species. In areas of gaps and fragmented vegetation, corridor edges were smoothed to minimise the edge/unit area ratio and consequent adverse edge effects.

In heavily disturbed areas stands of Camphor Laurel *Cinnamomum camphora* and Indian Coral Tree *Erythrina crista-galli* were included in corridors to improve continuity, because although introduced species, they contribute to corridor functionality for some frugivorous and nectarivorous conservation-priority vertebrates such as the fruit-doves *Ptilinopus* spp and flying-foxes *Pteropus* spp. However, these stands represent priority areas within corridors for rehabilitation and restoration.

The selection process resulted in a corridor system that followed the occurrence of wet forests and to a lesser extent, forests with the highest levels of canopy cover, producing a system that most efficiently established connections across the LGA of greatest benefit to assemblages of the vertebrate species considered most at risk. This meant that corridors were often cut or narrowed within larger patches of vegetation to exclude stands of lower ranked key habitats, with the result that corridors did not necessarily encompass the full extent of a vegetation patch.

The final selection of corridors was influenced to a limited extent by the locations of records of conservation-priority species (taking into account the inherent biases in their collection), particularly species considered significant on the basis of their inclusion in Priority Assemblages 1.1-4 and 2.1 (**Table 2**).

**TABLE 4 KEY HABITATS SUPPORTING PRIORITY VERTEBRATE ASSEMBLAGES IN THE LISMORE LGA**

Derived from key habitats listed for priority assemblages in **Table 3**.

\*Landmark mapping refers to vegetation types in the grey and blue zones (Landmark Ecological Services 2011) and CMA mapping to vegetation types in the green zone (CMA mapping held in LCC's GIS).

key habitat	priority assemblages											
	1.1	1.2	1.3	1.4	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4
<b>Landmark mapping*</b>												
Blackbutt-Tallowwood		+	+			+	+		+	+		+
Brush Box tall moist forest	+	+	+	+	+	+	+	+	+			
Flooded Gum-Tallowwood-Brush Box	+	+	+	+	+	+	+	+	+		+	
Dry Rainforest			+				+	+				
Forest Red Gum grassy open forest										+	+	
Forest Red Gum-River Oak											+	
Forest Red Gum-Swamp Box											+	+
Forest Red Gum-Tallowwood										+		+
Paperbark											+	
Paperbark-Swamp Oak											+	
Riparian rainforest-lower reaches			+				+	+	+		+	
Riparian rainforest-mid reaches			+				+	+	+		+	
River Oak											+	
Subtropical Rainforest	+	+	+	+	+	+	+	+	+			
Swamp Oak											+	
Swamp Oak-River Oak											+	
<b>CMA mapping*</b>												
Coastal Flooded Gum	+	+	+	+	+	+	+	+	+			
Escarpment Red Gum										+		+
Grey Box-Northern Grey Gum										+		+
Northern Moist Blackbutt		+	+	+	+	+	+		+	+		
Northern Ranges Dry Tallowwood										+		+
Northern Wet Tallowwood-Blue Gum	+	+	+	+	+	+	+		+			
Open Shrubby Brushbox-Tallowwood										+		+
River Oak											+	
Sub-Tropical and Warm Temperate Rainforest	+	+	+	+	+	+	+	+	+			
Sub-Tropical Rainforest	+	+	+	+	+	+	+	+	+			
Turpentine		+			+	+	+					
Warm Temperate Rainforest	+	+	+			+	+					
Wet Bangalow-Brushbox	+	+	+	+	+	+	+					
Wet Bloodwood-Tallowwood												+
Wet Flooded Gum-Tallowwood	+	+	+	+	+	+	+	+	+			

These records mostly occurred in previously identified refuges (**s.2.3**) and resulted in links being established to a few that could not be connected in continuous linkages (e.g. corridors to Wilson Nature Reserve and Rotary Park, **Fig. 5**).

**TABLE 5 KEY HABITATS RANKED ACCORDING TO SIGNIFICANCE FOR PRIORITY ASSEMBLAGES IN THE LISMORE LGA**

Derived from priority assemblages listed for key habitats in **Table 4**, 1 = highest significance.

\*Landmark mapping refers to vegetation types in the grey and blue zones (Landmark Ecological Services 2011) and CMA mapping to vegetation types in the green zone (CMA mapping held in LCC's GIS).

key habitat	ranking
<b>Landmark mapping*</b>	
Flooded Gum-Tallowwood-Brush Box	1
Brush Box tall moist forest	2
Subtropical Rainforest	2
Blackbutt-Tallowwood	3
Riparian rainforest-lower reaches	4
Riparian rainforest-mid reaches	4
Dry Rainforest	5
Forest Red Gum grassy open forest	6
Forest Red Gum-Tallowwood	6
Forest Red Gum-Swamp Box	7
Forest Red Gum-River Oak	8
Paperbark	8
Paperbark-Swamp Oak	8
River Oak	8
Swamp Oak	8
Swamp Oak-River Oak	8
<b>CMA mapping*</b>	
Sub-Tropical Rainforest	1
Sub-Tropical and Warm Temperate Rainforest	1
Coastal Flooded Gum	1
Wet Flooded Gum-Tallowwood	1
Northern Wet Tallowwood-Blue Gum	2
Wet Bangalow-Brushbox	3
Northern Moist Blackbutt	4
Warm Temperate Rainforest	5
Turpentine	6
Escarpment Red Gum	7
Grey Box-Northern Grey Gum	7
Northern Ranges Dry Tallowwood	7
Open Shrubby Brushbox-Tallowwood	7
River Oak	8
Wet Bloodwood-Tallowwood	9

In addition, 100m and 50m wide riparian buffers were applied to all major watercourses (rivers) and minor named watercourses (creeks) throughout the LGA, creating a 200m and 100m wide local corridor network. This subsidiary network was included because of the established significance of riparian corridors generally for vertebrate movements (MacNally *et al.* 2000, Jansen and Robertson 2001) and their demonstrated importance in the LGA for providing habitat for conservation-priority species, particularly species such as the Black Bittern and Koala (**Appendix 5**). Riparian areas also provided existing narrow but continuous linear habitat in many areas of the LGA extensively cleared for agriculture and linked corridors providing ridge to gully connections.

Although existing vegetation cover (particularly in the northern section of the LGA) was found to exist that would have allowed additional local corridors to be identified linking the selected corridors, these have not been incorporated into the system at this stage. This is to enable a focus on the most cost-effective actions to establish connectivity across the LGA through rehabilitation of gaps and restoration of vegetation condition in the selected network, as driven by the priority assemblages. In addition, the provision of riparian buffers to all major and minor named streams is expected to provide an adequate level of local connection while the regional and sub-regional network is consolidated.

### 3.4 Limitations

A restricted budget precluded computer analysis and modelling of correlations between the occurrences of species and species assemblages and vegetation types, together with the systematic derivation of corridor pathways and a computer-based prioritisation of areas within corridor sectors for rehabilitation and restoration.

The incompatibility of the vegetation mapping of the green, and the grey and blue zones was also a limiting factor. Field inspections undertaken within the green zone (**Appendix 5**) revealed inaccuracies in the CMA mapping, which necessarily had been undertaken at a broad regional scale with little or no ground truthing at the local level.

Vegetation types used in the CMA mapping did not conform readily to the types assigned in the Landmark mapping and in some cases were not present in the green zone. An example of the former is the dry rainforest type recognised by the Landmark mapping, which was subsumed into the subtropical rainforest type in the CMA mapping, a significant difference as the two types support different vertebrate assemblages.

Field inspections showed stands of forest mapped as Richmond Range Spotted Gum in the Bungabee, Leicester and Jiggi areas in the green zone to be dominated by Forest Red Gum *Eucalyptus tereticornis* and Grey Ironbark *E. siderophloia*. This vegetation type conforms to the Forest Red Gum grassy open forest type mapped by Landmark in the blue and grey zones, and may have been more appropriately consigned to Escarpment Redgum under the CMA system. Notably, neither Large-leaved Spotted Gum *Corymbia henryi* or Spotted Gum *C. maculata* appear to occur naturally in the LGA.

Similarly, stands mapped as Baileys Stringybark and Very Wet New England Blackbut in the Bungabee and Nimbin Rocks areas in the green zone are inaccurate and these types do not appear to be present in the LGA. Other vegetation mapped as Wet Heath in the Keerong area in the green zone was found to be wet eucalypt forest with Camphor Laurel. Further, forest mapped as Wet Bloodwood-Tallowwood in the Davis Road area in the green zone was found to conform more accurately to the Northern Wet Tallowwood-Blue Gum type.

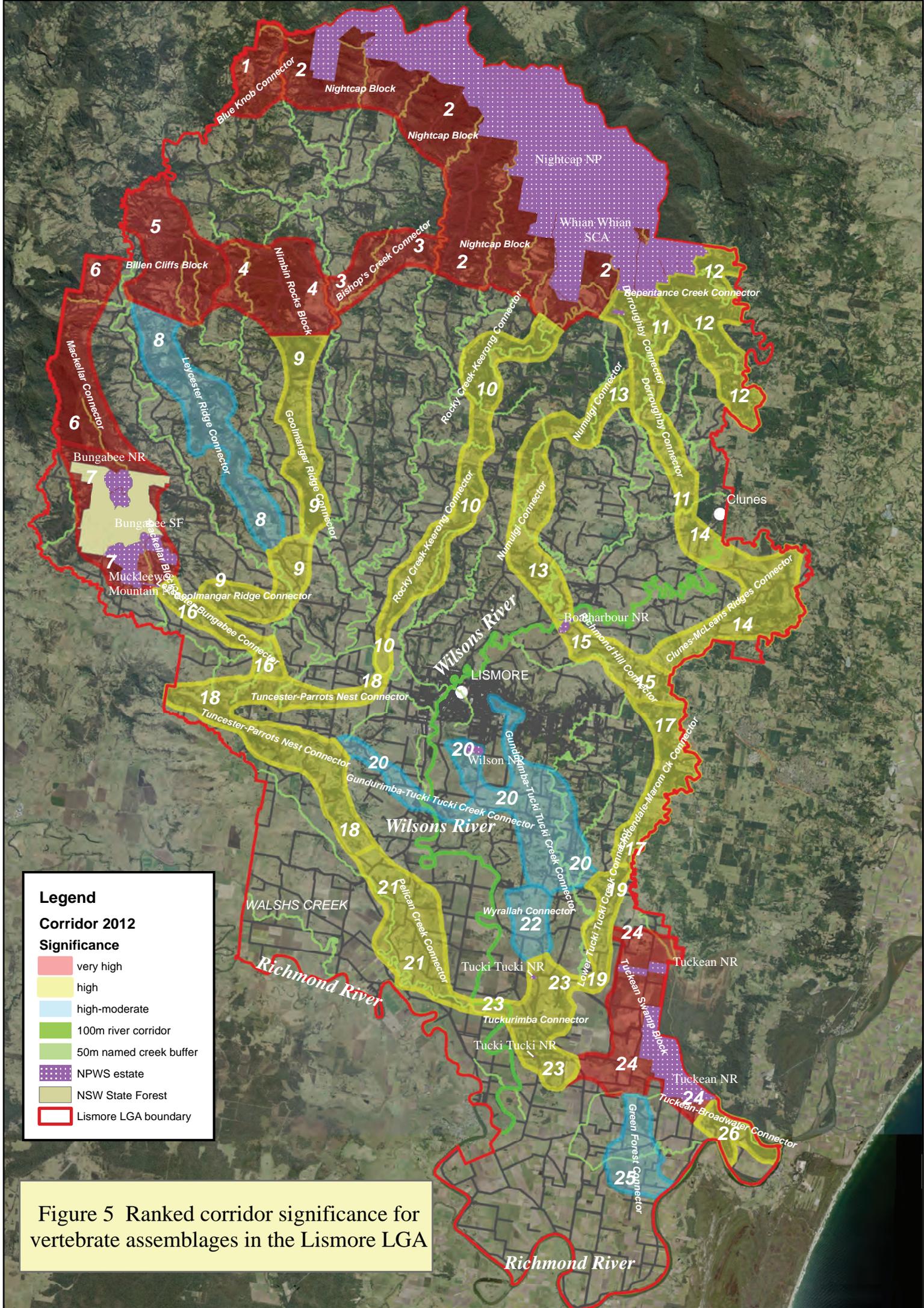


Figure 5 Ranked corridor significance for vertebrate assemblages in the Lismore LGA

As a consequence, the identification of key habitats used to predict the likelihood of the occurrence of priority assemblages in the green zone was probably less accurate than for identification of key habitats in the blue and grey zones.

#### 4.0 IDENTIFIED KEY HABITATS AND CORRIDORS SYSTEM

The key habitats and corridors system identified for the Lismore LGA following the process outlined in **s.3** above is depicted in **Fig. 5**. The system comprises 26 sectors, consisting of five major vegetation blocks or refuges linked by 21 connectors (**Appendix 8, Fig. 5**). The junctions between blocks and connectors, and between the connectors themselves were selected where gaps in vegetation cover or where boundaries between broad habitats (vegetation types) occurred, or where watercourses cut corridors. Sector significance is ranked at three levels, very high, high and high-moderate (**Appendix 8, Fig. 5**). Very high and high levels correspond with the regional and sub-regional ranking respectively assigned in the NPWS system, while high-moderate indicates a ranking at the local level. Major refuges are rated as of very high significance as are the corridors directly linking these. Other corridors connecting the refuges across the LGA or to important adjacent habitats are rated as of high or high-moderate significance, depending on the level of linkage provided between major refuges and the relative proportions of the highest ranked key habitats.

Other sector attributes provided in **Appendix 8** describe the condition, broad habitats present, suitability for priority assemblages and significant vertebrate species known from each sector. Significant species are defined as species listed in the five highest priority assemblages (Assemblages 1.1-4 and 2.1, **Table 2**).

**Appendix 8** also lists actions required to achieve optimum functioning of the sectors, based on their present condition. "Protect" indicates the presence of habitats in relatively pristine condition, mostly contained within the major corridor blocks, that require little regeneration action other than the provision of buffers where necessary. "Rehabilitate" indicates the presence of cleared gaps in corridor sectors that require re-establishment of vegetation structure and function, whereas "restore" indicates the presence of degraded vegetation, often dominated by introduced species such as Camphor Laurel or Indian Coral Tree, that requires restoration with species from the original plant community.

The identified key habitats and corridors system corresponds relatively closely with the NPWS system (Scotts 2003) and the LCCDLEP-OM, incorporating most of the key habitats and all the regional and sub-regional corridors in very high and high ranked corridors respectively (**Fig. 5**). Truncated NPWS sub-regional corridors are extended and connected through links containing the highest ranked key habitats and the boundaries of regional and sub-regional corridors are refined by alignment with these key habitats. The corridors are

supplemented by several local corridors containing higher ranked key habitats, with boundaries aligned to those key habitats, and by a riparian network buffering major and minor watercourses.

There is less conformity between the identified system and the DECC climate change corridors system (DECC 2007), as the broad pathways of the latter are replaced by corridors based on existing vegetation cover and directed by the occurrence of the most significant key habitats. However, the linkage through the centre of the LGA in the latter is maintained in the former by two narrower corridors.

Linkages to important refuges for conservation-priority vertebrate species outside the LGA are provided for:

- the northern Mackellar Range including Boorabee State Forest by the Blue Knob Connector and Billen Cliffs and Mackellar Blocks)
- Andrew Johnston Big Scrub Nature Reserve by the Repentance Creek Connector
- Booyong Reserve by the Clunes-McLeans Ridges Connector
- Davis Scrub and Victoria Park Nature Reserves and the Blackwall Range by the Lindendale-Marom Creek and Tuckean-Broadwater Connectors and the Tuckean Swamp Block
- Broadwater National Park by the Green Forest and Tuckean-Broadwater Connectors

## 5.0 PRIORITISATION OF CORRIDORS FOR REGENERATION

The corridor sectors are prioritised for regeneration action into six categories, initially on the basis of significance (**s.4.0, Fig. 5**), and then in terms of tenure, in linking significant areas and connecting to important areas of habitat in adjoining LGAs, and as providing optimum habitat for the highest priority assemblages (**Appendix 8**).

The highest priority sectors comprise those in the regional network (very high significance) not protected in the National Park estate and consequently most in need of regeneration attention. The second highest priority sectors consist of those in the regional network already protected in the National Park estate.

The third highest priority sectors comprise those in the sub-regional network (high significance), providing the main linkages between regional sectors or linking to important areas of habitat in adjoining LGAs. The fourth highest priority sectors represent sub-regional links of less significance providing smaller areas of habitat for the highest priority assemblages.

The fifth and sixth highest priority sectors constitute the local network (high-moderate significance), providing linkages of lower significance and catering for mostly lower priority assemblages, the latter providing linkages of lower significance than the former.

**TABLE 6 PRIORITISATION OF CORRIDOR SECTORS FOR REGENERATION IN THE LISMORE LGA**

no.	name	status	priority for rehabilitation/restoration
1	<b>Blue Knob Connector</b>	regional	priority 1 – 1
2	<b>Nightcap Block</b>	regional	priority 1 – 2
3	<b>Bishop's Creek Connector</b>	regional	priority 1 – 1
4	<b>Nimbin Rocks Block</b>	regional	priority 1 – 1
5	<b>Billen Cliffs Block</b>	regional	priority 1 – 1
6	<b>Mackellar Connector</b>	regional	priority 1 – 1
7	<b>Mackellar Block</b>	regional	priority 1 – 2
8	<b>Leycester Ridge Connector</b>	local	priority 3 – 2
9	<b>Goolmangar Ridge Connector</b>	sub-regional	priority 2 – 2
10	<b>Rocky Creek - Keerong Connector</b>	sub-regional	priority 2 – 1
11	<b>Dorrougby Connector</b>	sub-regional	priority 2 – 1
12	<b>Repentance Creek Connector</b>	sub-regional	priority 2 – 1
13	<b>Numulgi Connector</b>	sub-regional	priority 2 – 2
14	<b>Clunes-McLeans Ridges Connector</b>	sub-regional	priority 2 – 1
15	<b>Richmond Hill Connector</b>	sub-regional	priority 2 – 1
16	<b>Leycester-Bungabee Connector</b>	sub-regional	priority 2 – 1
17	<b>Lindendale-Marom Creek Connector</b>	sub-regional	priority 2 – 1
18	<b>Tuncester-Parrots Nest Connector</b>	sub-regional	priority 2 – 1
19	<b>Lower Tucki Tucki Creek Connector</b>	sub-regional	priority 2 – 1
20	<b>Gundurimba-Tucki Tucki Creek Connector</b>	local	priority 3 – 1
21	<b>Pelican Creek Connector</b>	sub-regional	priority 2 – 2
22	<b>Wyrallah Connector</b>	local	priority 3 – 2
23	<b>Tuckurimba Connector</b>	sub-regional	priority 2 – 2
24	<b>Tuckean Swamp Block</b>	sub-regional	priority 1 – 2
25	<b>Green Forest Connector</b>	sub-regional	priority 3 – 1
26	<b>Tuckean-Broadwater Connector</b>	sub-regional	priority 2 – 2



## 6.0 RECOMMENDATIONS

It is recommended that the vegetation in the green zone (LCC vegetation zone) be remapped as soon as possible to confirm the identification of key habitats and the selection of corridors in that section of the LGA. This is also essential for an accurate inventory of the LGA's natural resources and the preparation of studies to inform planning decisions, such as a biodiversity strategy. Mapping should use the types (or compatible types) adopted for the Landmark mapping of the blue and grey zones where appropriate, and a similar methodology for the selection of additional types not present in the blue and grey zones.

Actions to rehabilitate and restore corridor sectors should be guided by the prioritisation derived in **s.5 (Table 6, Fig. 6)**, with gaps and degraded areas in the highest priority sectors receiving primary attention, followed by lower priority sectors down the order.

However, landholders within any of the identified corridor sectors should be encouraged to undertake vegetation rehabilitation and restoration whenever the opportunity arises. In this regard, LCC could assist relevant landholders in applying for vegetation restoration funding through the Northern Rivers CMA or under the Australian Government's current Biodiversity Fund scheme, highlighting regeneration of the identified key habitats and corridors system as a key objective of applications.

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**APPENDIX 1 OCCURRENCE OF CONSERVATION-PRIORITY  
TERRESTRIAL VERTEBRATE SPECIES RECORDED IN MAJOR AND  
MINOR REFUGES IN THE LISMORE LGA**

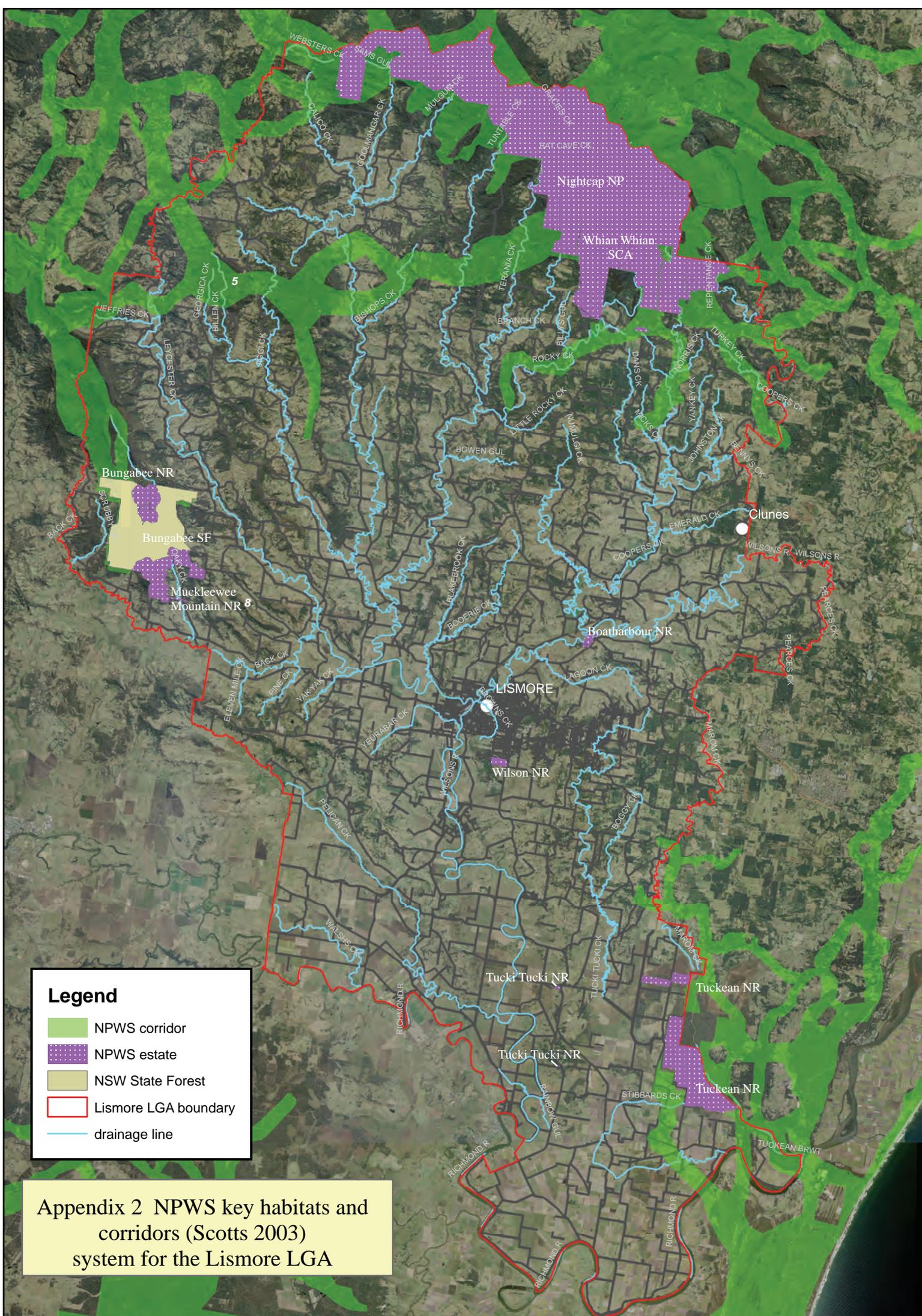
Records from OEH Atlas of NSW Wildlife database extracted 11 November 2010 and 13 September 2011, supplemented by records from local observers.

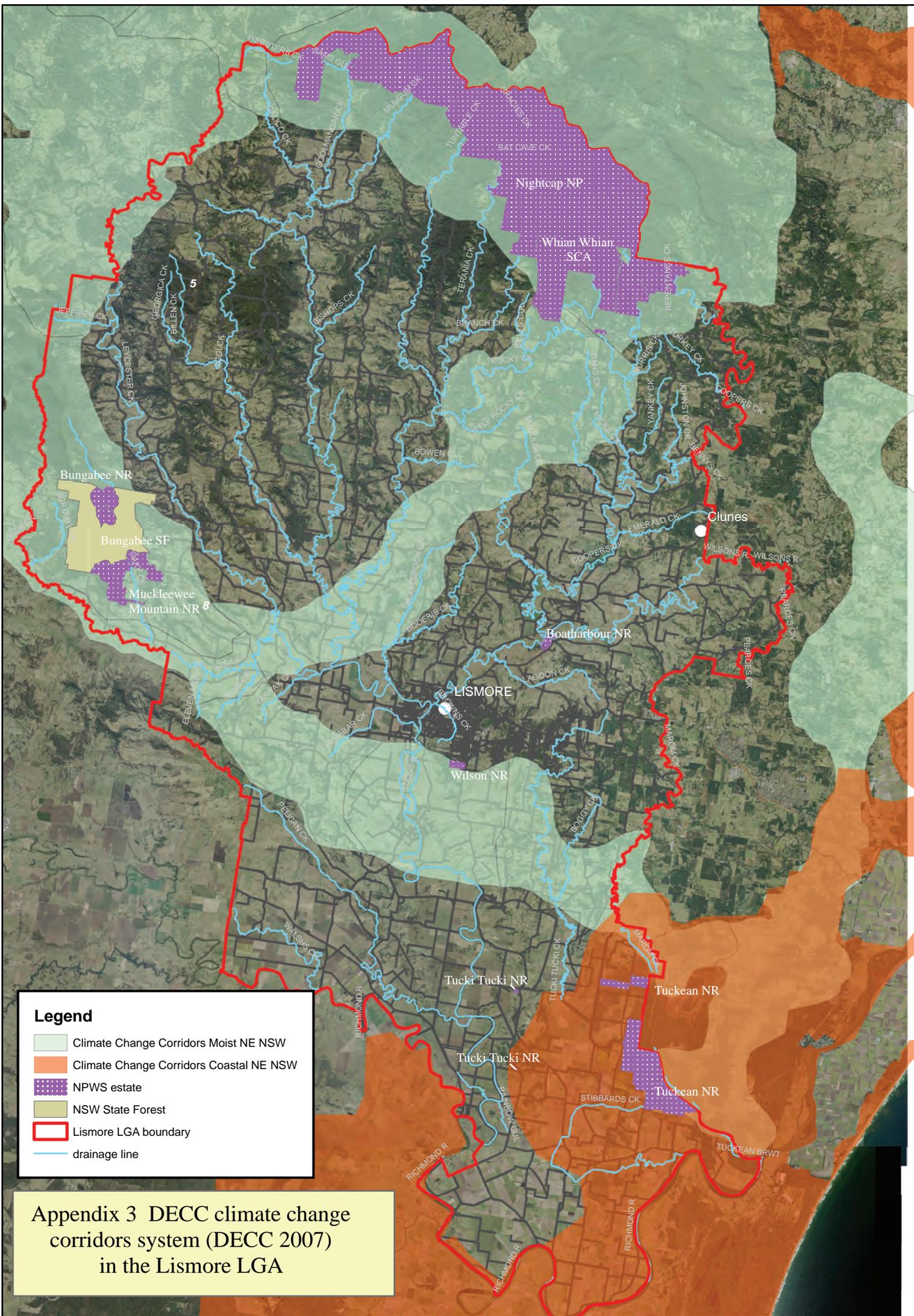
Refuges:	1	Nightcap Range (incl. Nightcap NP, Nightcap SRA)
	2	Mackellar Range (incl. Bungabee NR, Mucklewee Mountain NR)
	3	Tuckean Swamp (incl. Tuckean NR)
	4	Boatharbour NR
	5	Wilson NR
	6	Rotary Park
	7	Brockley
	8	Lower Rocky Creek, Dunoon
	9	Rock Valley

	refuges	1	2	3	4	5	6	7	8	9
<b>species</b>										
<b>amphibians</b>										
	Green-thighed Frog	+								
	Pearson's Tree Frog	+	+						+	
	Whirring Tree Frog	+								
	Pouched Frog	+	+							
	Fletcher's Frog	+								
	Fleay's Barred Frog	+								
	Giant Barred Frog	+								
	Loveridge's Frog	+							+	
<b>reptiles</b>										
	Southern Leaf-tailed Gecko	+							+	
	Scute-snouted Calyptotis	+								
	Three-toed Snake-toothed Skink	+								
	Major Skink	+	+							
	Land Mullet	+	+		+	+	+		+	
	McPhee's Skink	+								
	Martin's Skink		+							
	Blue-speckled Forest-skink	+				+				
	Short-limbed Snake-skink	+								
	Orange-tailed Shadeskink	+							+	
	Rose's Skink	+							+	
	Gully Shadeskink	+								
	Southern Angle-headed Dragon	+								
	White Crowned Snake									
	Dwarf Crowned Snake	+			+	+	+		+	
	Stephen's Banded Snake	+								
	Rough-scaled Snake	+							+	
<b>birds</b>										
	Wompoo Fruit-dove	+	+	+	+	+		+		
	Superb Fruit-dove	+								
	Rose-crowned Fruit-dove	+	+		+	+	+	+	+	
	Top-knot Pigeon	+	+	+	+	+	+	+	+	+
	Marbled Frogmouth	+				+				
	Black Bittern	+	+	+	+				+	
	Little Eagle	+								+
	Pale-vented Bush-hen	+	+	+						+

cont. **Appendix 1**      **Occurrence of conservation-priority terrestrial vertebrate species recorded in major and minor refuges in the Lismore LGA**

refuges	1	2	3	4	5	6	7	8	9
Glossy Black-cockatoo	+	+						+	+
Little Lorikeet	+	+	+						
Little Bronze-cuckoo		+							
Powerful Owl	+	+							+
Barking Owl									
Sooty Owl	+	+						+	
Masked Owl	+	+						+	
Albert's Lyrebird	+	+	+					+	
Regent Bowerbird	+	+		+	+		+	+	
Eastern Bristlebird	+								
Regent Honeyeater	+								
Little Shrike-thrush	+	+	+	+	+	+	+	+	
Paradise Riflebird	+								
Pale-yellow Robin	+	+		+			+	+	
Grey-crowned Babbler			+						
Varied Sittella	+	+							
Barred Cuckoo-shrike	+	+							
Olive Whistler	+								
White-eared Monarch	+	+						+	
<b>mammals</b>									
Spotted-tailed Quoll	+	+	+						
Subtropical Antechinus	+	+							
Common Planigale			+						
Koala	+	+	+		+			+	+
Yellow-bellied Glider	+	+							
Squirrel Glider		+							+
Greater Glider	+	+							
Long-nosed Potoroo	+	+							
Parma Wallaby	+								
Red-legged Pademelon	+								
Red-necked Pademelon	+	+							
Eastern Blossom-bat	+								
Eastern Tube-nosed Bat	+	+							
Black Flying-fox	+	+	+	+	+	+		+	
Grey-headed Flying-fox	+	+	+	+	+			+	+
Eastern Horseshoe Bat	+	+						+	
Yellow-bellied Sheath-tailed Bat	+	+							
Beccari's Free-tailed Bat			+						
East-coast Free-tailed Bat	+								
Little Bent-winged Bat	+	+	+	+	+			+	
Eastern Bent-winged Bat	+							+	
Golden-tipped Bat	+								
Eastern Long-eared Bat	+		+		+			+	
Large-eared Pied Bat	+								
Eastern False Pipistrelle	+								
Southern Myotis	+							+	
Greater Broad-nosed Bat	+		+					+	
Central-eastern Broad-nosed Bat		+							
Eastern Forest Bat	+	+		+	+			+	
Fawn-footed Melomys	+	+						+	
<b>Total species</b>	73	40	17	13	15	6	6	30	8
<b>Total Threatened species</b>	45	23	14	5	7	1	2	15	7
<b>Total non-Threatened species</b>	28	17	3	8	8	5	4	15	1

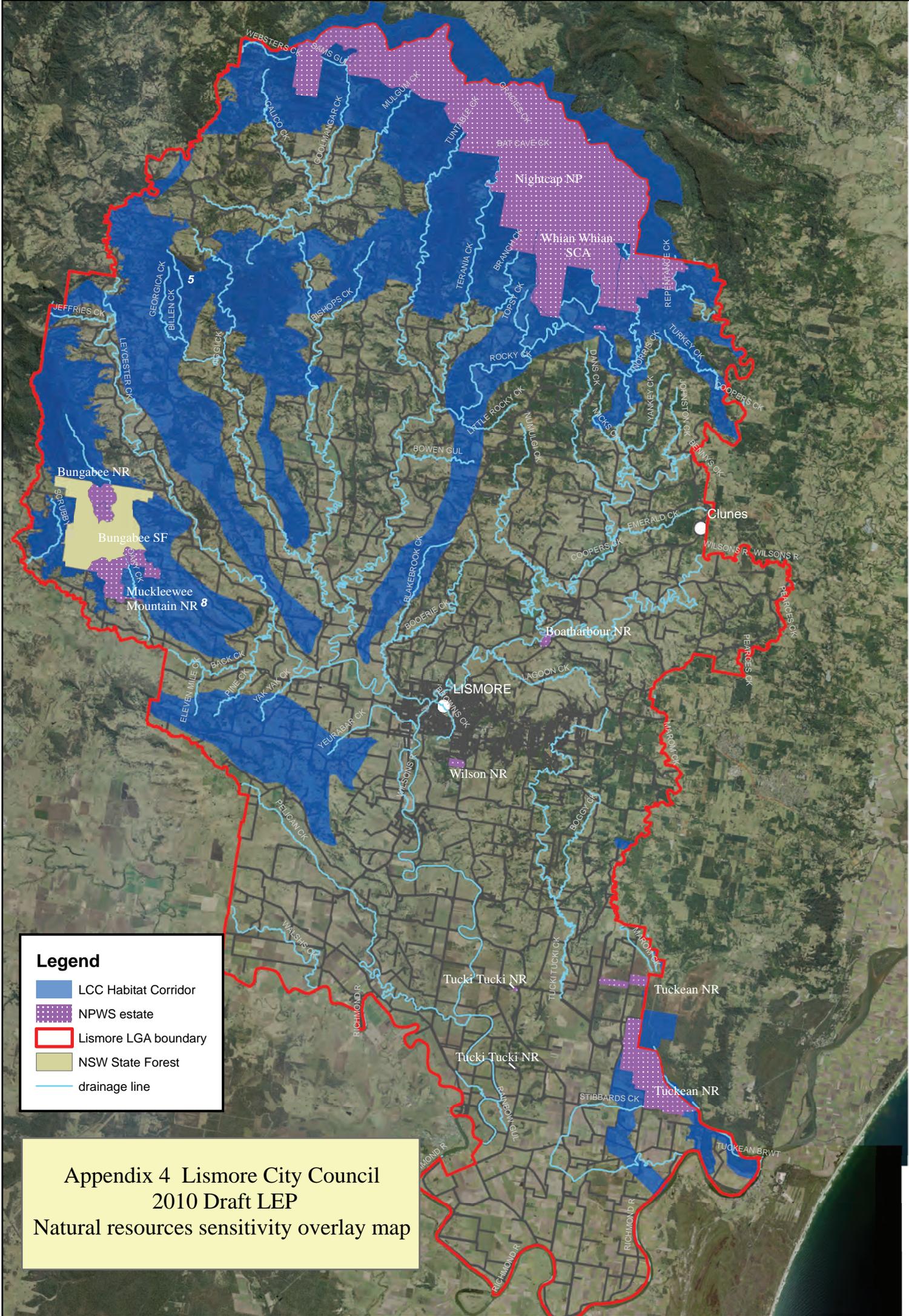




**Legend**

- Climate Change Corridors Moist NE NSW
- Climate Change Corridors Coastal NE NSW
- NPWS estate
- NSW State Forest
- Lismore LGA boundary
- drainage line

Appendix 3 DECC climate change corridors system (DECC 2007) in the Lismore LGA



**Legend**

- LCC Habitat Corridor
- NPWS estate
- Lismore LGA boundary
- NSW State Forest
- drainage line

Appendix 4 Lismore City Council  
 2010 Draft LEP  
 Natural resources sensitivity overlay map

**APPENDIX 5 DETAILS OF FIELD INSPECTIONS TO CHECK MAPPED VEGETATION AND ITS SUITABILITY AS HABITAT FOR CONSERVATION-PRIORITY TERRESTRIAL VERTEBRATE SPECIES IN THE LISMORE LGA**

Refer to **Appendix 6** for GPS locations recorded during field inspections (indicating locations of observed target species, other attributes etc).

Zones are LCC planning zones – grey, blue and green.

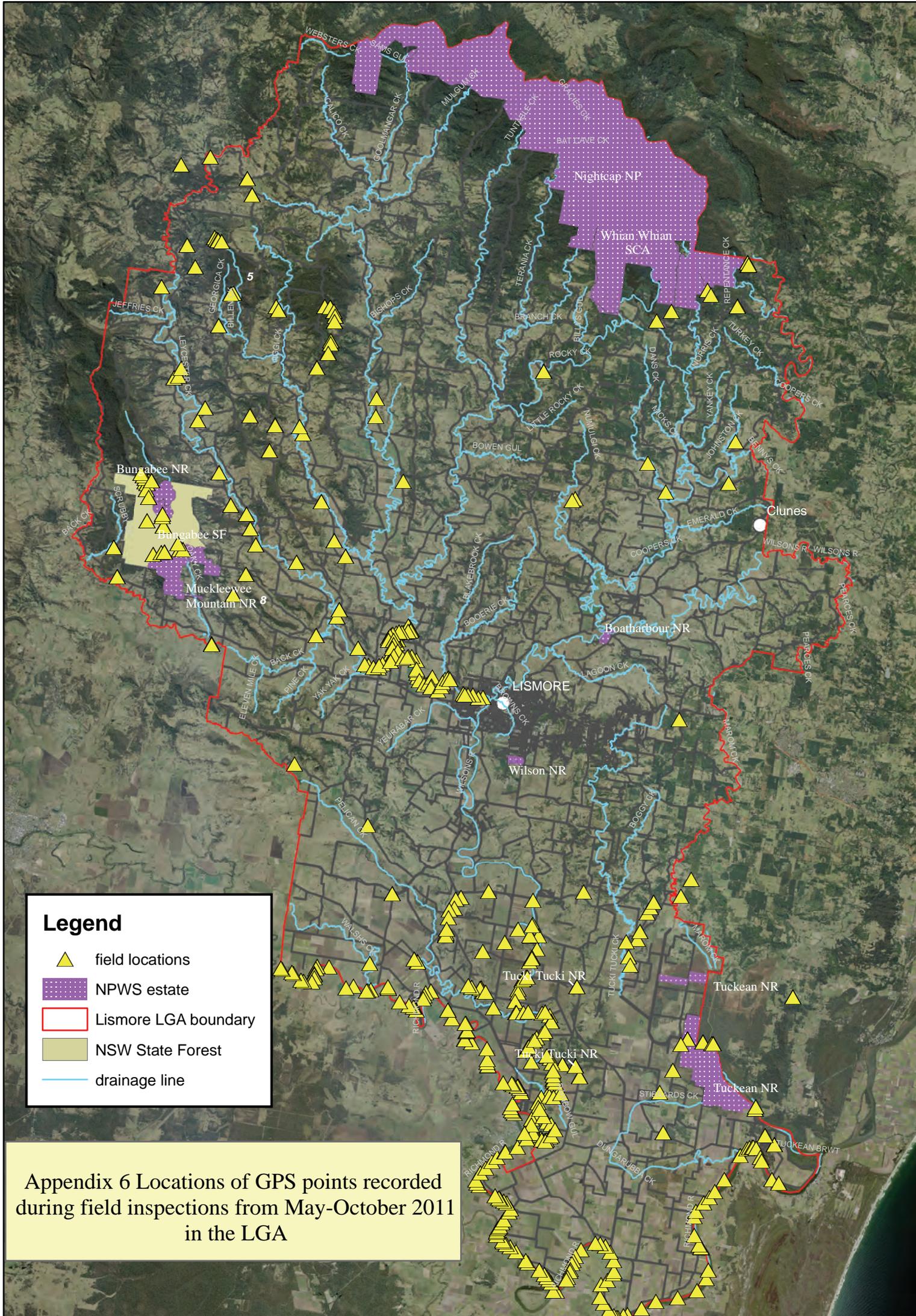
field inspection		date	conservation-priority species recorded during inspections	Easting	Northing
no.	area (+ zone)				
1	Marom Creek, Tucki, Gollan, Cooks, Grennan, Tregagle and Webber Roads; Tucki Tucki Creek (grey zone)	5 May 2011	Topknot Pigeon	534455	6803587
				534606	6803822
			Koala	534455	6803587
			Koala	534606	6803822
	Tuckean Island Road, Tuckean Swamp (grey zone)	5 May 2011			
	Tucki Tucki Road, Tucki Tucki Nature Reserve North (grey zone)	5 May 2011			
	Pelican Creek and Spring Grove Roads (blue zone)	5 May 2011			
2	Wilson's River: Wyrallah to Coraki (grey, blue zones)	13 May 2011	Koala	528878	6801200
			Koala	528600	6800267
			Koala	528067	6799120
			Koala	528106	6798590
			Koala	528143	6798579
			Koala	529778	6798190
			Koala	529838	6795763
			Koala	529873	6795410
			Koala	529892	6795325
			Koala	529549	8792540
			Koala	529510	6792520
			Koala	529485	6792519
			Koala	529339	6792574
			Koala	529084	6792728
			Koala	529045	6792760
			Koala	528960	6792831
			Koala	528931	6792854
			Koala	529501	6792477
			Koala	529894	6794576
			Koala	529977	6795253
Koala	529493	6798598			
3	Richmond River: North Woodburn to Pelican Island (blue zone)	16 May 2011	Koala	527483	6787766
			Koala	527250	6788319
			Koala	526681	6791203
4	Goolmangar Road, Goolmangar (blue zone)	5 June 2011			

cont. **Appendix 5 Details of field inspections to check mapped vegetation and its suitability as habitat for conservation-priority terrestrial vertebrate species in the Lismore LGA**

field inspection		date	conservation-priority species recorded during inspections	Easting	Northing
no.	area				
5	Leycester Creek: Lismore to lower reaches of Terania Creek (blue zone)	24 June 2011	Topknot Pigeon	522346	6815500
			Black Bittern	523177	6816772
	Bungabee Road, Back Creek (green zone)	24 June 2011			
6	Elliott Road, Clunes (blue zone)	26 June 2011			
	Graydon Road, Corndale (blue zone)	26 June 2011			
	Mackie Road, Rosebank (blue zone)	26 June 2011			
7	Parrot's Nest-Caniaba (blue zone)	27 June 2011			
	McMahon's Road, South Gundurimba (blue zone)	27 June 2011	Koala	525280	6803953
			Koala	525113	6802271
			Koala	524977	6802343
			Koala	524808	6802140
			Koala	524808	6802040
			Koala	524850	6802523
	Flood Reserve Road, Ruthven (blue zone)	27 June 2011	Koala	526591	6799564
			Koala	526475	6799734
			Koala	526433	6799723
			Koala	526432	6799731
			Koala	526029	6799774
			Koala	526682	6799552
	Coraki Road, Pelican Creek (blue zone)	27 June 2011	Koala	527057	6798802
	Rogerson Road, Codrington (blue zone)	27 June 2011	Koala	523470	6801011
			Koala	523496	6800981
	Tatham Road, Walsh's Creek (blue zone)	27 June 2011	Koala	521234	6800907
8	Richmond River: Coraki to Tatham (blue zone)	28 June 2011	Koala	528035	6793800
			Koala	527863	6794070
			Koala	527961	6794248
			Koala	528365	6794790
			Koala	528294	6794979
			Koala	528003	6795143
9	Bagotville Road, Dungarubba (blue zone)	30 August 2011			
	Tuckean Nature Reserve (grey zone)	30 August 2011	Wompoo Fruit-dove	536917	6797174
			Topknot Pigeon	537339	6797104
			Little Shrike-thrush	537339	6797104

cont. **Appendix 5 Details of field inspections to check mapped vegetation and its suitability as habitat for conservation-priority terrestrial vertebrate species in the Lismore LGA**

field inspection		date	conservation-priority species recorded during inspections	Easting	Northing
no.	area				
<b>10</b>	Stibbard Lane, Green Forest (blue zone)	1 September 2011			
	Maxwell Lane, Paffs Hill (grey zone)	1 September 2011			
	Tucki Tucki Nature Reserve South area (grey zone)	1 September 2011	Koala	531105	6795541
			Wompoo Fruit-dove	530302	6796120
	Tucki Tucki Nature Reserve North (grey zone)	1 September 2011	Koala	530982	6799797
	Fraser Road, Dunoon	1 September 2011			
<b>11</b>	Yeager and Bice Roads, Leicester (blue, green zones)	6 September 2011			
	Back Creek and O'Neill Roads, Bentley (green zone)	6 September 2011			
	Bungabee Nature Reserve and State Forest (green zone)	6 September 2011	Red-necked Pademelon	510734	6821919
<b>12</b>	Rock Valley Road, Rock Valley, Wongavale, Chelmsford and Larnook (blue, green zones)	8 September 2011			
	Martin Road, Billen Cliffs (green zone)	8 September 2011			
	Stony Chute Road, Stony Chute (green zone)	8 September 2011			
	Mountain Top Road, Mountain Top (green zone)	8 September 2011			
	Oakey Creek Road, Georgica (green zone)	8 September 2011			
	Billen Road, Mount Billen (green zone)	8 September 2011			
<b>13</b>	Jiggi, Bertoli and Warby Roads, Jiggi (blue, green zones)	14 September 2011	Grey-headed and Black Flying-fox camp	517920	6826396
	Davis Road, Georgica (green zone)	14 September 2011			
	O'Neill Road, Bentley (green zone)	14 September 2011			
	Bungabee Nature Reserve and State Forest (green zone)	14 September 2011			
<b>14</b>	Martin Road, Billen Cliffs (green zone)	15 September 2011			
<b>15</b>	Alphadale Road, Lindendale (grey zone)	23 September 2011	Koala	535804	6812494
	Henson Road, Wyrallah (grey zone)	23 September 2011	Koala	531303	6804308
<b>16</b>	Fox, Maso and Minyon Falls Roads, Repentance Creek (blue zone)	3 October 2011	Pouched Frog	538564	6832135
			Pouched Frog	538541	6832104
			Pouched Frog	535436	6831872
	Nightcap Range Road and Middleton Way, Dorroughby (blue zone)	3 October 2011	Pouched Frog	534743	6831420









cont. **Appendix 7 Conservation-priority species recorded in sectors of Lismore LGA key habitats and corridors system**

<b>corridor sector</b>	<b>15</b>	<b>16</b>	<b>17</b>	<b>18</b>	<b>19</b>	<b>20</b>	<b>21</b>	<b>22</b>	<b>23</b>	<b>24</b>	<b>25</b>	<b>26</b>
Eastern Blossom-bat												
Eastern Tube-nosed Bat												
Black Flying-fox	+		+			+	+		+	+	+	
*Grey-headed Flying-fox	+					+				+		
Eastern Horseshoe Bat												
Yellow-bellied Sheath-tailed Bat												
Beccari's Free-tailed Bat										+		
East-coast Free-tailed Bat												
Little Bent-winged Bat	+					+				+		
Eastern Bent-winged Bat												
Golden-tipped Bat												
Eastern Long-eared Bat						+				+	+	
*Large-eared Pied Bat												
Eastern False Pipistrelle												
Southern Myotis			+						+			
Greater Broad-nosed Bat										+		
Central-eastern Broad-nosed Bat									+			
Eastern Forest Bat	+					+						
Fawn-footed Melomys												
<b>Total species</b>	<b>17</b>	<b>0</b>	<b>9</b>	<b>2</b>	<b>2</b>	<b>17</b>	<b>2</b>	<b>2</b>	<b>6</b>	<b>17</b>	<b>7</b>	<b>1</b>

## APPENDIX 8 ATTRIBUTES OF CORRIDOR SECTORS FOR LISMORE LGA KEY HABITATS AND CORRIDORS SYSTEM

Regional corridor status based on NPWS key habitats and corridors system (Scotts 2003) and attributes derived from vegetation types identified by Landmark and CMA mapping, records of conservation-priority vertebrate species (**Appendix 7**) and key habitats supporting vertebrate assemblages (**Table 4**).

corridor sector			
no.	name	attributes	
1	<b>Blue Knob Connector</b>	significance and status	very high significance as regional link from Nightcap Range to Mackellar Range through to Boorabee State Forest
		condition	fragmented, degraded
		broad habitats	dominated by moist sclerophyll forest, some rainforest patches
		priority assemblages	key habitats important for Priority 2.4 and 3.4 assemblages, less important for Priority 1.1-3, 2.1-3, 3.1 and 3.3 assemblages
		significant species records	Giant Barred Frog, Greater Broad-nosed Bat
		actions	rehabilitate, restore
2	<b>Nightcap Block</b>	significance and status	very high significance as regional refuge
		condition	mostly intact, edges degraded, some gaps
		broad habitats	dominated by rainforest and wet sclerophyll forest
		priority assemblages	key habitats important for Priority 1.1-4 and 2.1-4 assemblages, less important for Priority 3.1-4 assemblages
		significant species records	Pearson's Tree Frog, Pouched Frog, Fletcher's Frog, Fleay's Barred Frog, Giant Barred Frog, Loveridge's Frog, Southern Leaf-tailed Gecko, Short-limbed Snake-skink, Orange-tailed Shade-skink, Stephen's Banded Snake, Marbled Frogmouth, Sooty Owl, Albert's Lyrebird, Barred Cuckoo-shrike, Red-legged Pademelon, Eastern Tube-nosed Bat, Little Bent-winged Bat, Golden-tipped Bat, Eastern Long-eared Bat, Large-eared Pied Bat, Greater Broad-nosed Bat
		actions	protect, restore, rehabilitate
3	<b>Bishop's Creek Connector</b>	significance and status	very high significance as regional link from Nightcap Block to Nimbin Rocks Block
		condition	fragmented, degraded
		broad habitats	patches of moist and wet sclerophyll forest and rainforest
		priority assemblages	key habitats important for Priority 1.2-4, 2.1-4, 3.1 and 3.4 assemblages, less important for Priority 3.3 assemblage
		significant species records	nil
		actions	rehabilitate, restore
4	<b>Nimbin Rocks Block</b>	significance and status	very high significance as refuge in regional link from Nightcap Range to Mackellar Range
		condition	mostly intact, edges degraded, some gaps
		broad habitats	dominated by moist sclerophyll forest, some rainforest patches
		priority assemblages	key habitats important for Priority 2.4, 3.2 and 3.4 assemblages, less important for Priority 1.3, 2.2, 2.3 and 3.3 assemblages
		significant species records	Giant Barred Frog, Little Bent-winged Bat
		actions	protect, restore, rehabilitate

cont. **Appendix 8 Attributes of sectors for Lismore LGA key habitats and corridors**

<b>5</b>	<b>Billen Cliffs Block</b>	significance and status	very high significance as refuge in regional link from Nightcap Range to Mackellar Range
		condition	mostly intact, edges degraded, some gaps
		broad habitats	dominated by dry and moist sclerophyll forest, some wet sclerophyll forest and rainforest patches
		priority assemblages	key habitats important for Priority 2.4, 3.2 and 3.4 assemblages, less important for Priority 1.3, 2.2, 2.3 and 3.3 assemblages
		significant species records	nil
		actions	protect, restore, rehabilitate
<b>6</b>	<b>Mackellar Connector</b>	significance and status	very high significance as regional link from Mackellar Block to northern Mackellar Range
		condition	mostly intact, edges degraded, some gaps
		broad habitats	dominated by dry and moist sclerophyll forest, some wet sclerophyll forest and rainforest patches
		priority assemblages	key habitats important for Priority 2.2-4, 3.2-4 assemblages, less important for Priority 1.1-4, 2.1 and 3.1 assemblages
		significant species records	Pearson's Tree Frog, Pouched Frog, Sooty Owl, Albert's Lyrebird, Eastern Tube-nosed Bat
		actions	protect, restore, rehabilitate
<b>7</b>	<b>Mackellar Block</b>	significance and status	very high significance as regional refuge
		condition	mostly intact, edges degraded
		broad habitats	dominated by dry and moist sclerophyll forest, some wet sclerophyll forest and rainforest patches
		priority assemblages	key habitats important for Priority 2.2-4, 3.2-4 assemblages, less important for Priority 1.3, 2.1 and 3.1 assemblages
		significant species records	Pearson's Tree Frog, Sooty Owl, Barred Cuckoo-shrike, Little Bent-winged Bat
		actions	protect, restore, rehabilitate
<b>8</b>	<b>Leycester Ridge Connector</b>	significance and status	moderate significance as local link joining Billen Cliffs Block to Goolmangar Ridge Connector
		condition	fragmented, degraded
		broad habitats	dry and moist sclerophyll forest patches, some wet sclerophyll forest patches, a few rainforest patches
		priority assemblages	key habitats important for Priority 3.2 and 3.4 assemblages, less important for Priority 2.3 and 2.4 assemblages
		significant species records	nil
		actions	rehabilitate, restore
<b>9</b>	<b>Goolmangar Ridge Connector</b>	significance and status	high significance as sub-regional link joining Nimbin Rocks Block to Leycester Ridge and Tuncester Connectors through to Mackellar Range
		condition	fragmented, degraded
		broad habitats	dry and moist sclerophyll forest patches, some wet sclerophyll forest and rainforest patches
		priority assemblages	key habitats important for Priority 3.2-3.4 assemblages, less important for Priority 1.1, 2.3 and 2.4 assemblages
		significant species records	Giant Barred Frog
		actions	rehabilitate, restore

cont. **Appendix 8 Attributes of sectors for Lismore LGA key habitats and corridors**

<b>10</b>	<b>Rocky Creek - Keerong Connector</b>	significance and status	high significance as sub-regional link connecting to Tuncester-Parrots Nest Connector and through to Mackellar Range Block
		condition	fragmented, degraded at edges, numerous gaps
		broad habitats	rainforest patches including Camphor Laurel, some dry and moist sclerophyll patches, a few wet sclerophyll patches
		priority assemblages	key habitats important for Priority 1.2, 1.3, 2.1-4 and 3.4 assemblages, less important for Priority 1.1, 3.2 and 3.3 assemblages
		significant species records	Pearson's Tree Frog, Loveridge's Frog, Southern Leaf-tailed Gecko, Orange-tailed Shade-skink, Sooty Owl, Albert's Lyrebird, Little Bent-winged Bat, Eastern Long-eared Bat, Greater Broad-nosed Bat
		actions	rehabilitate, restore
<b>11</b>	<b>Dorrroughby Connector</b>	significance and status	high significance as sub-regional link connecting to Clunes-McCleans Ridges Connector and through to Booyong Reserve
		condition	fragmented, degraded at edges, numerous gaps
		broad habitats	dominated by rainforest patches including Camphor Laurel, a few wet sclerophyll forest patches
		priority assemblages	key habitats important for Priority 1.2-4 and 2.2-4 assemblages, less important for Priority 2.1, 3.2 and 3.3 assemblages
		significant species records	Pouched Frog, Stephen's Banded Snake, Marbled Frogmouth, Sooty Owl
		actions	rehabilitate, restore
<b>12</b>	<b>Repentance Creek Connector</b>	significance and status	high significance as sub-regional link connecting through to Goonengery and Mount Jerusalem National Parks and Andrew Johnston Big Scrub Nature Reserve
		condition	partly fragmented, degraded at edges, some gaps
		broad habitats	dominated by wet sclerophyll forest and rainforest including Camphor Laurel
		priority assemblages	key habitats important for Priority 1.1-4, 2.1-4 and 3.3 assemblages, less important for Priority 3.2 assemblage
		significant species records	Pouched Frog, Orange-tailed Shade-skink, Eastern Tube-nosed Bat
		actions	rehabilitate, restore
<b>13</b>	<b>Numulgi Connector</b>	significance and status	high significance as sub-regional link connecting Dorrroughby and Richmond Hill Connectors
		condition	fragmented, degraded at edges, numerous gaps
		broad habitats	dominated by rainforest patches including Camphor Laurel, a few wet sclerophyll forest patches
		priority assemblages	key habitats important for Priority 1.2-4 and 2.2-4 assemblages, less important for Priority 2.1, 3.2 and 3.3 assemblages
		significant species records	Stephen's Banded Snake, Marbled Frogmouth, Sooty Owl
		actions	rehabilitate, restore

cont. **Appendix 8 Attributes of sectors for Lismore LGA key habitats and corridors**

<b>14</b>	<b>Clunes-McLeans Ridges Connector</b>	significance and status	high significance as sub-regional link connecting Dorroughby and Richmond Hill Connectors and Booyong Reserve
		condition	fragmented, degraded at edges, numerous gaps
		broad habitats	dominated by rainforest patches including Camphor Laurel
		priority assemblages	key habitats important for Priority 1.3 and 2.1-4 assemblages, less important for Priority 3.1 and 3.3 assemblages
		significant species records	Short-limbed Snake-skink
		actions	rehabilitate, restore
<b>15</b>	<b>Richmond Hill Connector</b>	significance and status	high significance as sub-regional link including Boatharbour Nature Reserve connecting Numulgi, Clunes-McLeans Ridges and Lindendale-Marom Creek Connectors
		condition	fragmented, degraded at edges, numerous gaps
		broad habitats	rainforest patches including Camphor Laurel and dry and moist sclerophyll forest patches
		priority assemblages	key habitats important for Priority 1.3, 2.2-4, 3.3 and 3.4 assemblages
		significant species records	Little Bent-winged Bat
		actions	rehabilitate, restore
<b>16</b>	<b>Leycester-Bungabee Connector</b>	significance and status	high significance as sub-regional link connecting Mackellar Block to Goolmangar Ridge and Tuncester Connectors
		condition	fragmented, degraded at edges, numerous gaps
		broad habitats	dry and moist sclerophyll forest patches, a few rainforest patches
		priority assemblages	key habitats important for Priority 3.3 and 3.4 assemblages
		significant species records	nil
		actions	rehabilitate, restore
<b>17</b>	<b>Lindendale-Marom Creek Connector</b>	significance and status	high significance as sub-regional link including Brockley refuges, connecting Richmond Hill and Lower Tucki Tucki Creek Connectors through to Victoria Park Nature Reserve and Blackwall Range
		condition	fragmented, degraded at edges, numerous gaps
		broad habitats	rainforest patches including Camphor Laurel, a few dry and moist sclerophyll forest patches
		priority assemblages	key habitats important for Priority 2.3 and 2.4 assemblages, less important for Priority 2.2, 3.1 and 3.3 assemblages
		significant species records	nil
		actions	rehabilitate, restore
<b>18</b>	<b>Tuncester-Parrots Nest Connector</b>	significance and status	high significance as sub-regional link connecting Rocky Creek-Keerong, Leycester-Bungabee, Gundurimba-Tucki Tucki Creek and Pelican Creek Connectors
		condition	fragmented, degraded at edges, numerous gaps
		broad habitats	dry sclerophyll forest and rainforest patches
		priority assemblages	key habitats important for Priority 2.3, 2.4, 3.2 and 3.4 assemblages
		significant species records	nil
		actions	rehabilitate, restore

cont. **Appendix 8 Attributes of sectors for Lismore LGA key habitats and corridors**

<b>19</b>	<b>Lower Tucki Tucki Creek Connector</b>	significance and status	high significance as sub-regional link connecting Lindendale-Marom Creek, Gundurimba-Tucki Tucki Creek and Tuckurimba Connectors through to Tuckean Swamp Block
		condition	fragmented, degraded at edges, numerous gaps
		broad habitats	dry sclerophyll forest patches, some rainforest including Camphor Laurel patches, a few swamp sclerophyll forest patches
		priority assemblages	key habitats important for Priority 2.3, 2.4, 3.2 and 3.4 assemblages, less important for Priority 3.3 assemblage
		significant species records	nil
		actions	rehabilitate, restore
<b>20</b>	<b>Gundurimba-Tucki Tucki Creek Connector</b>	significance and status	moderate significance as local link connecting to Wilson Nature Reserve and Rotary Park and connecting Tuncester-Parrots Nest, Lower Tucki Tucki Creek and Wyrallah Connectors
		condition	fragmented, degraded
		broad habitats	dry sclerophyll forest and rainforest including Camphor Laurel patches
		priority assemblages	key habitats important for Priority 1.4, 2.2-4 and 3.1-4 assemblages, less important for Priority 1.2 and 1.3 assemblages
		significant species records	Marbled Frogmouth, Little Bent-winged Bat, Eastern Long-eared Bat
		actions	rehabilitate, restore
<b>21</b>	<b>Pelican Creek Connector</b>	significance and status	high significance as sub-regional link connecting Tuncester-Parrots Nest and Tuckurimba Connectors
		condition	fragmented, degraded at edges, numerous gaps
		broad habitats	dry sclerophyll forest patches, some swamp sclerophyll forest patches, a few rainforest including Camphor Laurel patches
		priority assemblages	key habitats important for Priority 3.2-4 assemblages, less important for Priority 2.3 and 2.4 assemblages
		significant species records	nil
		actions	rehabilitate, restore
<b>22</b>	<b>Wyrallah Connector</b>	significance and status	moderate significance as local link connecting to Gundurimba-Tucki Tucki Creek and Tuckurimba Connectors
		condition	fragmented, degraded
		broad habitats	some rainforest including Camphor Laurel patches, a few dry sclerophyll and swamp sclerophyll forest patches
		priority assemblages	key habitats important for Priority 2.3, 2.4 and 3.3 assemblages, less important for Priority 3.2 and 3.4 assemblages
		significant species records	nil
		actions	rehabilitate, restore

cont. **Appendix 8 Attributes of sectors for Lismore LGA key habitats and corridors**

<b>23</b>	<b>Tuckurimba Connector</b>	significance and status	high significance as sub-regional link connecting Lower Tucki Tucki Creek, Pelican Creek, Wyrallah Connectors and Tuckean Swamp Block
		condition	fragmented, degraded at edges, numerous gaps
		broad habitats	rainforest including Camphor Laurel and swamp sclerophyll forest patches, some dry sclerophyll forest patches
		priority assemblages	key habitats important for Priority 2.3, 2.4 and 3.3 assemblages, less important for Priority 3.4 assemblage
		significant species records	nil
		actions	rehabilitate, restore
<b>24</b>	<b>Tuckean Swamp Block</b>	significance and status	very high significance as regional refuge
		condition	mostly intact, some fragmentation, degraded at edges, some gaps
		broad habitats	dominated by swamp sclerophyll forest, swamp sclerophyll forest patches, some rainforest including Camphor Laurel patches
		priority assemblages	key habitats important for Priority 2.3, 2.4 and 3.3 assemblages, less important for Priority 3.4 assemblage
		significant species records	Albert's Lyrebird, Little Bent-winged Bat, Eastern Long-eared Bat, , Greater Broad-nosed Bat
		actions	protect, restore, rehabilitate
<b>25</b>	<b>Green Forest Connector</b>	significance and status	moderate significance as local link connecting Tuckean Swamp Block through to Broadwater National Park
		condition	fragmented, degraded at edges, numerous gaps
		broad habitats	swamp sclerophyll forest patches, some dry sclerophyll forest patches
		priority assemblages	key habitats important for Priority 2.3, 2.4 and 3.3 assemblages, less important for Priority 3.4 assemblage
		significant species records	Eastern Long-eared Bat
		actions	rehabilitate, restore
<b>26</b>	<b>Tuckean-Broadwater Connector</b>	significance and status	high significance as sub-regional link connecting Tuckean Swamp Block through to Broadwater National Park
		condition	fragmented, degraded at edges, some gaps
		broad habitats	dry and moist sclerophyll forest patch, some swamp sclerophyll forest patches, a few rainforest patches
		priority assemblages	key habitats important for Priority 3.3 and 3.4 assemblages
		significant species records	nil
		actions	rehabilitate, restore