ASSESSMENT | PLANNING | MANAGEMENT

# Wagga Wagga Planning Study

## Environmental / Biodiversity report for Lloyd

(Project No. 069-052)

Report prepared for:
Willana Associates
on behalf of Wagga Wagga City Council

March 2008

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## Executive Summary

Wagga Wagga City Council (WWCC) is in the process of preparing a draft Local Environment Plan (LEP) for the Wagga Wagga Local Government Area (WWLGA). The draft plan is intended to implement the strategic planning undertaken in the Wagga Wagga Spatial Plan 2007 (WWCC 2006) and will be prepared in accordance with the *Standard Instrument (Local Environmental Plans) Order 2006*.

Eco Logical Australia Pty Ltd was commissioned by Wagga Wagga City Council to prepare a study of the biodiversity values of a site at Lloyd, Wagga Wagga, along with seven other sites (each subject to an individual report). The biodiversity studies will feed into the broader environmental study for each proposed development site. Each biodiversity report presents the ecological values of the subject lands and whether development of the site will "maintain or improve" biodiversity.

This biodiversity report seeks to present the ecological values of the Lloyd development site and to discuss the potential impacts on ecological values, including threatened species, endangered populations and endangered ecological communities, arising from development of the site. Moreover the report seeks to provide a framework for maintaining and improving biodiversity at the Lloyd site.

The specific objectives of the project are to:

- Describe the ecological values of the site
- Describe potential impacts of proposed development
- Recommend ways to minimise impacts on ecological values of the site
- Where impacts are unavoidable, to recommend offsets which ensure larger, viable areas of native vegetation and habitat are retained in such a way as to enhance landscape connectivity.

The report aims to provide a structure plan for the Lloyd development site which will allow development of the site while avoiding impacts to native vegetation and threatened species habitats.

Much of the native vegetation on Lloyd site occurred as sparse trees and native pasture while areas of remnant woodland vegetation occurred to the west and south east of the site. Native vegetation was predominately restricted to the ridgelines and mid to upper-slopes of the site.

The site contained two vegetation communities, Box – gum woodland and White Box – White Cypress Pine woodland, both of which have been extensively cleared within the Murrumbidgee catchment. Box – gum woodland comprised the majority of remnant woodland at the site and occurred in 'moderate to good' condition. This community is listed as an endangered ecological community under the TSC Act and as critically endangered under the Commonwealth EPBC Act. White Box – White Cypress Pine woodland, while not listed as a threatened ecological community, is considered vulnerable within the Wagga Wagga LGA (Priday and Mulvaney 2005). The remainder of vegetation at the site was identified as scattered paddock trees and exotic grassland.



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The study site occupies an important position in the landscape, as it forms part of a fragmented link between the Murrumbidgee River to the north of the site and Livingstone National Park approximately 30 km to south. Vegetation at the site also provides linkages to other areas of vegetation east and west of the site.

Six threatened fauna species are known to utilise the site while another six threatened species are considered likely to occur. In addition, three species listed as migratory under the Commonwealth EPBC Act have the potential to occur at the site.

The development potential of the Lloyd site is constrained by the presence of 279.6 ha of 'moderate to good' condition native vegetation, much of which is a listed endangered ecological community or critically endangered ecological community, and provides habitat for a range of threatened species. Despite this, extensive areas of scattered paddock trees and exotic grassland vegetation (318.4 ha in total) within the site are potentially developable.

A structure plan has been produced which outlines the recommended location of potentially developable lands, lands to be retained and areas in which offsets may be located. In general, the location of retained lands and offset areas at the site aim to:

- Increase connectivity between currently isolated woodland patches
- Increase vegetation cover of riparian corridors on site
- Reduce soil erosion.

The loss of remnant trees within potentially developable lands of Lloyd will require offsetting to a ratio of 10:1. Moreover, remnant trees retained within a residential zoning will also require offsetting. It is likely that such offsets can be accommodated on site within 'moderate to good' condition vegetation. It is recommended that remnant trees within potentially developable lands be retained and incorporated into future Master Planning so as to maximise the retention of biodiversity values within any future urban landscape.



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# Contents





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# 1. Introduction

## 1.1 Project Background

Wagga Wagga City Council (WWCC) is in the process of preparing a draft Local Environment Plan (LEP) for the Wagga Wagga Local Government Area (WWLGA). The draft plan is intended to implement the strategic planning undertaken in the Wagga Wagga Spatial Plan 2007 (WWCC 2006) and will be prepared in accordance with the *Standard Instrument (Local Environmental Plans) Order 2006*.

Preparation of the draft LEP requires that 8 environmental studies be undertaken at sites within the WWLGA that are proposed to be subject to significant zoning changes. These sites are:

- Boorooma East
- Estella West
- Lloyd
- Bomen
- Eastern Industrial – Copland Street South
- Eastern Industrial – Hammond Avenue North
- Edison Road
- Moorong Street

Eco Logical Australia Pty Ltd has been commissioned by Wagga Wagga City Council to prepare a study of the biodiversity values of each of the above sites. The biodiversity studies will feed into the broader local environmental study (LES) for each proposed development site. Each biodiversity report will present the ecological values of the subject lands and determine whether development of the site is likely to "maintain or improve" biodiversity.

This document presents the biodiversity report for the proposed development site known as Lloyd. Biodiversity reports for each of the 7 additional development sites are presented as separate documents.

## 1.2 Project Objectives

This biodiversity report seeks to present the ecological values of the Lloyd site and to discuss the potential impacts on ecological values, including threatened species, endangered populations and endangered ecological communities, arising from development of the site. Moreover, the report seeks to provide a framework for maintaining and improving biodiversity at the Lloyd site.

The specific objectives of the project are to:

- Describe the ecological values of the site
- Describe potential impacts of proposed development
- Recommend ways to minimise impacts on ecological values of the site
- Where impacts are unavoidable, to recommend off sets which ensure larger, viable areas of native vegetation and habitat are retained in such a way as to enhance landscape connectivity.



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The report aims to provide a structure plan for the Lloyd site which will allow development of parts of the site while improving or maintaining the biodiversity values of the site.

### 1.3 Study Area

The Lloyd site occurs to the south west of the existing urban area of the city of Wagga Wagga on the South West Slopes of New South Wales. The site occupies an area of approximately 598 ha and is bound by the Olympic Highway and Main Southern Railway Line to the west, Red Hill Road to the north, and Glenfield and Mangoplah Roads to the east. The southern boundary of the site is delineated by the southern property boundaries of Delaney, Trustees of the Roman Catholic Church and Forster (Map 1).

Current land use at the site is predominately rural with the majority of the site consisting of native pasture sparsely to moderately grazed by sheep and cattle. A road base quarry is located near the centre of the site and represents the most intensive land use at the site. Two water reservoirs occur at the site and are situated on the eastern most ridge line toward the centre of the site.

Land use south of the site is predominately rural, consisting of grazing paddocks as well as some recent rural residential development at Glenoak Estate. The western boundary of the site abuts a rail easement and Silvalite Reserve. Beyond the Olympic Highway is Kapooka Army Base comprising buildings surrounded by grass fields and native forest. The urban development of Glenfield Park occurs to the north of the site while the existing suburb of Lloyd and Jubilee Park (with playing fields) is situated to the east of the site.

The site is undulating with two prominent ridgelines running south through the site before meeting to form a single ridgeline towards the south. Elevation across the site ranges from approximately 328 metres on the ridge in the south to approximately 216 m in the north east of the site. The site drains to the north towards the Murrumbidgee River which is approximately 3 km north of the proposal site.

The site is predominately covered by the Lloyd soils group described by Chen and McKane (1997) with smaller areas of Becks Lane, Livingstone and Pulletop soils. These soils are prone to erosion and terracing has been established on some slopes to help alleviate erosion and sediment transport. Erosion is common along the drainage lines within the site.

Native vegetation occurs across the majority of the site as pockets of disturbed woodland and as mixed native and exotic grassland with isolated paddock trees. Woodland vegetation is generally confined to the ridgeline and upper slopes in the western and southern parts of the site and along the roadside at the western and eastern boundaries (Map 1). Improved pasture dominates vegetation in the north of the site.

The site is located approximately 30 km north of Livingstone National Park and approximately 30 km north east of the Rock Nature Reserve. Remnant woodland vegetation at the site forms a fragmented corridor linking Livingstone National Park



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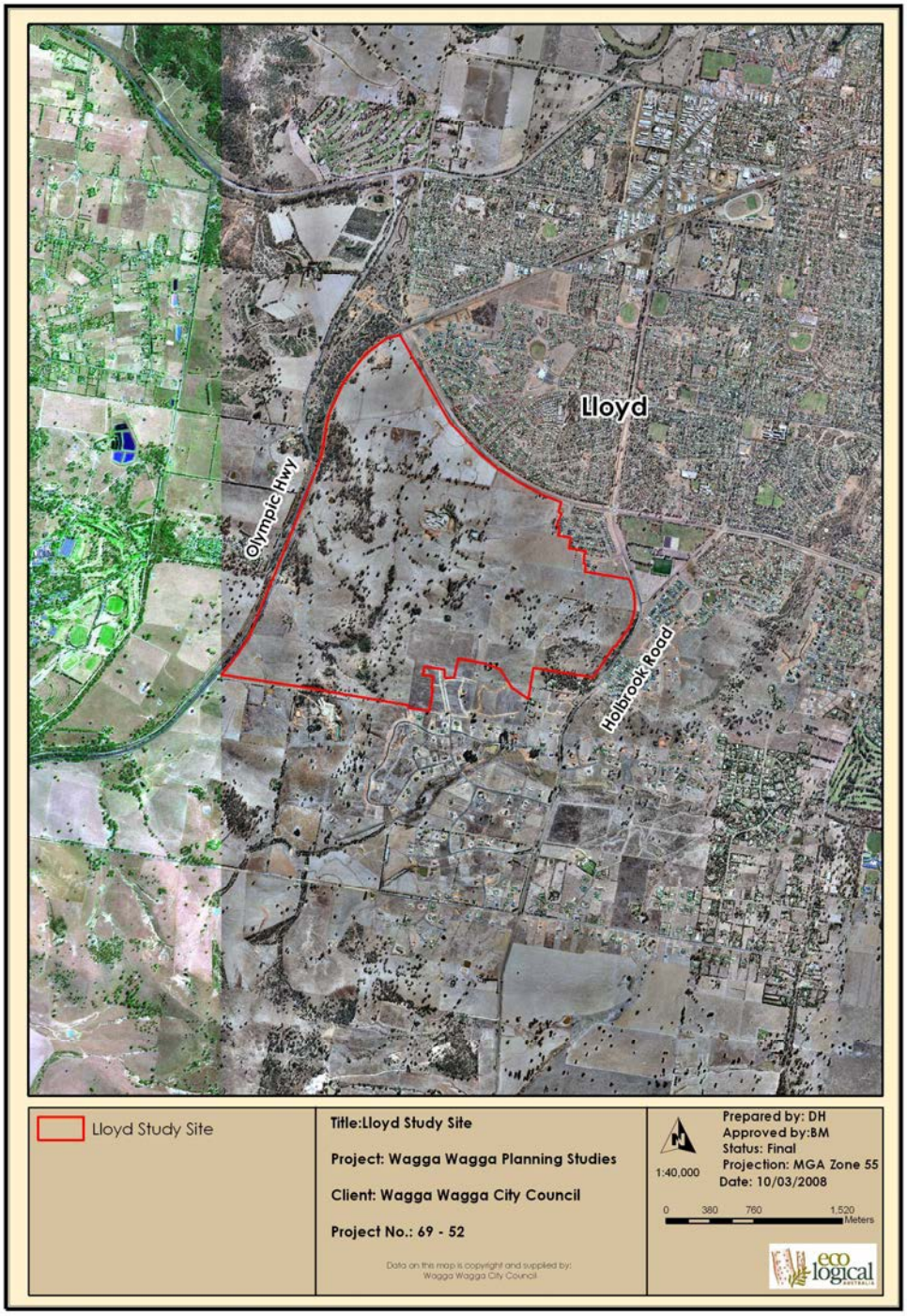
with the Murrumbidgee River through Gelston Park and Gregadoo Hills and remnants north of the river.




**Map 1 – Location of proposed Lloyd development site**



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## 1.4 Legislative Summary

The following provides a brief summary of the main pieces of legislation relevant to biodiversity conservation within the study area.

**NSW Native Vegetation Act, 2003 (NV Act)**
The objects of the *Native Vegetation Act, 2003* (NV Act) are to manage native vegetation on a regional basis through bringing an end to broadscale clearing and seeking to protect and improve areas of existing native vegetation, particularly those areas of high conservation value. The NV Act also seeks to encourage the revegetation and rehabilitation of land in accordance with the principles of ecologically sustainable development.

Under the NV Act, clearing of native vegetation is not permitted unless the clearing is in accordance with a development consent granted in accordance with the NV Act or unless the clearing is in accordance with a property vegetation plan (PVP). Clearing of unprotected regrowth, of certain groundcover and clearing associated with routine agricultural management activities (RAMAs) does not constitute clearing of native vegetation under the Act and therefore does not require a consent approval or PVP.

Under the NV Act, clearing of native vegetation cannot be undertaken unless it **improves or maintains** environment outcomes. Mitigating actions or offsets which provide gains equal to, or exceeding, losses from clearing, may be required in order for clearing of native vegetation to meet the improve or maintain requirements under the Act. Under the Act, native vegetation which is in '**moderate to good condition'** and is of a type, or within a landscape that is highly cleared (>70%), can not be offset and is not permitted to be cleared.

**Environmental Planning and Assessment Act 1979**
The NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) is the principal planning legislation for the state, providing a framework for the overall environmental planning and assessment of development proposals. Various legislation and instruments, such as the NSW *Threatened Species Conservation Act 1995* (TSC Act), are integrated with the EP&A Act.

The LES is being prepared in accordance with section 57 of the EP&A Act. Issues to be addressed in the LES were raised during consultation with agencies (conducted in accordance with sections 34A and 62 of the EP&A Act).

**NSW Threatened Species Conservation Act, 1995 (TSC Act)**
The TSC Act aims to protect and encourage the recovery of threatened species, populations and ecological communities listed under the Act. The integration of the TSC Act with the NSW Environmental Planning and Assessment Act (EP&A Act) requires consideration of the likelihood of a development (Part 4 of the EP&A Act) or an activity (Part 5 of the EP&A Act) significantly affecting threatened species, populations and ecological communities or their habitat. This is undertaken through the preparation of a '7-part test' (Section 5A).


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Schedule 1 of the TSC Act lists threatened species, populations and ecological communities and species that are endangered or presumed extinct. Schedule 2 lists vulnerable species and Schedule 3 lists key threatening processes.

The TSC Act defines 'endangered' as a species, population or ecological community that is likely to become extinct or is in immediate danger of extinction. A species that is 'presumed extinct' has not been located in nature during the preceding fifty years despite the searching of known and likely habitats. A 'vulnerable' species is likely to become endangered unless the circumstances and factors threatening its survival or evolutionary development cease to operate.

The site is known or potential habitat for a number of threatened species, ecological communities and/or migratory species listed under the Act.

The TSC Act provides for the preparation of recovery plans and threat abatement plans, some of which apply to the site. Biodiversity certification of Local Environment Plans (LEPs) is also facilitated through this Act.

**Commonwealth Environment Protection & Biodiversity Conservation Act, 1999 (EPBC Act)**

Approval from the Commonwealth Environment Minister is required under the EPBC Act if the action (can include a project, development, undertaking or activity) will, or is likely to, have a significant impact on matters considered to be of national environmental significance (NES matters). NES matters relevant to this study include threatened species, ecological communities and migratory (JAMBA/CAMBA) species that are listed under the Act.

The EPBC Act does not define significant impact but identifies matters that are necessary to take into consideration. If the matter is referred to the Minister a decision is generally required within 20 days in relation to whether an action requires Commonwealth approval.

The site is known or potential habitat for a number of threatened species, ecological communities and/or migratory species listed under the Act.

**NSW Noxious Weeds Act, 1993 (NW Act)**

The objectives of the Noxious Weeds Act are to identify which noxious weeds require control measures, identify control measures suitable to those species and to specify the responsibilities of both public and private landholders for noxious weed control.

The Noxious Weeds Act allows for the declaration of weeds as noxious within a Local Control Area (LCA) and assigns a weed control class to each declared noxious weeds. The Lloyd site is located within the Wagga Wagga City Council LCA. Currently 106 species or groups of species are listed as noxious weeds within the Wagga Wagga City Council LCA. Noxious weeds are known to occur on the site.

**Water Management Act 2000**



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The Water Management *Act 2000* and *Water Act 1912* control the extraction of water, the use of water, the construction of works such as dams and weirs and the carrying out of activities in or near water sources in New South Wales. 'Water sources' include any river, lake, estuary, place where water occurs naturally on or below the surface of the ground and New South Wales coastal waters.

Approval is required under the *Water Management Act* for carrying out of a 'controlled activity' on 'waterfront land' (s91). Controlled activities' include:

- the construction of buildings or carrying out of works;
- the removal of material or vegetation from land by excavation or any other means;
- the deposition of material on land by landfill or otherwise; or
- any activity that affects the quantity or flow of water in a water source.

'Waterfront land' is defined as the bed of any river or lake, and any land lying between any permanent or intermittent waterbody or lake and a line drawn parallel to and forty metres inland from either the highest bank or shore (in relation to non-tidal waters) or the mean high water mark (in relation to tidal waters). The distance of forty metres can be reduced by the regulations. Depending upon the regulations, land adjoining coastal waters may also be waterfront land.

It is an offence to carry out a controlled activity on waterfront land except in accordance with an approval.

The removal of vegetation or material from within 40 m of waterbodies within the site would require approval under the Act.



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# 2. Description of Methods

## 2.1 Review of existing information

The site has been the subject of a number of previous biodiversity and planning documents. A description of each report and their major findings is provided below.

- **Mullins, B.J and Sutherland, L.J. (2002a) *Lloyd Neighbourhood Local Environment Study, Environmental Investigations.* An unpublished report provided to Willana Associates, Charles Sturt University Wagga Wagga.**

  This report detailed environmental investigations undertaken as part of a Local Environmental Study prepared in response to proposed rezoning of Lloyd Neighbourhood. The study was confined to the north western portion of the current Lloyd site. Detailed flora and fauna survey recorded 105 flora species and 45 fauna species at the site. The report recorded 1 threatened fauna species, the common bentwing bat (*Miniopterus schreibersii*) at the site and considered a further four threatened species (superb parrot, swift parrot, diamond firetail and brown treecreeper) as likely to infrequently inhabit the site. The report also confirmed the presence of the white box, yellow box, Blakely's red gum woodland (box-gum woodland) endangered ecological community at the site. This ecological community occurred on the western slopes and ridgeline of the site.

  The report indicated that conservation value of the site ranged from low to high. Areas of box-gum woodland on the slopes and ridges offered moderate to high habitat value for threatened fauna and the box-gum woodland EEC. Improved pasture on the lower slopes in the north of the site was considered of low conservation value. The report recommended that woodland areas be retained to provide habitat and a regionally important north south corridor for fauna movement.

- **Willana Associates P/L (2002) *Lloyd Neighbourhood – Local Environmental Study*. An unpublished report prepared for Wagga Wagga City Council.**

  The Local Environmental Study (LES) was prepared for the Lloyd Neighbourhood to consider the suitability, staging and future land use of the area in response to a formal rezoning application by several landowners. The LES summarises information presented in Mullins and Sutherland (2002a) and presents additional information relating to the natural, built and socio-economic environments.

- **Mullins, B.J. and Sutherland, L.J. (2002b) *Review of Environmental Factors; Red Hill Road Extension*. A report to Wagga Wagga City Council, Charles Sturt University Wagga Wagga.**

  This report presents a review of environmental factors as they relate to a proposed extension of the western limit of Red Hill Road. Red Hill Road forms the northern boundary of the current Lloyd site. The study considered a



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range of environmental factors including soils, water quality, air quality, noise and biodiversity.

Surveys conducted during the study found that the north of the Lloyd site contains 2 distinct vegetation communities; woodland and grassland. The grassland can be further broken up into improved pasture and mixed native and exotic grassland. Vegetation within the woodland areas was considered consistent with the box-gum woodland EEC and was found to contain a number of key attributes of high quality woodland including hollow bearing trees mixed age canopy and native understorey components.

The study presented results of fauna surveys conducted by Mullins and Sutherland (2002a) (reviewed above) as well as additional targeted threatened species surveys. Targeted surveys indicated that woodland areas within the site provide important habitat for the superb parrot, squirrel glider and common bentwing bat. The report also identified the presence of swift parrot, brown treecreeper and grey-crowned babbler on site. The report also found that large paddock trees at the site frequently contained hollows and provided foraging, breeding and roosting habitat for a range of mobile fauna.

- **Eco Logical Australia P/L (2006) *Assessment of Significance – Lloyd Masterplan, Wagga Wagga.* An unpublished report to Ehkuk P/L and Resolve Planning.**

  This report considered the likely impacts associated with implementation of a proposed Masterplan for the Lloyd site described in Mullins and Sutherland (2002a) and Willana and Associates (2002).

  A site inspection was conducted for the report, however, detailed information concerning flora, fauna and vegetation communities at the site was sourced from earlier ecological reports on the area (i.e. Mullins and Sutherland 2002a and Mullins and Sutherland 2002b).

  The report found that the Lloyd site contained a number of ecological values of high to moderate conservation value including threatened species, an endangered population and an endangered ecological community as well as important fauna habitat. The report found that the proposed Lloyd Masterplan failed to adequately address the ecological values of the site and, therefore, was likely to have a significant impact on threatened species at the site.

## 2.2 Desktop Assessment

The NSW National Parks and Wildlife Atlas of NSW Wildlife and Commonwealth Environmental Protection and Biodiversity Conservation Act (1999) Protected Matters Search Tool were used to supplement surveys undertaken in this site in order to compile a comprehensive list of threatened flora and fauna, populations and endangered ecological communities likely or with the potential to occur at the site. The searches were performed on 4/09/2007 for the Wagga Wagga LGA. Likelihood



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of occurrences for threatened species, populations and communities for the Lloyd site were then made based on the habitat characteristics of the site, results of the field survey and professional judgement (Appendix 3). Five terms for the likelihood of occurrence of species were used and are defined below:

- "yes" = the species was or has been observed on the site
- "likely" = a medium to high probability that a species uses the site
- "potential" = suitable habitat for a species occurs on the site, but there is insufficient information to categorise the species as likely to occur, or unlikely to occur
- "unlikely" = a very low to low probability that a species uses the site
- "no" = habitat on site and in the vicinity is unsuitable for the species.

Aerial photography produced in 2004 and 2006 for the Wagga Wagga area was provided by Wagga Wagga City Council and was used to map the current extent of vegetation at the site.

### 2.3 Field Survey Methodology

Survey of the site was conducted during the period between 15th and 24th August, 2007. Weather conditions ranged from fine and sunny to cold and rainy during the survey period. Weather conditions for the period are summarised in (Table 1).

**Table 1: Weather conditions for the survey period 15th – 24th August, 2007.**

| Date | Day | Temps (°C) | | Rain (mm) |
|---|---|---|---|---|
| | | Min | Max | |
| 15 | We | 1.5 | 16 | 0 |
| 16 | Th | 2.3 | 16.6 | 0 |
| 17 | Fr | 5 | 12.2 | 14.2 |
| 18 | Sa | 5.5 | 14.4 | 1.8 |
| 19 | Su | 3.2 | 15.8 | 0.2 |
| 20 | Mo | 4.1 | 17.7 | 0.2 |
| 21 | Tu | 1.4 | 16.8 | 0 |
| 22 | We | 3.4 | 15.2 | 0 |
| 23 | Th | 2.8 | 16.6 | 0 |
| 24 | Fr | 7.3 | 17.2 | 0 |

Prior to field survey, aerial photography of the site was assessed and vegetation zones requiring survey mapped. Vegetation Zones were mapped according to the methods described in the *BioMetric Tool* v1.8 (Ayers et al. 2005).

The aim of the field survey was to accurately and quantitatively record the type, condition and extent of vegetation at the site. Field survey also aimed to record the various types of fauna habitat present within the site and the types and degree of disturbance acting on ecological values at the site.

Targeted fauna surveys were not conducted in the current study, rather incidental fauna sightings were recorded.



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A number of previous reports have been prepared for parts of the current study area. More exhaustive flora and fauna survey was conducted during these studies and included trapping (target surveys for arboreal mammals and bats), ANABAT detection, bird census surveys and systematic vegetation survey. The results of these surveys have been used to supplement investigation undertaken for the current study.

Vegetation within the study area was assessed using three methods:

- Systematic Vegetation survey (vegetation plots)
- Vegetation Traverses
- Tree Counts

Systematic vegetation surveys were conducted using the methods described in Appendix 3 of the *BioMetric Tool* v1.8 Operation Manual (Ayers et al. 2005). The location of vegetation plots was biased towards vegetation zones containing woodland vegetation or mixed native/exotic grasslands (Map 2).

Vegetated areas that were not assessed through vegetation plots, including areas of paddock trees and exotic pasture, were surveyed using the random traverse method. During the random traverse, all flora species encountered were recorded (Map 2).

All large trees at the site (i.e. > 40 cm diameter at breast height (DBH)) were identified and there location recorded either via a handheld GPS unit or by marking their location on a high resolution aerial photograph. Large trees were assigned to a size class (Large - > 40 cm, < 80 cm DBH and Very Large - > 80 cm DBH).

Following completion of the field survey, data collected was used to run the BioMetric Tool v1.8 (Ayers et al. 2005). BioMetric is a tool for assessing terrestrial biodiversity at the scale of patch, paddock or property (Ayers et al. 2005). Readers should consult the BioMetric Tool Operational Manual (Ayers et al. 2005) for a detailed discussion of the assessment process under the BioMetric Tool v1.8.

## 2.4 Consultation

Consultation was held with Mark Sheahan (NSW Department of Environment and Climate Change) on the 16th August, 2007. The consultation process included discussion of the assessment methodology at the site and included an onsite meeting to discuss practical application of the agreed methodology.


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## 2.5 Desktop review results

The species, populations and communities considered to have the potential to occur on the site based on the habitat present are outlined in Table 2.

**Table 2: Species, populations and communities listed under the TSC Act and EPBC Act for which the site represents habitat**

| Scientific Name | Common Name | Status | | Habitat |
|---|---|---|---|---|
| | | TSC Act | EPBC Act | |
| **Threatened species** | | | | |
| *Ardea ibis* | Cattle Egret | | M | Stock paddocks, pastures, croplands, garbage tips, wetlands, tidal mudflats |
| *Hirundapus caudacutus* | White-throated Needletail | | M | Open space above canopy. Forages over large areas |
| *Merops ornatus* | Rainbow Bee-eater | | M | Open woodlands with sandy, loamy soils, dunes, cliffs, mangroves golf courses |
| *Polytelis swainsonii* | Superb Parrot | V | V | Breeds along inland rivers in river red gum, feeding in box woodland with 10km of nest tree. West of dividing range. |
| *Pomatostomus temporalis temporalis* | Grey-crowned Babbler (eastern subspecies) | V | | Inhabits open Box-gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains |
| *Stagonopleura guttata* | Diamond Firetail | V | | Open eucalypt forests, woodlands. |
| *Climacteris picumnus victoriae* | Eastern subspecies of Brown Treecreeper | V | | Drier forests / woodlands / scrubs with fallen branches. |
| *Saccolaimus flaviventris* | Yellow-bellied Sheathtail Bat | V | - | Forages in most habitats across its very wide range, with and without trees. Roosts and breeds in living or dead hollow bearing trees. |
| *Chalinolobus picatus* | Little Pied bat | V | - | Dry open forest, open woodland, mulga woodlands, chenopod shrublands, cypress pine forest, malle and bramble box. Roosts and breeds in tree hollows, fissures or cracks, buildings, power poles, fence posts, caves, |


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| Scientific Name | Common Name | Status | | Habitat |
|---|---|---|---|---|
| | | TSC Act | EPBC Act | |
| | | | | cliff crevices, mineshafts and tunnels. |
| *Nyctophilus timoriensis* (south eastern form) | Eastern Long-eared Bat | V | V | Inhabits a variety of vegetation types, including mallee, bulloak *Allocasuarina luehmannii* and box eucalypt dominated communities, but it is distinctly more common in box/ironbark/cypress-pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland |
| *Petaurus norfolcensis* | Squirrel Glider | V | | In the region occurs in Box-gum woodlands, box-ironbark woodlands and river red gum woodland. |
| **Threatened Ecological Populations** | | | | |
| *Petaurus norfolcensis* – endangered population Wagga Wagga | Squirrel Glider population in the Wagga Wagga LGA | E | | Inhabits a wide range of open forest, woodland and riverine forest habitats. Utilise remnants of various sizes, including small remnants and even small stands of trees within Travelling Stock Reserves, roadside reserves or private land. Often utilise linear remnant vegetation along roadsides or rivers and streams |
| **Threatened Ecological Communities** | | | | |
| | White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland | E | CE | Western slopes and plains |


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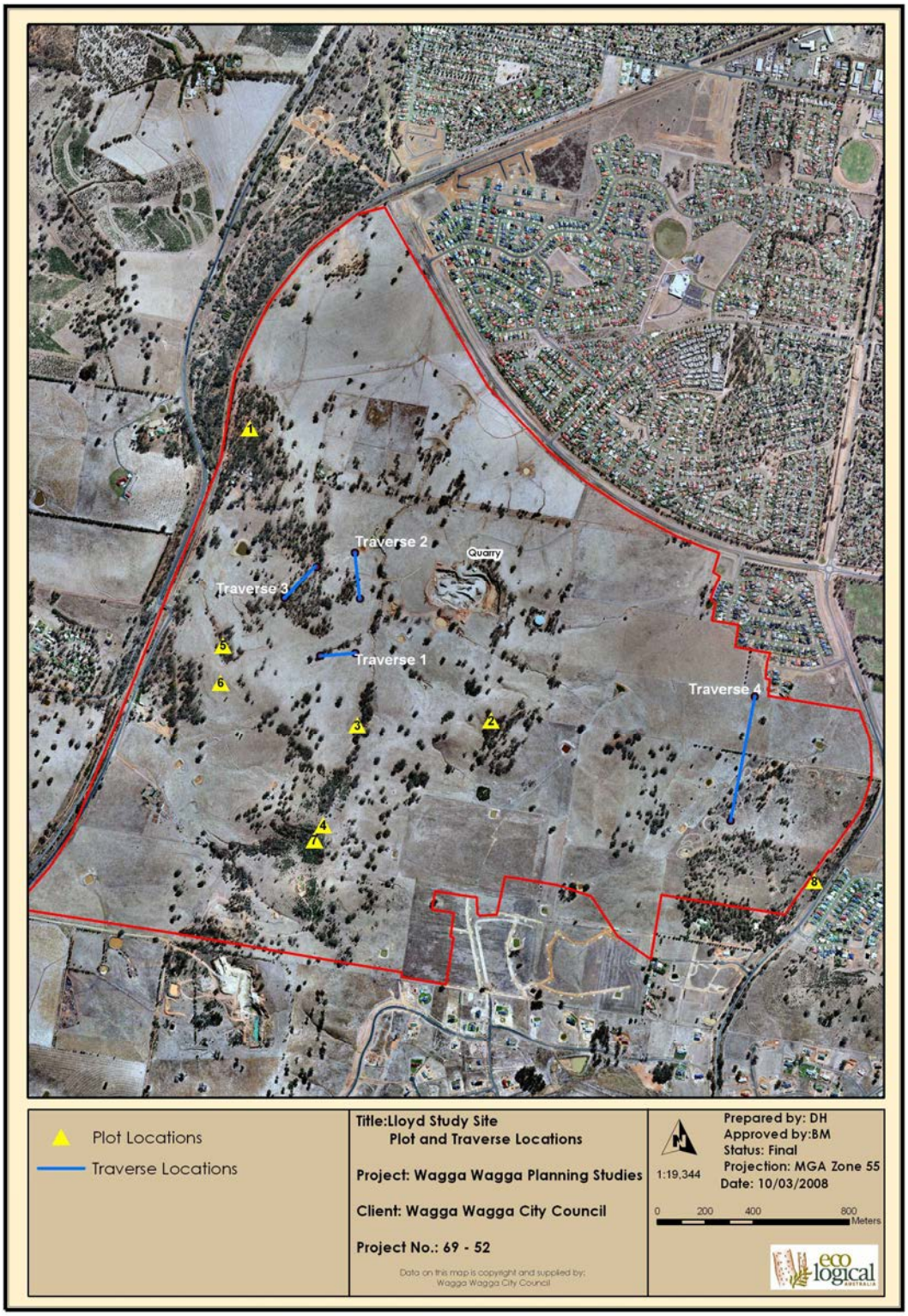


**Map 2 – Location of vegetation plots and traverses.**



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## 2.6 Field Survey Results

### *2.6.1 Flora*

A total of 86 flora species were recorded by systematic survey (Map 2) and random traverses during the current study. 112 flora species were recorded during surveys by Mullins and Sutherland (2002a and b). A combined list of flora species recorded during this and previous studies is presented in Appendix 1. A combined total of 146 flora species have been recorded at or adjacent to the site, with the current study adding 36 species to the overall total.

No threatened flora were recorded during this or any previous surveys nor are they considered likely to occur on site (ELA 2006). *Pultenaea foliolosa* was recorded on site in woodland remnants in the west and east, and this species is noted as being of local conservation significance (Mullins and Sutherland 2002a).

40 weed species are known to occur at the site, 8 of which are declared noxious weeds in the Wagga Wagga LGA (Table 3). Black locust (*Robinia pseudoacacia*) is know to occur at the site and is an environmental weed.

**Table 3 Noxious weed species identified on site (Mullins and Sutherland 2002a).**

| Common Name | Scientific Name | Class |
|---|---|---|
| African Boxthorn | Lycium ferocissimum | 4 |
| Bathurst Burr | *Xanthium spinosum* | 4 |
| Blackberry | *Rubus fruticosus* agg. spp | 4 |
| Broomrape | *Orobanche spp.* | 1 |
| Horehound | *Marrubium vulgare* | 4 |
| Paterson's Curse | *Echium plantagineum* | 4 |
| St John's Wort | *Hypericum perforatum* | 4 |
| Tree of Heaven | *Ailanthus altissima* | 4 |

Notes: Class 4 -The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority.
Class 1 - The plant must be eradicated from the land and the land must be kept free of the plant.

### *2.6.2 Fauna*

A total of 14 species of fauna were observed during the field survey period at the site (Table 4). Birds were the most common fauna group recorded with 11 species observed. Common bird species included the starling (*Sturnus vulgaris*), Australian magpie (*Gymnorhina tibicen*), eastern rosella (*Platycercus eximius*) and noisy miner (*Manorina melanocephala*). Two threatened bird species, the grey-crowned babbler (*Pomatostomus temporalis*) and superb parrot (*Polytelis swainsonii*) were also encountered at the site, but in low numbers.

A dead squirrel glider (*Petaurus norfolcensis*), listed as an endangered population within the Wagga Wagga LGA, was observed at the site. The animal had been snagged on a strand of barbed wire presumably while attempting to glide from one tree to another. A large mob of grey kangaroos (*Macropus giganteus*) was observed over several days at the site.

One reptile species, a robust ctenotus (*Ctenotus robustus*) was recorded at the site.



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Previous surveys within the Lloyd site have identified 16 mammals, 44 birds, 2 reptiles and 3 amphibians (Mullins and Sutherland 2002a and 2002b). A list of these species is provided in Appendix 2.

**Table 4: Fauna species recorded during field survey of the proposed Lloyd development site.**

| Species Name | Common Name | Status |
|---|---|---|
| *Gymnorhina tibicen* | Australian Magpie | - |
| *Platycercus eximius* | Eastern Rosella | - |
| *Eolophus roseicapillus* | Galah | - |
| *Colluricincla harmonica* | Grey Shrike-thrush | - |
| *Pomatostomus temporalis* | Grey-crowned Babbler | Vulnerable |
| *Manorina melanocephala* | Noisy Miner | - |
| *Petaurus norfolcensis* | Squirrel Glider | Endangered Population |
| *Sturnus vulgaris* | Starling | - |
| *Pardalotus striatus* | Striated Pardalote | - |
| *Aquila audax* | Wedge-tailed Eagle | |
| *Corcorax melanorhamphos* | White-winged Chough | - |
| *Gerygone fusca* | Western Gerygone | - |
| *Polytelis swainsonii* | Superb Parrot | -Vulnerable |
| *Ctenotus robustus* | Robust Ctenotus | - |
| *Macropus giganteus* | Grey kangaroo | - |

Six threatened species have been observed on the site or immediately adjacent in Silvalite Reserve during this and previous surveys. These include superb parrot (*Polytelis swainsonii*), grey-crowned babbler (*Pomatostomus temporalis temporalis*), squirrel glider (*Petaurus norfolcensis*), swift parrot (*Lathamus discolor*), brown treecreeper (Climacteris picumnus victoriae), and eastern bent-wing bat (*Miniopterus schreibersii*).

Three species listed as migratory under the EPBC Act were considered likely or to potentially occur at the site; rainbow bee-eater (*Merops ornatus*), cattle egret (*Ardea ibis*) and white-throated needletail (*Hirandapus caudacutus*). Five threatened species listed under the TSC Act and/or EPBC Act are considered likely, or to potentially occur at the site despite not having been recorded previously at the site; yellow-bellied sheathtail bat (*Saccolaimus flaviventris*) eastern long-eared bat (south eastern form) (*Nyctophilus timoriensis*), bush-stone curlew (*Burhinus grallarius*), painted honeyeater (*Grantiella picta*), turquoise parrot (Neophema pulchella) and little pied bat (*Chalinolobus picatus*).

The site contained habitat for a range of fauna species. Habitat varied in condition from good to moderate quality woodland containing large, hollow bearing trees and native understorey vegetation, to exotic grassland and improved pasture offering limited foraging habitat for common species such as Australian magpie and galah. Surface rock and massive granite outcrops occurred at high points along the


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ridgelines in the south western parts of the site and may provide habitat for a number of reptiles.

Fauna habitat observed at the site included:

- Woodland vegetation
- Mixed native/exotic grassland
- Ephemeral streams and riparian areas
- Large hollow bearing trees
- Large paddock trees
- Surface rock
- Woody debris

Surveys in 2002 (Mullins and Sutherland 2002b) showed that the western parts of the site were used as a flyway by superb parrots, with up to 180 birds counted in 1 hour, mainly flying in one direction. Subsequent surveys have recorded other areas further west of the site being used as a flyway (ELA 2006).

## 2.7 Special Considerations

Vegetation surveys were undertaken during late winter and are, therefore, likely to underestimate native groundcover due to the many non-native annuals that grow in the region at that time. The region is currently experiencing average rainfall after an extended period of drought which may also favour the dominance of exotic species during the time of survey. Eco Logical Australia (2006) reported that sites in the south and west of Lloyd appeared dominated by natives. The dominance of natives was likely affected by the timing of the survey which occurred in autumn and during a dry period (ELA 2006).

Access to properties in the south east corner of the site was not available during the survey period and so vegetation in this area was not assessed in detail. Notes on the composition, structure and levels of disturbance within the woodland remnants were made from adjacent, accessible properties.

## 2.8 Consultation

Consultation was held with Mark Sheahan (NSW Department of Environment and Climate Change) on the 16th August, 2007. The consultation process included discussion of the assessment methodology at the site and included an onsite meeting to discuss practical application of the agreed methodology.


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# 3. Assessment of Vegetation

## 3.1 Areas of Native Vegetation

Much of the native vegetation on site occurs as sparse trees and mixed native/exotic derived grassland with areas of remnant woodland vegetation occurring to the west and south east. Native vegetation is predominately restricted to the ridgelines and mid to upper-slopes of the site (Map 3).

Exotic grassland and isolated paddock trees dominate the lower slopes and valley floors of the site with native grass and herb species sparse to absent in these areas (Map 3).

## 3.2 Regional Scale Assessment

### *3.2.1 Mitchell Landscapes*

A review of the Mitchell Landscapes mapping within the Wagga Wagga area found that 2 Mitchell Landscapes occur within the Lloyd site; Wonga Hills and Ranges Ecosystem in the NSW South West Slopes Bioregion and Murrumbidgee – Tarcutta Channels and Floodplains Ecosystem, also within the NSW South West Slopes Bioregion (Mitchell 2002). The majority of the site lies within the Wonga Hill and Ranges landscape with only a very small area (8.66 ha) in the north east of the site within the Murrumbidgee – Tarcutta Channels and Floodplain landscape (Map 4).

The degree of vegetation clearance for the Mitchell Landscapes and the amount and percentage of Mitchell Landscape present within the study site is shown in Table 5. Both landscapes have been extensive cleared (>70%) in the past for agricultural production.

**Table 5 –Mitchell landscapes within the study area**

| Mitchell Landscape | Degree of Clearance | Area within Study Area | % of Study Area |
|---|---|---|---|
| Wonga Hills and Ranges | 88 % | 599.53 | 99.14% |
| Murrumbidgee – Tarcutta Channels and Floodplains | 91 % | 5.18 | 0.86% |



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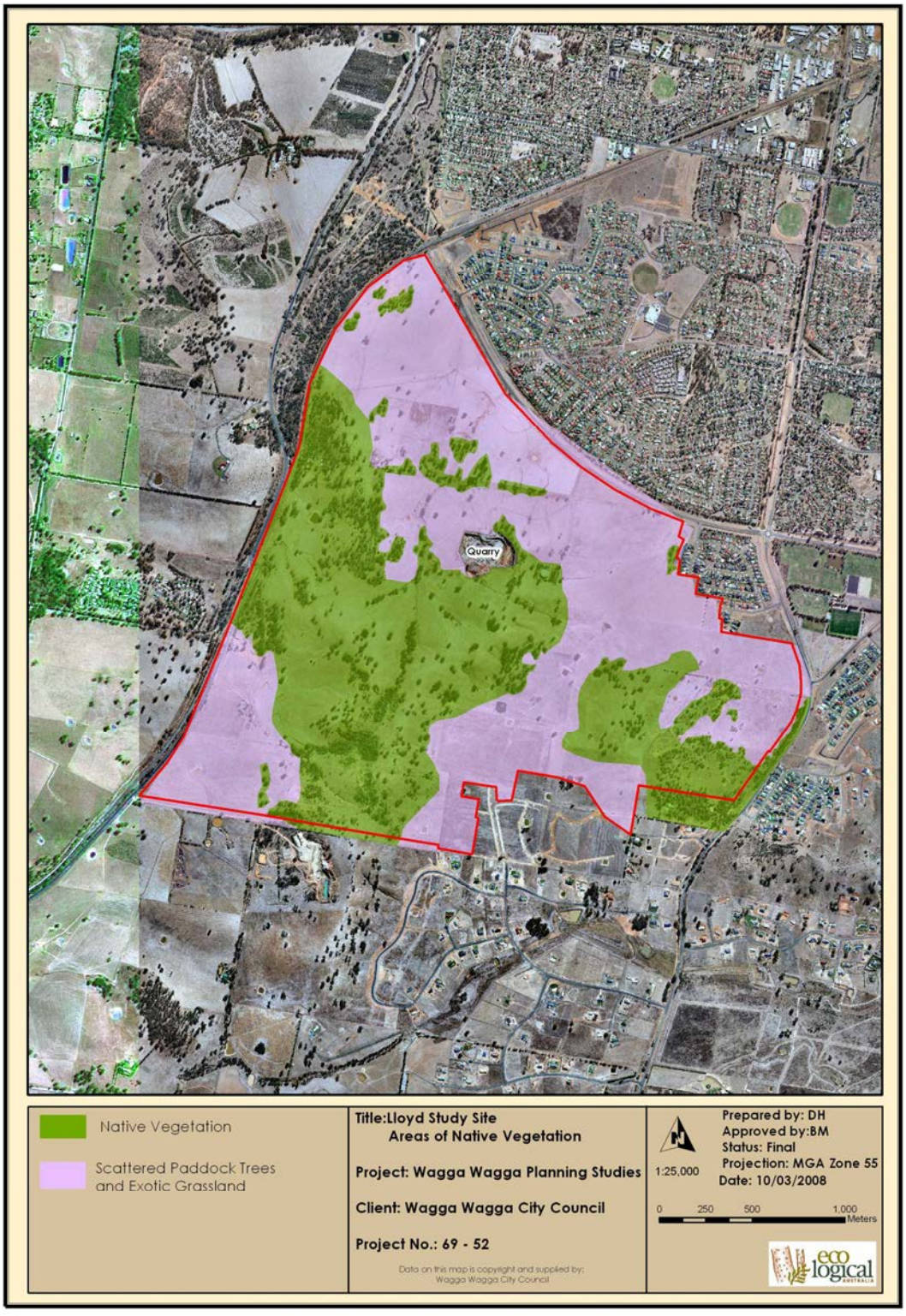


**Map 3 – Areas of native vegetation at the site.**



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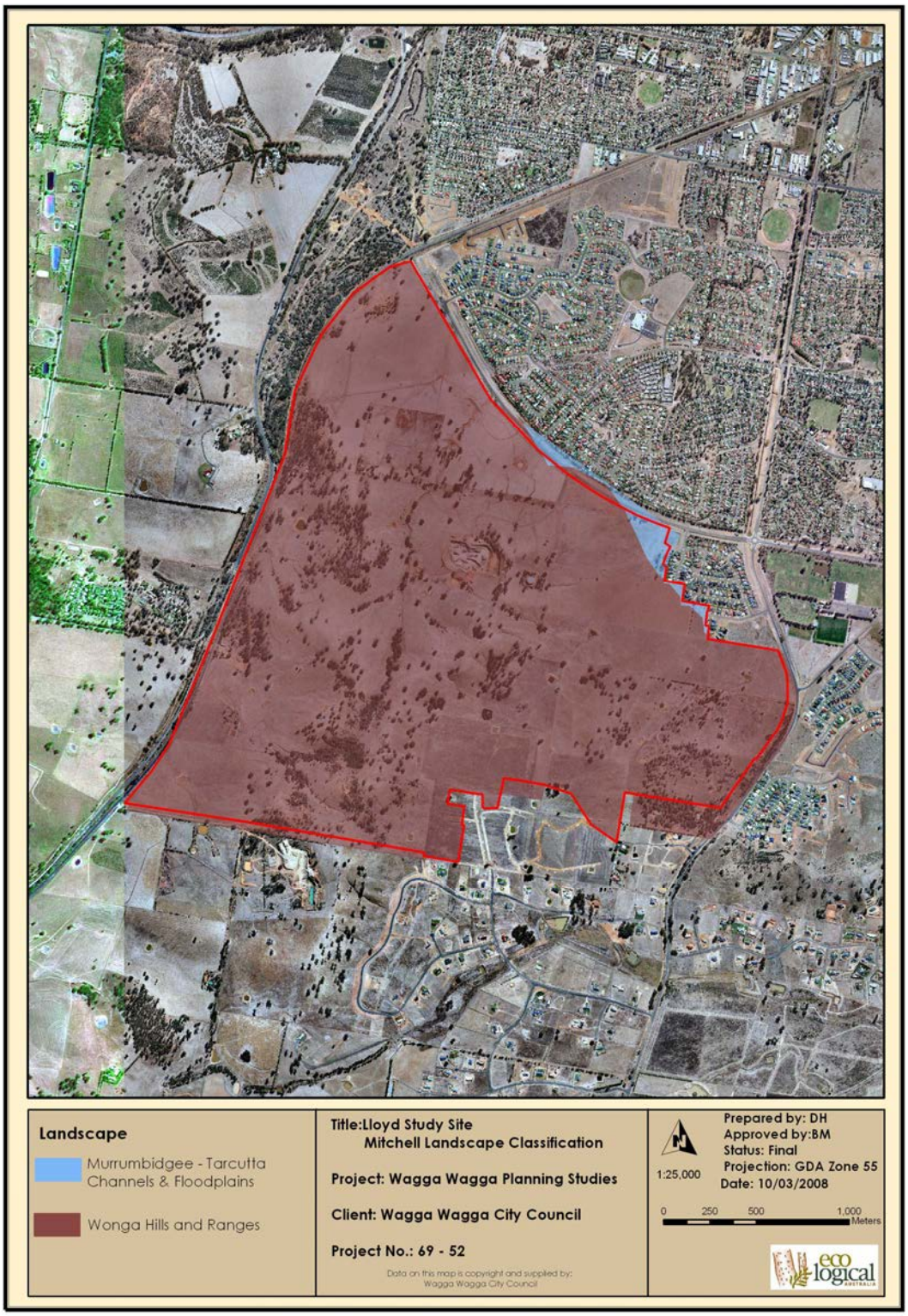


**Map 4 – Mitchell landscapes at the site**



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*3.2.2 Vegetation Types*

Two vegetation types occur at the site; White Box Woodland and Wagga Wagga Hills Forest (Priday and Mulvaney 2005). The former encompasses scattered paddock trees and mixed native and exotic pasture which occurs over much of the site as well as more intact remnant woodland restricted to the western and south eastern parts of the site (Map 5). The woodland comprises a canopy dominated by white box (*Eucalyptus albens*) and Blakely's red gum (*E. blakelyi*), with red stringybark (*E. macrorhyncha*) also occurring.

White box woodland forms part of the broader ecological community known as White Box, Yellow Box, Blakely's Red Gum Woodland which is listed as an endangered ecological community under the TSC Act and as a critically endangered ecological community White Box, Yellow Box, Blakely's Red Gum grassy woodland and derived native grassland under the Commonwealth EPBC Act. Both communities are widely referred to as Box-gum Woodland.

According to DECC identification guidelines for the Box-Gum EEC (DECC 2005c) secondary or derived grasslands where the tree overstorey has been removed and only the Box-Gum Woodland understorey is present is considered part of the endangered ecological community within NSW. Mixed native and exotic derived grassland occurring between patches of more intact canopy within the site are therefore considered part of the Box – Gum EEC. The DECC has indicated that all remnants of the Box-gum woodland ecological community are of conservation value (Priday and Mulvaney 2005). This includes remnants ranging in condition from highly modified to near natural. Derived grassland vegetation which occurs between patches of intact woodland on the slopes and ridges of the site does not contain the appropriate native herbaceous diversity required to be considered consistent with box- gum woodland under the EPBC Act (DEH 2006).

Wagga Wagga Hills Forest is represented by two small patches of relatively good condition woodland at the site. The Wagga Wagga hills forest is consistent with the white box – white cypress pine woodland described in the *BioMetric Tool* (DECC 2005a). This community is located on the upper eastern and western slopes of the ridgeline in the south of the site where it occupies areas of skeletal, low fertility soils (Map 5). The community is characterised by dense stands of white cypress (*Callitris glaucophylla*) with white box and Blakely's red gum occurring sporadically. Priday and Mulvaney (2005) list the Wagga Wagga Hills Forest vegetation community as vulnerable owing to the very restricted distribution of the community. Wagga Wagga Hills Forest identified on site is not considered to be consistent with the box – gum endangered ecological community as it is listed under both NSW and federal legislation.

According to the *BioMetric Tool* (DECC 2005a), an estimated 95 % of the original extent of both the box – gum woodland and white box – white cypress pine woodland has been cleared since European settlement.

Vegetation communities on site are degraded from prolonged agricultural use, but there are several elements of value. The woodlands have some shrub cover, much of which is compromised by stock (grazing and trampling). Species present include


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*Pultenaea foliolosa, Lissanthe strigosa, Calytrix tetragona, Acacia lanigera, Tricoryne elatior* and *Bursaria spinosa*. Native grasses present include *Aristida ramosa, Aristida behriana, Elymus scaber, Austrodanthonia caespitosa, Austrostipa bigeniculata* and *Austrostipa scabra.* Weed cover was generally high within woodland remnants with onion grass (*Romulea rosea* and *R. minutiflora*) the most commonly encountered weeds.

The proportion of native to exotic groundcover species appears to fluctuate across the site depending on season. ELA (2006) noted a high proportion of native grass and herb species in areas of low canopy cover during autumn while during late winter (current study) the proportion of perennial native species to exotic species (generally annual) was generally low.



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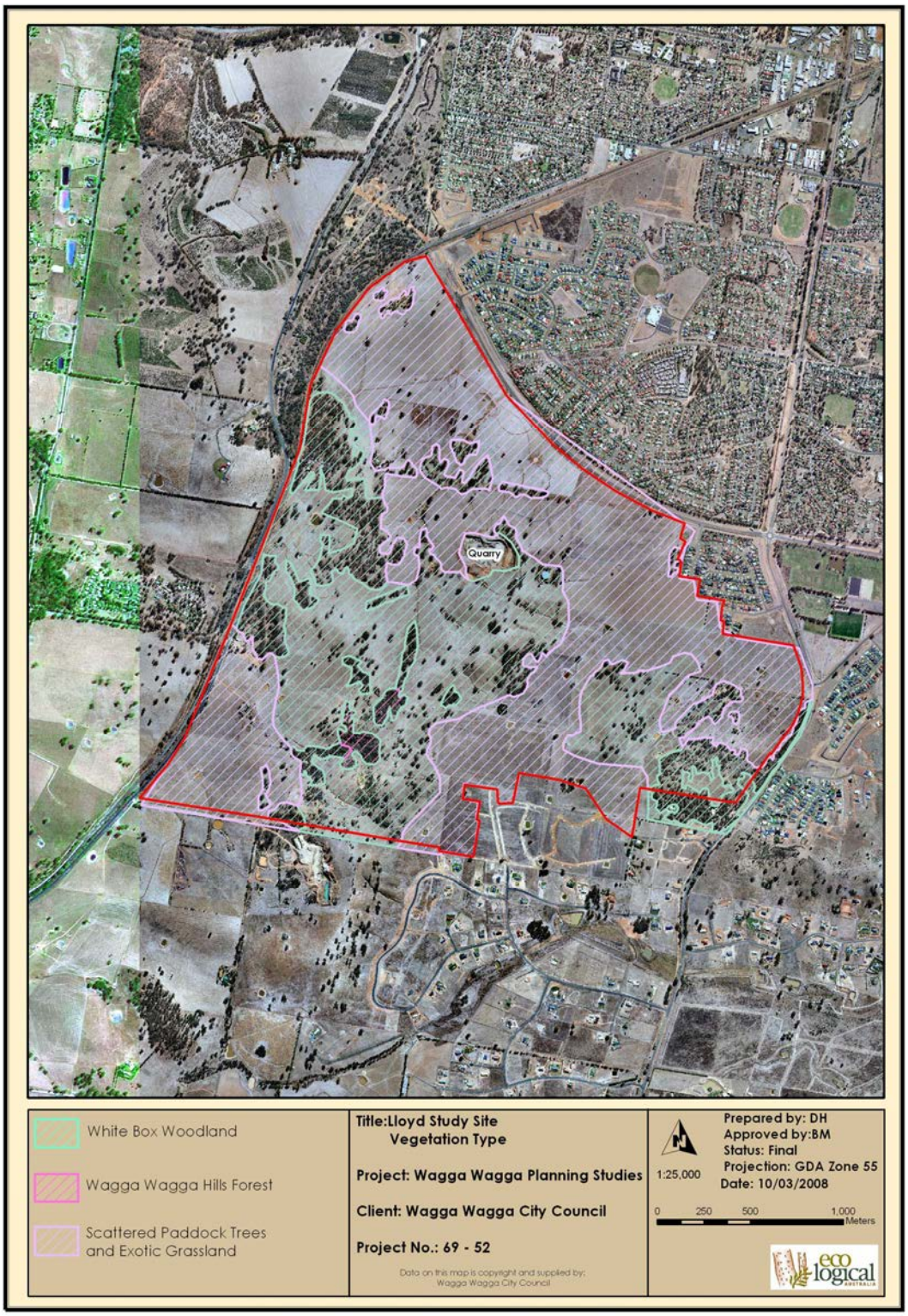


**Map 5 – Vegetation types on site**



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**Table 6 – Vegetation types on site, their area within the site and the degree to which this vegetation type has been cleared from its previous extent**

| Vegetation Type | Degree of Clearance | Area within Study Area | % of Study Area |
|---|---|---|---|
| White Box Woodland (Box – gum Woodland) | 95 % | 273.48 ha | 45.28 |
| Wagga Wagga Hills Forest (White Box – White Cypress Pine Woodland) | 95 %* | 6.14 | 1.02 |

### 3.3 Landscape Scale Assessment

The landscape value of the site is defined by the extent of vegetation cover, the connectivity of vegetation within the site to patches of native vegetation outside the site and the overall size of remnant vegetation patches connected to the site (Ayers *et al.* 2005).

Vegetation on site provides a north – south link between vegetation within Silvalite Reserve to the north and patchily vegetated slopes and ridges to the south of the site. Vegetation at the site is also connected to the ridgeline west of the Kapooka Army Barracks. Vegetation in the south east of the site forms the southern limit of a vegetation corridor which runs from the Murrumbidgee River in a south west direction along Willans Hill.

Broadly, the study site occupies an important position in the landscape, as it forms part of a fragmented link between the Murrumbidgee River to the north of the site and Livingstone National Park approximately 30 km to south.

A summary of the outcomes of the landscape scale assessment as described in Ayers *et al.* (2005) is provided in Table 7 below. Overall the site was found to have a low landscape value due to the generally low vegetation cover within and surrounding the site.

**Table 7 – Landscape Value of Vegetation.**

| Landscape Attribute | Current Score |
|---|---|
| % Cover within 1.75 km radius (1000 ha) | < 10 % |
| % Cover within 0.55 km radius (100 ha) | < 10 % |
| % Cover within 0.2 km radius (10 ha) | < 10 % |
| Connectivity value | Moderate |
| Total adjacent remnant area | Very Large |
| **Calculated Landscape Value** | **33** |



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## 3.4 Site Scale Assessment

*3.4.1 Assessment Zone Delineation*

Vegetation within the Lloyd site was broken up into 3 discrete assessment zones based on the type, condition and quality of the vegetation following examination of recent aerial photography of the site.

Areas of woodland vegetation with a more or less intact native canopy were broken up into 2 assessment zones based on the amount of overstorey cover and understorey vegetation. The resulting assessment zones were:

- Zone 1 – White Box Woodland – 'moderate to good condition'
- Zone 2 – Wagga Wagga Hills Forest – 'moderate to good condition'
- Zone 3 – Scattered paddock trees and exotic grassland

The resulting assessment zones are presented in Map 6 below.



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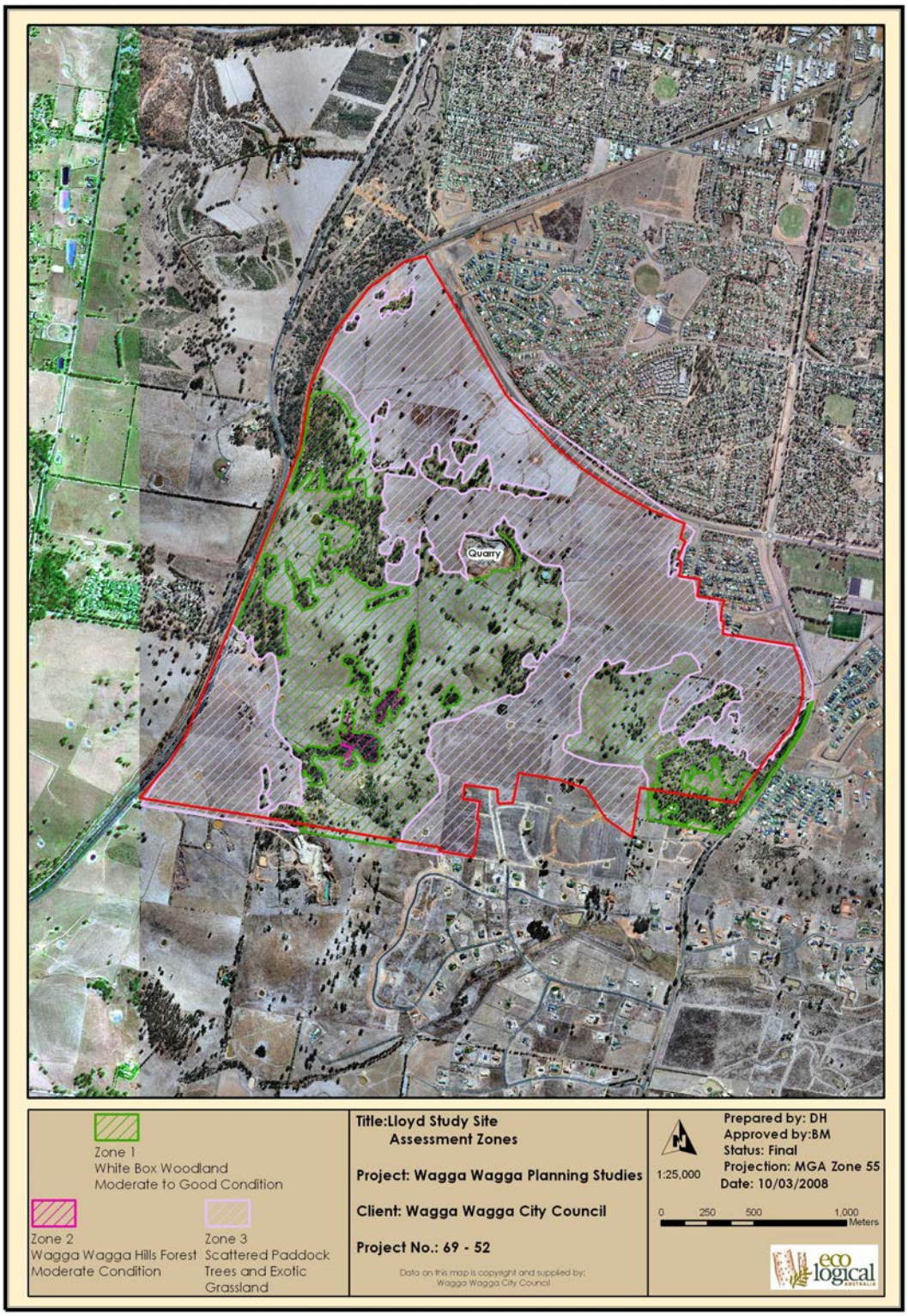


**Map 6 – Assessment Zones at the site**



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### *3.4.2 Condition and Quality of Vegetation*

Assessment of vegetation within Zone 1 confirmed the vegetation was in 'moderate to good' condition compared to the benchmark condition for western slopes grassy woodlands vegetation class (DECC 2005b) of which box – gum woodland is a part. Native overstorey cover ranged from 0 to 20.5 % across the 7 vegetation plots compared to the benchmark of 8 to 15 % (Table 8). The variation in overstorey cover reflected the patchy nature of eucalypt canopy trees within this zone. The understorey vegetation was predominately native in Zone 1 with native groundcover vegetation other than grass or shrubs (e.g. sedges and herbs) dominating the groundcover (Table 8). For all plots within Zone 1, greater than 50 % of groundcover vegetation was found to be native indicating that vegetation within this zone was not in low condition (Ayers *et al.* 2005).

**Table 8 – Site Assessment for Zone 1 using the *BioMetric Tool* (see Ayers et al. 2005). The table shows the benchmark values for the relevant vegetation community and the assessed values generated from plots within each assessment zone.**

| Variables | Benchmarks | | | Plot No. | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 8 |
| Native plant species | | ≥ | 19 | 17 | 8 | 16 | 14 | 13 | 15 | 22 |
| Native over-storey cover | 8 | to | 15 | 16 | 17 | 20.5 | 0 | 17 | 0 | 18 |
| Native mid-storey cover | 1 | to | 5 | 0 | 0 | 0 | 0 | 1 | 0 | 12 |
| Native ground cover (grasses) | 16 | to | 50 | 6 | 8 | 0 | 10 | 16 | 30 | 14 |
| Native ground cover (shrubs) | 0 | to | 4 | 2 | 0 | 0 | 0 | 4 | 0 | 4 |
| Native ground cover (other) | 1 | to | 5 | 32 | 6 | 12 | 20 | 12 | 8 | 16 |
| Exotic plant cover | | | | 4 | 84 | 72 | 70 | 0 | 62 | 62 |
| Number of trees with hollows | | ≥ | 5 | 2 | 3 | 5 | 0 | 0 | 0 | 1 |
| Overstorey regeneration | | | 1 | 50 | 0 | 0 | 0 | 100 | 0 | 100 |
| Total length of fallen logs | | ≥ | 50 | 21 | 10.5 | 85 | 0 | 15.5 | 0 | 2 |

A single vegetation plot was conducted within Zone 2 reflecting the small area of vegetation within this zone (approximately 6 ha). The vegetation plot indicated that vegetation within Zone 2 was in 'moderate to good' condition with the majority of site attributes recorded within the published benchmark for western slopes grassy woodlands vegetation class (DECC 2005b) of which white box – white cypress pine woodland is a part (Table 9).

While no vegetation plots were undertaken within Zone 3 at the site, traverses across Zone 3 were sufficient to confirm the groundcover vegetation was predominately exotic and highly disturbed by grazing and pasture improvement. A visual assessment of this zone using aerial photography confirmed that overstorey cover was less than 25 % of the lower benchmark for box – gum woodland (DECC 2005).



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**Table 9: Site Assessment for Zone 2 using the *BioMetric Tool* (see Ayers et al. 2005). The table shows the benchmark values for the relevant vegetation community and the assessed values generated from plots within each assessment zone.**

| Variables | Benchmarks | | | Plot No. 7 |
|---|---|---|---|---|
| Native plant species | | ≥ | 19 | 15 |
| Native over-storey cover | 8 | to | 15 | 15.5 |
| Native mid-storey cover | 1 | to | 5 | 24 |
| Native ground cover (grasses) | 16 | to | 50 | 2 |
| Native ground cover (shrubs) | 0 | to | 4 | 0 |
| Native ground cover (other) | 1 | to | 5 | 10 |
| Exotic plant cover | | | | 80 |
| Number of trees with hollows | | ≥ | 5 | 0 |
| Overstorey regeneration | | | 1 | 100 |
| Total length of fallen logs | | ≥ | 50 | 23 |

### *3.4.3 Vegetation Condition Categories*

The condition of vegetation at the site varied from 'moderate to good' to scattered paddock trees on the basis of the amount of overstorey cover and proportion of native to exotic species within the groundcover (Ayers *et al.* 2005). While there are a few remnant trees on site, the majority of the canopy is likely to be regrowth that has established over the last 60 years.

'Moderate to good' condition vegetation at the site generally consisted of a sparse to mid-dense eucalypt canopy with a native dominated groundcover. A shrub layer was generally absent from 'moderate to good' condition White Box Woodland due to persistent livestock grazing, however, a sparse shrub layer was recorded within this vegetation type at the western and eastern edges of the site. Regenerating white cypress pine (*Callitris glaucophylla*) formed a dense understorey layer within 'moderate to good' Wagga Wagga Hills Forest at the site. Overall, approximately 279.6 ha of vegetation at the site was found to be in 'moderate to good' condition. This included approximately 273.5 ha of White Box Woodland and 6.1 ha of Wagga Wagga Hills Forest (Map 7).

Scattered paddock trees and exotic grassland dominated the north, north east and south west of the study site and consisted of scattered paddock trees consistent with the White Box Woodland community. The majority of vegetation at the site was included as scattered paddock trees and exotic groundcover (~ 318 ha).

### *3.4.4 Summary of Assessment Zone Information*

The site contained two vegetation communities, box – gum woodland and white box – white cypress pine woodland, both of which have been extensively cleared within the Murrumbidgee catchment. Box – gum woodland comprised the majority of remnant woodland at the site and occured in 'moderate to good' condition. This community is listed as an endangered ecological community under the TSC Act and Commonwealth EPBC Act. White box – white cypress pine woodland, while not



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listed as a threatened ecological community, is considered vulnerable within the Wagga Wagga LGA (Priday and Mulvaney 2005).

Broadly, the study site occupies an important position in the landscape, as it forms part of a fragmented link between the Murrumbidgee River to the north of the site and Livingstone National Park approximately 30 km to south. Vegetation at the site also provides linkages to other areas of vegetation east and west of the site.

**Table 10 – Summary Information on Vegetation Assessment**

| Assessment Zone No. | Area (ha) | Vegetation Type | Vegetation Condition | Landscape Value | Biometric Score | No. Large and very large trees. |
|---|---|---|---|---|---|---|
| 1 | 273.5 | White Box Woodland (Box – gum woodland) | Moderate to Good | 33 | 54 | 790 |
| 2 | 6.1 | Wagga Wagga Hills Forest (White Box – White Cypress Pine Woodland) | Moderate to Good | | 29 | 19 |
| 3 | 318.4 | Scattered Paddock Trees and Exotic Grassland | Scattered Paddock Trees | | N/A | 49 |



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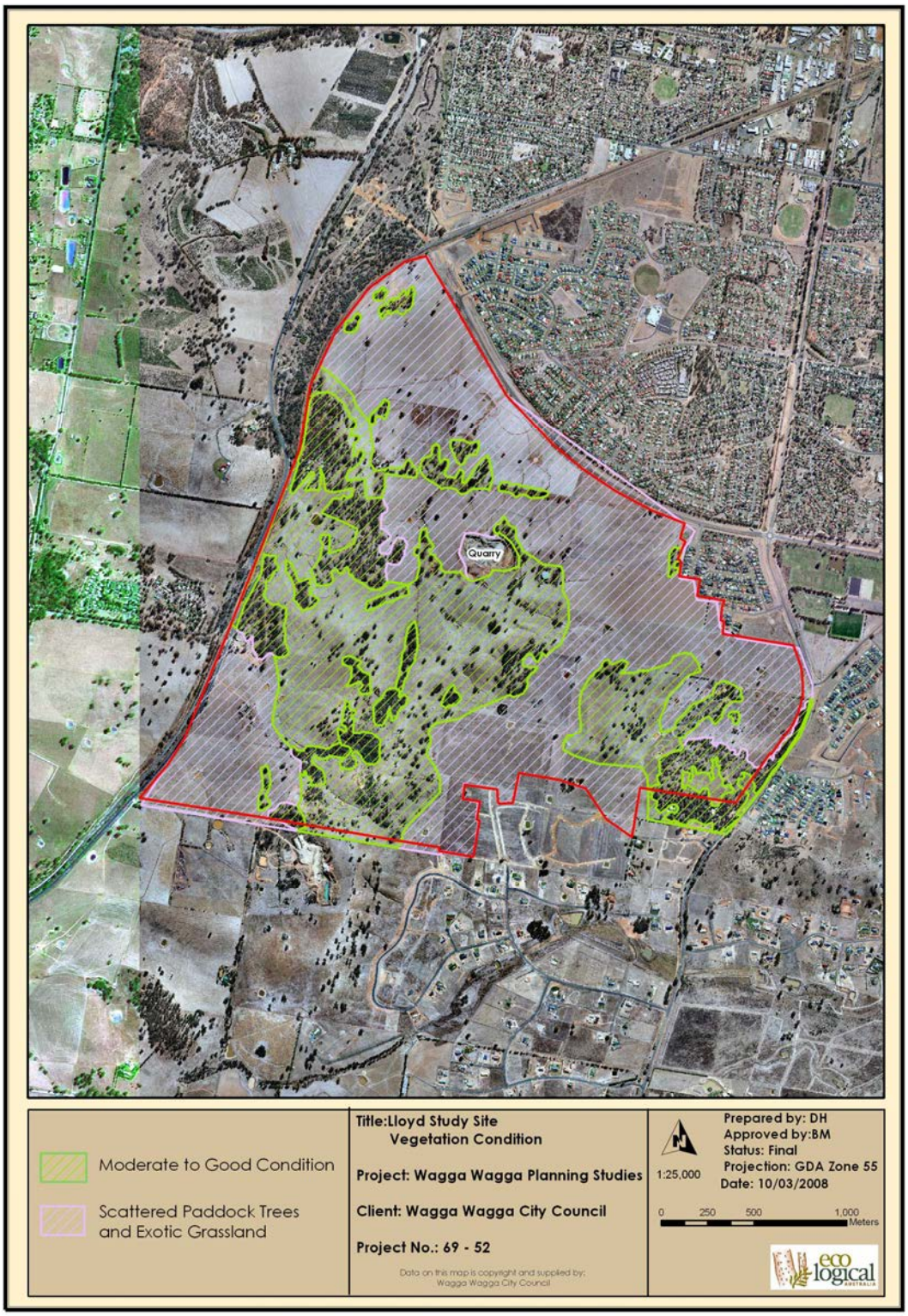


**Map 7 – Vegetation condition at the site.**



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# 4. Threatened Species

## 4.1 Threatened Species

The current and previous surveys have identified a total of 6 threatened fauna species, listed under the TSC Act and/or EPBC Act, utilising the site; superb parrot (*Polytelis swainsonii*), swift parrot (*Lathamus discolor*), brown treecreeper (Climacteris picumnus victoriae), grey-crowned babbler (*Pomatostomus temporalis temporalis*), squirrel glider (*Petaurus norfolcensis*) and eastern bent-wing bat (*Miniopterus schreibersii*). Other species listed under the TSC Act and/or the EPBC Act such as yellow-bellied sheathtail bat (*Saccolaimus flaviventris*) eastern long-eared bat (south eastern form) (*Nyctophilus timoriensis*), bush-stone curlew (*Burhinus grallarius*), painted honeyeater (*Grantiella picta*), turquoise parrot (Neophema pulchella) and little pied bat (*Chalinolobus picatus*) have not been recorded at the site but are considered likely to occur based on available habitat and the distribution of species in the region.

Three species listed as migratory under the Commonwealth EPBC Act have the potential to occur at the site; white-throated needletail (*Hirundapus caudacutus*), cattle egret (*Ardea ibis* and rainbow bee-eater (*Merops ornatus*).

One endangered population, the squirrel glider population in the Wagga Wagga LGA, was recorded at the site as was one endangered ecological community, yellow box – white box – Blakely's redgum grassy woodland and derived native grassland (commonly referred to as box – gum woodland). Box – gum woodland is listed as a critically endangered ecological community under the EPC Act.

No threatened flora species have been recorded during this or previous surveys at the site. The site is unlikely to contain any habitat for threatened flora species. *Pultenaea foliolosa* was recorded in woodland remnants in the west of the site and within roadside remnant vegetation in the east of the site. This species is considered to be of local conservation significance (Mullins and Sutherland 2002).


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Table 11 below presents species identified as having the potential to occur at the site and the amount of habitat available for each species at the site.



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**Table 11 – Habitat available for Threatened species considered likely, or with the potential to occur at the site.**

| Species | Breeding Habitat | | Foraging Habitat | | Roosting/Shelter Habitat | |
|---|---|---|---|---|---|---|
| | Description | Habitat on Site (ha or No. trees) | Description | Habitat on Site (ha or No. trees) | Description | Habitat on Site (ha or No. trees) |
| Bush Stone Curlew | Open grassy woodland with fallen dead timber, leaf litter. | Yes – approx. 279.6 ha | As per breeding habitat. | Yes – approx. 279.6 ha | As per breeding habitat. | Yes – approx. 279.6 ha |
| Grey Crowned Babbler | Nests in shrubs and eucalypt saplings or outermost leaves of low branches of mature eucalypts. | Yes – approx. 279.6 ha | Inhabits open Box-gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands | Yes – approx. 279.6 ha | Inhabits open Box-gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands | Yes – approx. 279.6 ha |
| Brown Treecreeper | Nests in tree hollows within grassy woodland vegetation. patches of remnant woodland greater than 5ha that contain hollow bearing trees. | Yes – approx. 279.6 ha | Open grassy woodlands with fallen logs including remnants with a very sparse shrub and small tree layer. | Yes – approx. 279.6 ha | As per breeding and foraging habitat. | Yes – approx. 279.6 ha |
| Little Pied bat | Tree hollows, fissures or cracks, buildings, power poles, fence | Yes, numerous hollow bearing trees | Dry open forest, open woodland, mulga woodlands, chenopod | Yes – entire site | Tree hollows, fissures or cracks, buildings, power poles, fence | Yes, numerous hollow bearing trees |



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| Species | Breeding Habitat | | Foraging Habitat | | Roosting/Shelter Habitat | |
|---|---|---|---|---|---|---|
| | Description | Habitat on Site (ha or No. trees) | Description | Habitat on Site (ha or No. trees) | Description | Habitat on Site (ha or No. trees) |
| | posts, caves, cliff crevices, mineshafts, tunnels. | | shrublands, cypress-pine forest, mallee, Bimbil box. | | posts, caves, cliff crevices, mineshafts, tunnels for roosting. | |
| Diamond Firetail | Open eucalypt forests, woodlands, either in the shrubby understorey, or higher up, especially under hawk's or raven's nests. | Yes – approx. 279.6 ha | As per breeding habitat | Yes – approx. 279.6 ha | As per breeding habitat | Yes – approx. 279.6 ha |
| Painted Honeyeater | Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. Inhabits vegetation with 5 or more mistletoes per hectare. | Yes – approx. 279.6 ha | Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. Inhabits vegetation with 5 or more mistletoes per hectare. | Yes – approx. 279.6 ha | As per breeding and foraging habitat. | Yes – approx. 279.6 ha |
| Squirrel Glider | Trees with hollows > 5 cm diameter in eucalypt forests and woodlands (i.e. not in paddock trees) | Yes – approx. 279.6 ha | Mature or mixed age eucalypt woodland, especially with flowering shrubs and wattles in the understorey. Will occur where | Yes – approx. 279.6 ha | As per breeding and foraging habitat. | Yes – approx. 279.6 ha |


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| Species | Breeding Habitat | | Foraging Habitat | | Roosting/Shelter Habitat | |
|---|---|---|---|---|---|---|
| | Description | Habitat on Site (ha or No. trees) | Description | Habitat on Site (ha or No. trees) | Description | Habitat on Site (ha or No. trees) |
| | | | there is no understorey if there is > 1 species of Eucalypt. Occur in dry forests with ironbarks, box and bloodwoods and can use patches < 1 ha and isolated trees if within 75 m of other patches. | | | |
| Superb Parrot | Breeds along inland rivers in river red gum. Living or dead trees with hollows > 5 cm diameter. | Yes – approx. 279.6 ha | Feeds in box woodland with 10km of nest tree. West of dividing range. | Yes – approx. 279.6 ha | As per foraging type. | Yes – approx. 279.6 ha |
| Swift parrot | Does not breed in mainland Australia | No | Forests, woodlands, plantations, banksias, street trees and gardens on the mainland | Yes – approx. 279.6 ha | As per foraging habitat. | Yes – approx. 279.6 ha |
| Turquoise Parrot | Living or dead trees, fallen branches, fence posts or stumps with | No | Woodland or open forest and adjoining open areas including grassland and | Yes – approx. 279.6 ha | As per breeding and foraging habitat. | Yes – approx. 279.6 ha |



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| Species | Breeding Habitat | | Foraging Habitat | | Roosting/Shelter Habitat | |
|---|---|---|---|---|---|---|
| | Description | Habitat on Site (ha or No. trees) | Description | Habitat on Site (ha or No. trees) | Description | Habitat on Site (ha or No. trees) |
| | hollows > 5 cm diameter and within 100 m of moderate to good condition vegetation. | | shrubland up to 250 m from wooded habitat edge of moderate to good condition vegetation. | | | |
| Yellow bellied Sheathtail bat | Live or dead hollow bearing trees | Yes, numerous hollow bearing trees | Forages in most habitats across its very wide range, with and without trees..+ | Yes – entire site | Live or dead hollow bearing trees, under exfoliating bark, in burrows of terrestrial mammals in treeless areas, bird nests or sugar glider nests. | Yes, numerous hollow bearing trees |


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Proposed development of the study site may result in the loss of 318.4 ha of scattered paddock trees and exotic grassland vegetation, including approximately 49 large or very large paddock trees or stags. For the majority of threatened species identified as potentially occurring at the site, the loss of this habitat is not likely to result in a significant impact. The extent of habitat with the potential to be removed under the current proposal is summarised in Table 12 below together with an assessment of whether this loss would be acceptable and whether the loss would require offsetting.

**Table 12 – Standards for maintaining threatened species habitats.**

| Species | Ability to sustain a temporary reduction in the population / habitat on this property | Habitat Loss (ha) | Acceptability of loss/ Offset |
|---|---|---|---|
| Bush Stone Curlew | Yes - loss of 10 % of habitat. | Nil | Yes |
| Diamond Firetail | Yes – up to 10 % loss but no loss of riparian habitats | Nil | Yes |
| Grey Crowned Babbler | Yes – up to 10 % loss of habitat, but no loss of connectivity. | Nil | Yes |
| Brown Treecreeper | No loss of breeding habitat | Nil | Yes. |
| Little Pied bat | Yes | Loss of paddock trees | Yes, with offsets |
| Painted Honeyeater | Yes - loss of 10 % of habitat. | Nil | Yes |
| Regent Honeyeater | Yes - loss of 5 % of habitat. | Nil | Yes |
| Squirrel Glider | Yes - loss of 10 % of foraging habitat provided that clearing does not create treeless barriers to dispersal greater than 30 – 50 m wide. Sap feeding trees within 50 m of retained habitat to be protected. No loss of breeding habitat. | Some paddock trees | Yes, with offsets |
| Superb Parrot | Upper and lower slopes of Murrumbidgee: no loss of *Eucalyptus camaldulensis* | Loss of paddock trees | Yes, with offsets |



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| Species | Ability to sustain a temporary reduction in the population / habitat on this property | Habitat Loss (ha) | Acceptability of loss/ Offset |
|---|---|---|---|
| | with hollows > 5cm (ECH) and < 100 m from the Murrumbidgee River, 100m – 200m from the river up to 7 % loss ECH, > 200m from the river up to 10 % loss ECH. 10 % loss of foraging habitat. | | |
| Swift parrot | Yes – 5 % loss of foraging habitat except for mature *Eucalyptus albens* and *E. sideroxylon*. | Loss of paddock trees | Yes, with offsets |
| Turquoise Parrot | No loss of breeding habitat and up to 5 % loss of foraging habitat. | Nil | Yes |
| Yellow bellied Sheathtail bat | Up to 10 % loss of foraging habitat. Up to 10 % loss of hollow bearing trees. | Loss of paddock trees | Yes |


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### 4.2 Threatened Populations

One threatened population, squirrel glider population in the Wagga Wagga LGA, listed under Part 2 of Schedule 1 of the TSC Act, was encountered at the site during the current survey. Previous surveys have also encountered this species (Mullins and Sutherland 2002a and 2002b).

Hollow bearing trees occur within the proposal site and are known to be used by squirrel gliders for denning (ELA 2006). Remnant box – gum woodland also provides foraging habitat for the species. The site survey observed signs of glider activity in remnant woodland and scattered trees close to (within 100m) clumps of trees, suggesting that the species roams widely in the western, southern and south eastern parts of the site.

### 4.3 Endangered Ecological Communities

White Box, Yellow Box, Blakely's Red Gum Woodland (commonly referred to as box-gum woodland) was found to occur at the site (Map 8). This ecological community is listed as endangered under Part 3 of Schedule 1 of the TSC Act and as critically endangered under the Commonwealth EPBC Act.

Box–gum Woodland occurs in the study area as a degraded remnant and scattered paddock trees. In the study area, this community is generally highly modified with respect to species composition. At many sites where the community occurs, native understorey and ground layer vegetation has been replaced by improved pasture, cropping or weeds.

Remnant woodland occupies an area of approximately 273.5 ha across the site and varies in condition from moderate to good condition woodland and derived grassland.

The community has been depleted to such an extent throughout its range that all remnants are of conservation significance (Priday and Mulvaney 2005).

**Table 13 – Area of EECs at the site.**

| EEC | Area of EEC | | |
|---|---|---|---|
| | **Moderate to good condition (ha)** | **Low condition (ha)** | **Total (ha)** |
| Box-gum woodland | 273.5 | - | 273.5 |



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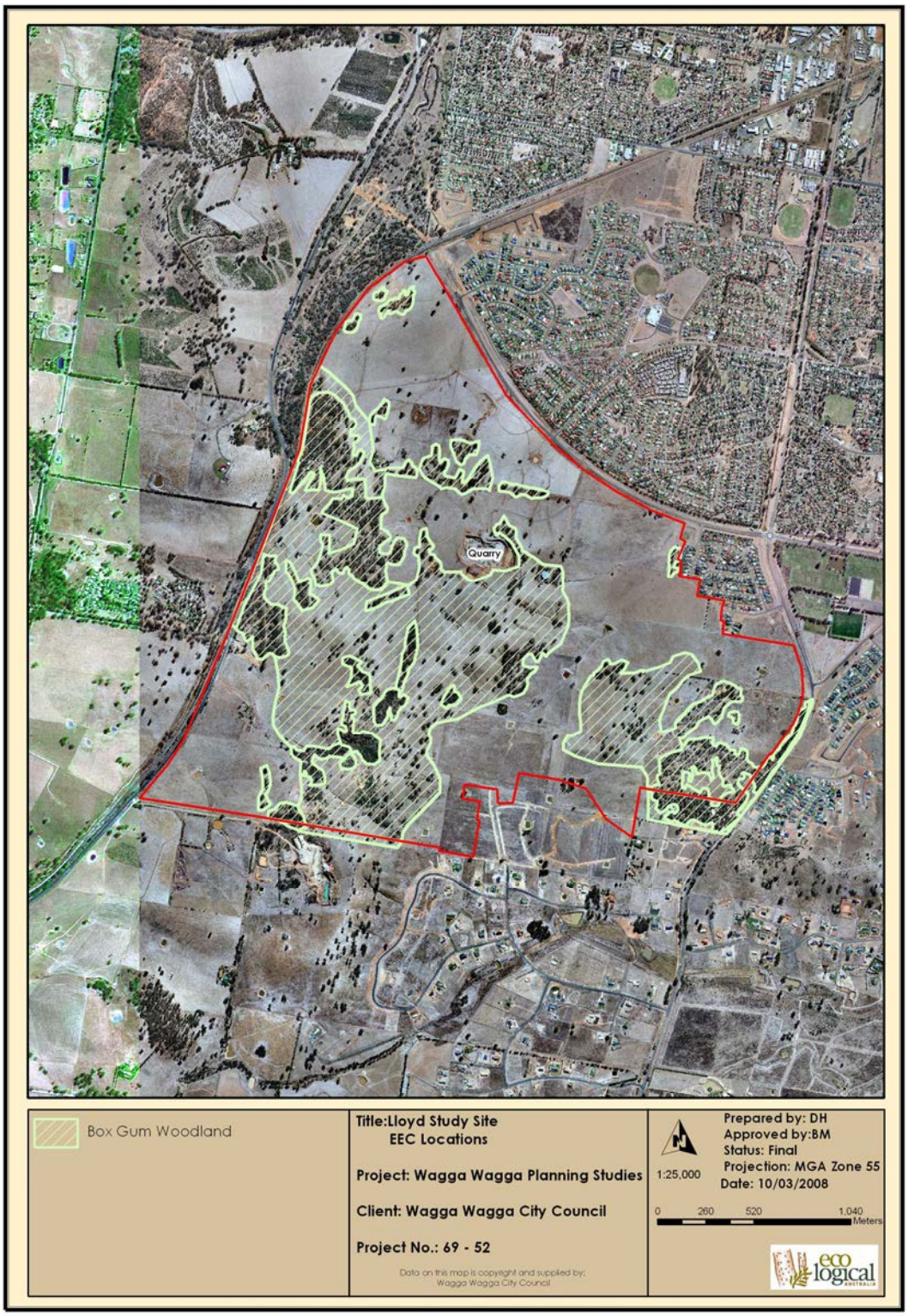


**Map 8 – Extent of EECs at the site.**



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# 5. Structure Plan

The site contains 279.6 ha of remnant woodland vegetation, the majority of which (273.5 ha) is consistent with the Box –Gum EEC (see Section 3.2.2). Woodland vegetation on site is in 'moderate to good' condition and both white box woodland and Wagga Wagga hills forest vegetation types have been extensively cleared (~95%) across their range. Under the Native Vegetation Act, native woodland vegetation at the site is not permitted to be cleared, regardless of available offsets or management actions because:

- It is in 'moderate to good condition'
- Is of a vegetation type that is greater than 70% cleared across its range (see Table 6)
- It occurs within 2 Mitchell landscapes which are greater than 70% cleared (see Table 5)

Areas of 'moderate to good' condition woodland within the Lloyd site are therefore considered highly constrained and unavailable for development (Map 9). These areas are of high biodiversity value and occur within a landscape which has been heavily cleared of native vegetation.

Much of the vegetation at the Lloyd site (318.4 ha (51%)) has been identified as scattered paddock trees overlying exotic grassland. These areas are considered to have limited conservation value within the landscape as the long-term viability of the vegetation is considered low (Ayers *et al.* 2005). Areas identified as containing scattered paddock trees overlying exotic grassland are therefore potentially suitable for development provided that relevant offsets to the loss of remnant paddock trees are achieved (Map 9).

An offset ratio of 10:1 is required for native woody vegetation at the Lloyd site DEC (2005d). This means that for every large tree (i.e. > 40 cm diameter at breast height DBH) removed, 10 large trees of the same species must be retained at the site. Furthermore, the removal of a small tree (i.e. < 40 cm DBH) must be offset through the planting of 10 trees of the same species.

Offset areas are required to be reserved and managed for conservation. This means that 'open space' zoning is not sufficient for offset areas, rather zoning must reflect the conservation objectives of the offset area and a conservation management plan for offset areas must be prepared and implemented. In addition to the above, any scattered paddock trees not located within 'open space' or 'conservation' area must be considered as cleared and their loss offset using the above ratios.

The total loss of paddock trees, assuming that all native vegetation not mapped as in 'moderate to good' condition is removed under the current proposal, is presented in Table 14. Also shown is the number of trees required to be retained, for each species, in order to achieve the offset ratio of 10:1.

**Table 14: Proposed loss and required offset of paddock trees at the proposed Lloyd development site.**

| | | No. of trees | Required Offset |
|---|---|---|---|



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| Species Name | Common Name | Large | Very Large | Large | Very Large | Total Offset |
|---|---|---|---|---|---|---|
| *Eucalyptus albens* | White Box | 28 | 14 | 280 | 140 | **420** |
| *Eucalyptus melliodora* | Yellow Box | 1 | - | 10 | - | **10** |
| *Eucalyptus blakelyi* | Blakely's Redgum | 3 | - | 30 | - | **30** |
| *Brachychiton populneus* | Kurrajong | 1 | - | 10 | - | **10** |
| *Unknown* | Stag | 2 | - | 20 | - | **20** |
| | | | | | **Overall Total** | **490** |

Sufficient offsets for the loss of paddock trees are likely to be available within retained lands at the site. In addition to the retained lands however, a potential offset area has been identified within 'potentially developable' land in the south east of the site. The adoption of this area as an offset site is highly desirable as it will help to establish a vegetated corridor running east to west across the site and thereby enhance the landscape value of the site.

While paddock trees positioned within residential zoned land (or similar) are required to be offset, it is recommended that paddock trees –particularly those containing hollows – be retained where possible at the site. Future master planning should aim to incorporate existing paddock trees into the urban/industrial landscape and so retain their values as fauna habitat.

The precise extent of retained areas relative to potentially developable areas will need to be determined in the context of other constraints to development (*i.e.* geotechnical, flooding, bushfire, etc), the impacts on threatened species and the potential to provide offsets to the losses associated with the potentially developable areas. The determination of the appropriate mix of retained areas and potentially developable Areas is an iterative process that will require further liaison between DECC and WWCC. As part of this process, the quantum of offsets associated with each potential mix of retained areas and potentially developable areas will need to be calculated. The data that has been collected for this report provides a basis for these calculations.

The areas proposed for retention, development and offsets at Lloyd, as determined on the basis of current investigation at the site, are presented in Map 9 below. In general, the location of offsets at the site should aim to:

- Increase connectivity between currently isolated woodland patches
- Increase vegetation cover of riparian corridors on site
- Reduce soil erosion

Management actions within retained vegetation at the site will further help to offset loss of scattered paddock trees. Moderate to good condition woodland vegetation at the site is resilient and likely to regenerate over time provided that factors currently preventing regeneration are managed. Management actions which are likely to enhance the condition of woodland vegetation within the Lloyd site include:


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- Stock exclusion
- Feral herbivore control
- Erosion control
- Retention of dead timber
- Retention of all native regrowth


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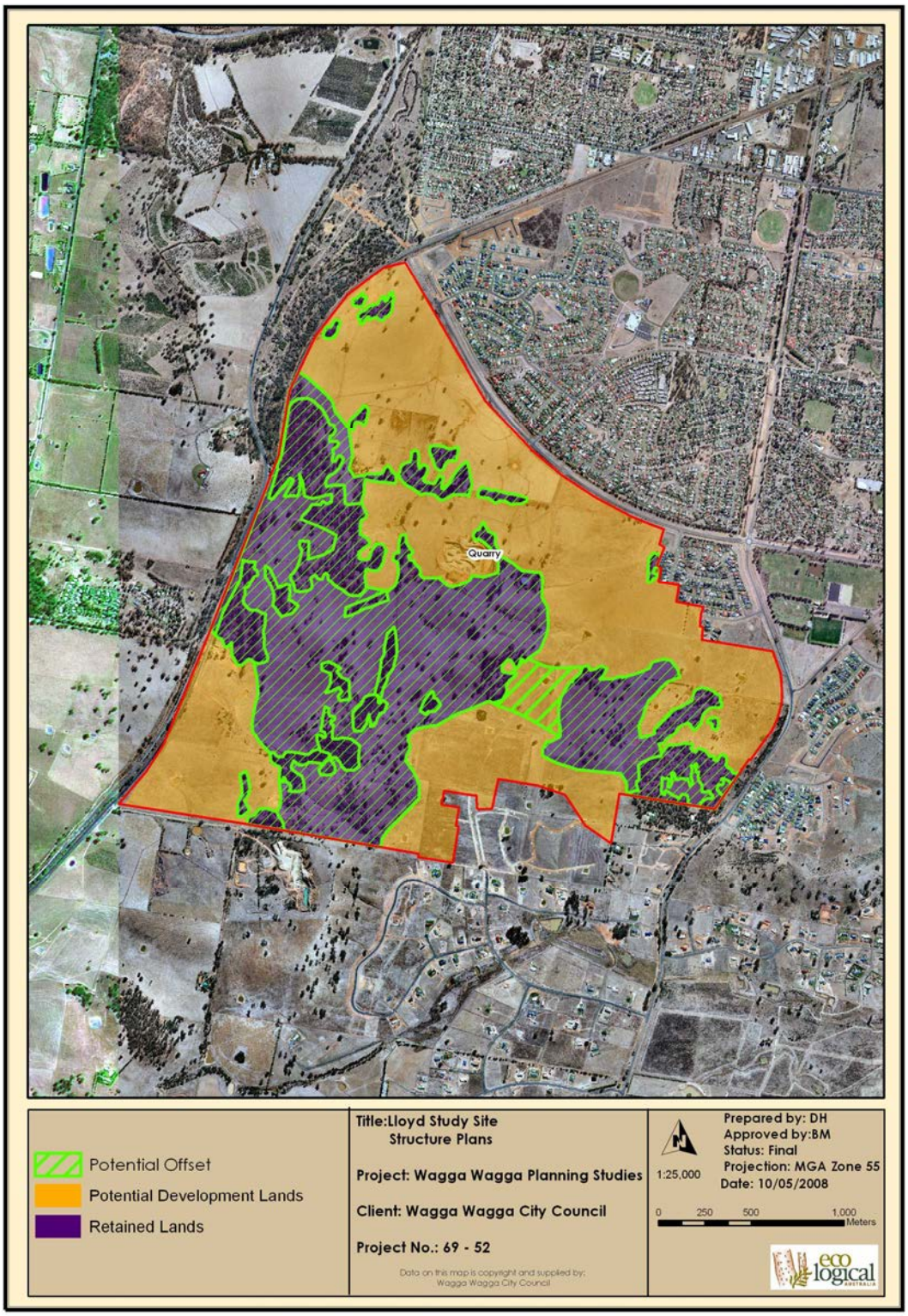


**Map 9: Structure plan for the site**



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# 7. Appendices

**Appendix 1: Flora species recorded at the study site. Data taken from ELA (2006) and results of current study.**

| | | Traverse | | | | | Vegetation Plot | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Scientific Name** | **Common Name** | **1** | **2** | **3** | **4** | | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | | **ELA (2006)** |
| *Acacia baileyana* | Cootamundra Wattle | | | | | | | | | | | | | | | √ |
| *Acacia deanei* | Deane's Wattle | | | | | | | | | | | | | | | √ |
| *Acacia decora* | Western Golden Wattle | | | | | | | | | | | | | √ | | √ |
| *Acacia laniger* | Woolly Wattle | | | | | | | | | | √ | | | √ | | √ |
| *Acacia montana* | | | | | | | | | | | | | | | | √ |
| *Acacia paradoxa* | | | | | | | | | | | | | | √ | | |
| *Acacia pycnantha* | | | | | | | | | | | | | | √ | | √ |
| *Acacia* spp. | Wattle | | | | | | √ | | | | | | | | | √ |
| *Acaena* sp. | | √ | | | | | | | √ | | | | | | | |
| *Ailanthus altissima* # | Tree of Heaven | | | | | | | | | | | | | | | √ |
| *Aira* sp.# | | | | | | | | | | | | | | | | √ |
| *Amyema miquelii* | Box Mistletoe | | | | | | | | | | | | | | | √ |
| *Arctotheca calendula* # | Capeweed | √ | √ | √ | √ | | √ | √ | √ | √ | √ | √ | √ | √ | | √ |
| *Aristida behriana* | Brush Wiregrass | | | | | | | | | | | | | | | √ |
| *Aristida ramosa* | Purple Wiregrass | | | | | | | | | | | | | | | √ |
| *Aristida* spp. | | | | | | | | | | | √ | √ | | √ | | |
| *Arthropodium minus* | Small Vanilla-lily | | | | | | | | | √ | √ | | | | | √ |
| *Arthropodium* sp. | | | | √ | | | √ | | | | | | √ | √ | | |
| *Asperula conferta* | Common Woodruff | | | | | | | | √ | | | | | | | √ |
| *Austrodanthonia caespitosa* | White-top | | | | | | | √ | | | | | | | | √ |
| *Austrodanthonia* spp. | Wallaby Grass | √ | √ | √ | √ | | √ | | √ | √ | √ | √ | √ | √ | | √ |
| *Austrostipa aristiglumis* | Plains Grass | | | | | | | | | | | | | | | √ |



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| Scientific Name | Common Name | Traverse | | | | Vegetation Plot | | | | | | | | ELA (2006) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | |
| *Austrostipa bigeniculata* | | | | | | | | √ | | | | | √ | √ |
| *Austrostipa densiflora* | | | | | | | | | | | | | | √ |
| *Austrostipa scabra* | | | √ | √ | | | | | √ | √ | √ | | √ | √ |
| *Austrostipa* spp. | | | | √ | √ | √ | √ | | √ | √ | √ | √ | | √ |
| *Avena fatua* # | Oats | | | | √ | | | | | | | | | √ |
| *Bothriochloa decipiens* | | | | | | | | | | | | | | √ |
| *Bothriochloa macra* | Pitted Blue Grass | | | | | | | | | | | | | √ |
| *Bothriochloa* spp. | | √ | √ | | √ | √ | | | √ | | √ | | √ | |
| *Brachychiton populneus* | Kurrajong | | | | | | | | | | | | | √ |
| *Xerochrysum viscosa* | Sticky Everlasting | | | | | | | | | | | | | √ |
| *Briza maxima* # | | | | | | | | | | | | | | √ |
| *Bromus diandrus* # | Great Brome | | | | | | | √ | | | | | | √ |
| *Bromus hordeaceus* # | Soft Brome | | | | | | | | | | | | | √ |
| *Bromus* spp. # | | √ | | | | | √ | √ | | | | | √ | |
| *Bursaria spinosa* | Black Thorn | √ | | | | | | | | | | | √ | √ |
| *Callistemon* sp. | Bottlebrush | | | | | | | | | | | | | √ |
| *Callitris glaucophylla* | White Cypress Pine | | | √ | | √ | | | | | | √ | √ | √ |
| *Calotis scabiosifolia* | | | | | | | | | | | | | √ | |
| *Carduus pycnocephalus* # | Slender Thistle | | | | | | | | | | | | | √ |
| *Carex appressa* | Tall Sedge | | | | | | | | | | | | | √ |
| *Carthamus lanatus* # | Saffron Thistle | | | | | | | | | | | | | √ |
| *Chamaesyce drummondii* | Caustic Weed | | | | | | | | √ | | | | | √ |
| *Cheilanthes sieberi* | Mulga Fern | | | | | | | | √ | √ | √ | | √ | √ |
| *Chloris truncata* | Windmill Grass | √ | | | | | | | | | √ | | | √ |
| *Chondrilla juncea* # | Skeleton Weed | | | | | | | | | | | | | √ |
| *Chrysocephalum apiculatum* | | | | | | √ | | | | | | | | |



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| Scientific Name | Common Name | Traverse | | | | Vegetation Plot | | | | | | | | ELA (2006) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | |
| *Cirsium vulgare* # | Spear Thistle | | | | | | | | | | | | | √ |
| *Citrullus lanatus* # | Camel Melon | | | | | | | | | | | | | √ |
| *Convolvulus erubescens* | Climbing Bindweed | | | | | | | | | | | | √ | √ |
| *Crassula sieberiana* | | | | | | | | | | | | √ | | |
| *Cynodon dactylon* | Couch | | | | | | | | √ | | | | | √ |
| *Cyperus eragrostis* # | Umbrella Sedge | | | | | | | | | | | | | √ |
| *Daucus glochidiatus* | | | | | | | | | | | | | √ | |
| *Desmodium varians* | | | | | | | | | | | | | | √ |
| *Dianella* sp. | | | | | | | | | | | | | | √ |
| *Dianella longifolia* | | | | | | √ | | | | √ | | | | |
| *Dichopogon sp.* | | | | | | √ | | √ | | | | | | |
| *Digitaria* spp. | | | | | | | | | | | | | √ | |
| *Dillwynia sericea* | | | | | | | | | | | | | √ | √ |
| *Dillwynia* sp. | | | | | | | | | | | | | | √ |
| *Drosera peltata* | | | | | | | | √ | | | | | | |
| *Echium plantagineum* # | Paterson's Curse | √ | √ | | √ | | √ | √ | √ | | | √ | | √ |
| *Ehrharta* sp. # | | | | | | | | | | | | √ | √ | |
| *Einadia nutans* | Climbing Saltbush | | | √ | | √ | | | | | | √ | | √ |
| *Elymus scaber* | Common Wheatgrass | | | | | | | | | | | | | √ |
| *Epilobium hirtigerum*# | Willowherb | | | | | | | | | | | | | √ |
| *Erodium botrys* # | Long Storksbill | √ | | √ | √ | | | √ | √ | | √ | √ | | |
| *Erodium cicutarium* # | Common Crowfoot | √ | | | | | | √ | √ | | | | | √ |
| *Erodium crinitum* | Blue Crowfoot | | | √ | | | | | √ | | √ | √ | | √ |
| *Eucalyptus albens* | White Box | √ | | √ | √ | √ | √ | √ | | √ | | √ | √ | √ |
| *Eucalyptus blakelyi* | Blakely's Red Gum | | | √ | | √ | | | | | | | √ | √ |
| *Eucalyptus dwyeri* | | | | | | | | | | | | | √ | |



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| Scientific Name | Common Name | Traverse | | | | Vegetation Plot | | | | | | | | ELA (2006) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | |
| *Eucalyptus macrorhyncha* | Red Stringybark | | | | | | | | | | | | | √ |
| *Eucalyptus melliodora* | Yellow Box | | | | | | | | | | | | | √ |
| *Eucalyptus microcarpa* | Grey Box | | | | | | | | | | | | | √ |
| *Galium aparine* # | Goosegrass | √ | | | | | | | | | | | | |
| *Galium* spp. | | | | | | | | √ | | | | | √ | |
| *Geranium solanderi* | Austral Cranesbill | √ | | | | | √ | √ | | | | | | √ |
| *Glycine clandestina* | Twining Glycine | | | | | | | | | | | | | √ |
| *Gonocarpus tetragynus* | Common Raspwort | | | | | √ | | | | | | | √ | √ |
| *Gonocarpus elatus* | | | | √ | | | | √ | √ | √ | √ | √ | √ | |
| *Goodenia hederacea* | Forest Goodenia | | | √ | | √ | | | | √ | √ | | | √ |
| *Haloragis* spp. | | | | | | | | √ | | | | | | |
| *Homopholis proluta* | Rigid Panic | | | | | | | | | | | | | √ |
| *Hordeum leporinum* # | Barley Grass | | √ | | | | √ | | | | | | | √ |
| *Hypericum perforatum* # | St John's Wort | | | | √ | | | | | | | | √ | √ |
| *Hypochaeris radicata* # | Flatweed | | | √ | | √ | √ | √ | √ | √ | √ | √ | | √ |
| *Hypoxis glabella* var. *glabella* | Tiny Star | | | | | | | | | | | √ | | |
| *Juncus usitatus* | | √ | | | | | | | | | √ | | | |
| *Juncus* sp. | | | | | | | | | | | | | | √ |
| *Lactuca serriola* # | Prickly Lettuce | | | | | | | | | | | | √ | |
| *Lepidium pseudohyssopifolium* # | Peppercress | | | | | | | | | | | | | √ |
| *Lissanthe strigosa* | Craneberry Heath | | | | | | | | | | | | √ | √ |
| *Lolium rigidum* # | Ryegrass | √ | √ | √ | √ | √ | √ | √ | | √ | √ | √ | √ | √ |
| *Lomandra filiformis* | | | | | | | | | | | | | | √ |
| *Lomandra multiflora* | | √ | | √ | √ | √ | √ | √ | √ | √ | | √ | √ | √ |
| *Lycium ferocissimum* # | African Boxthorn | | | | | | | | | | | | | √ |



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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | |
| *Malva parviflora* # | Small-flowered Mallow | √ | | | | | | | | | | | | √ |
| *Marrubium vulgare* # | Horehound | | | | | | | | | | | | | √ |
| *Medicago sativa* # | Lucerne | | | | | | | | | | | | | √ |
| *Medicago* spp. # | | | | | | √ | | | | | | | | |
| *Melaleuca* sp. | Paperbark | | | | | | | | | | | | | √ |
| *Melia azedarach* | White Cedar | | | | | | | | | | | | | √ |
| *Orobanche minor* # | Broomrape | | | | | | | | | | | | | √ |
| *Oxalis perennans* | Wood-sorrel | | | √ | | √ | √ | √ | √ | | √ | √ | √ | √ |
| *Paspalum dilatatum* # | Paspalum | | | | | | | | | | | | | √ |
| *Panicum effusum* | | | | | | | | | √ | | | | | |
| *Pennisetum clandestinum* # | Kikuyu | | | | | | | | | | | | | √ |
| *Persicaria* sp. | Slender Knotweed | | | | | | | | | | | | | √ |
| *Petrorhagia velutina* # | Velvet Pinks | | | | | | | | | | | | | √ |
| *Phalaris aquatica* # | Phalaris | | √ | | | | | | | | | | | √ |
| *Pinus* sp. # | | | | | | | | | | | | | | √ |
| *Polygonum aviculare* # | Wireweed | | | | | | | | | | | | | √ |
| *Portulaca oleracea* | Pigweed | | | | | | | | | | | | | √ |
| *Pterostylis* sp. | Greenhood | | | | | | | | | | | | | √ |
| *Pultenaea foliolosa* | | | | | | | | | | √ | √ | | √ | √ |
| *Robinia pseudoacacia* # | False Acacia | | | | | | | | | | | | | √ |
| *Romulea rosea* # | Onion Grass | √ | √ | √ | √ | √ | √ | √ | √ | √ | | √ | √ | √ |
| *Romulea minutiflora* # | Small-flowered Onion Grass | √ | | | | | | | | | √ | | | |
| *Rubus fruticosus* agg. spp # | Blackberry | | | | | | | | | | | | | √ |
| *Rumex brownii* | Slender Dock | | √ | | | | √ | √ | √ | | | | | √ |
| *Rumex* sp. | | | | | | | | | | | | | | √ |



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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | |
| *Salvia verbenaca* # | Wild Sage | √ | | | | | | | | | | | | √ |
| *Sclerolaena muricata* | Black Roly Poly | | | | | | | | | | | | | √ |
| *Silybum marianum* # | Variegated Thistle | √ | | | | | | | | | | | | √ |
| *Solenogyne dominii* | | | | | | | | | | | √ | √ | √ | |
| *Sonchus oleraceus* # | Common Sowthistle | √ | | | | | | √ | | | | | | |
| *Sporobolus* sp. | | | | | | | | | | | √ | | | √ |
| *Stellaria media* # | | | | | | | √ | | | | | | | |
| *Tricoryne elatior* | Yellow Rush-lily | | | | | | | | | | | √ | √ | √ |
| *Trifolium angustifolium* # | Narrow-leaf Clover | | | | | | | | | | | | | √ |
| *Trifolium glomeratum* # | Clustered Clover | | | | | | | | | | | | | √ |
| *Trifolium* sp. # | | | √ | √ | √ | | √ | | √ | | √ | √ | √ | √ |
| *Trifolium subterraneum* # | Subterraneum Clover | | | | | | √ | | | | | | | √ |
| *Trifolium arvense* # | Haresfoot Clover | √ | √ | √ | √ | | √ | √ | √ | | √ | √ | √ | |
| *Verbascum virgatum* # | Twiggy Mullein | | | | | | | | | | | | | √ |
| *Vittadinia* sp. | Fuzzweed | | | | | | | | | | | | √ | √ |
| *Vulpia bromoides* # | Silver Grass | | | | | | | | | | | | | √ |
| *Vulpia* spp. # | | | | √ | √ | | √ | √ | √ | | | √ | √ | |
| *Wahlenbergia* sp. | Native Bluebell | | | | | √ | | | | | | | | √ |
| *Wahlenbergia communis* | | | | | | | √ | | | | | | | |
| *Wurmbea dioica* | Early Nancy | | | | | | | | | | | √ | | |
| *Xanthium spinosum* # | Bathurst Burr | | | | | | | | | | | | | √ |

#Exotic species



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**Appendix 2: Fauna Species in the Study Area. Data taken from Mullins and Sutherland (2002a), ELA (2006) and results of the current study.**

| Scientific Name | Common Name |
|---|---|
| **MAMMALS** | |
| *Chalinolobus gouldii* | Gould's Wattled Bat |
| *Chalinolobus morio* | Chocolate Wattled Bat |
| *Felis catus* | Cat (feral) |
| *Lepus capensis* | Brown Hare |
| *Macropus giganteus* | Eastern Grey Kangaroo |
| *Miniopterus schreibersii* | Common Bent-wing Bat |
| *Nyctinomus australis* | White-striped Mastiff-bat |
| *Nyctophilus geoffroyi* | Lesser Long-eared Bat |
| *Nyctophilus gouldi* | Gould's Long-eared Bat |
| *Oryctolagus cuniculus* | Rabbit |
| *Ovis aries* | Sheep |
| *Petaurus norfolcensis* | Squirrel Glider |
| *Pseudocheirus peregrinus* | Common Ringtail Possum |
| *Tachyglossus aculeatus* | Short-beaked Echidna |
| *Vespadelus vulturnus* | Little Forest Bat |
| *Vulpes vulpes* | Fox |
| **BIRDS** | |
| *Gymnorhina tibicen* | Australian Magpie |
| *Corvus coronoides* | Australian Raven |
| *Chenonetta jubata* | Australian Wood Duck |
| *Coracina novaehollandiae* | Black-faced Cuckoo-shrike |
| *Elanus axillaris* | Black-shouldered Kite |
| *Acanthiza pusilla* | Brown Thornbill |
| *Climacteris picumnus* | Brown Treecreeper |
| *Turdus merula* | Common Blackbird |
| *Phaps chalcoptera* | Common Bronzewing |
| *Sturnus vulgaris* | Common Starling |
| *Ocyphaps lophotes* | Crested Pigeon |
| *Falcunculus frontatus* | Crested Shrike-tit |
| *Platycercus eximius* | Eastern Rosella |
| *Cacatua roseicapillus* | Galah |
| *Cracticus torquatus* | Grey Butcherbird |
| *Colluricincla harmonica* | Grey Shrike-thrush |
| *Pomatostomus temporalis* | Grey-crowned Babbler |
| *Passer domesticus* | House Sparrow |
| *Dacelo novaeguineae* | Laughing Kookaburra |
| *Hieraaetus morphnoides* | Little Eagle |
| *Philemon citreogularis* | Little Friarbird |
| *Glossopsitta pusilla* | Little Lorikeet |
| *Grallina cyanoleuca* | Magpie-lark |
| *Vanellus miles* | Masked Lapwing |
| *Falco cenchroides* | Nankeen Kestrel |
| *Manorina melanocephala* | Noisy Miner |


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| Scientific Name | Common Name |
|---|---|
| *Anas superciliosa* | Pacific Black Duck |
| *Cracticus nigrogularis* | Pied Butcherbird |
| *Anthochaera carunculata* | Red Wattlebird |
| *Psephotus haematonotus* | Red-rumped Parrot |
| *Anthus novaeseelandiae* | Richard's Pipit |
| *Ninox novaeseelandiae* | Southern Boobook |
| *Pardalotus striatus* | Striated Pardalote |
| *Coturnix pectoralis* | Stubble Quail |
| *Polytelis swainsonii* | Superb Parrot |
| *Lathamus discolor* | Swift Parrot |
| *Podargus strigoides* | Tawny Frogmouth |
| *Hirundo nigricans* | Tree Martin |
| *Aquila audax* | Wedge-tailed Eagle |
| *Artamus superciliosus* | White-browed Woodswallow |
| *Lichenostomus penicillatus* | White-plumed Honeyeater |
| *Corcorax melanorhamphos* | White-winged Chough |
| *Rhipidura leucophrys* | Willie Wagtail |
| *Platycercus flaveolus* | Yellow Rosella |

**FROGS**

| | |
|---|---|
| *Crinia parinsignifera* | Plains Froglet |
| *Crinia signifera* | Common Eastern Froglet |
| *Limnodynastes tasmaniensis* | Spotted Grass Frog |

**REPTILES**

| | |
|---|---|
| *Cryptoblepharus carnabyi* | Carnaby's Wall Skink |
| *Morethia boulengeri* | Boulenger's Skink |


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**Appendix 3: Likelihood of occurrence table for threatened species, endangered populations and endangered ecological communities recorded within the Wagga Wagga LGA.**

| Scientific Name | Common Name | Status | | Likelihood | Habitat |
|---|---|---|---|---|---|
| | | TSC Act | EPBC Act | | |
| **Threatened species - Fish** | | | | | |
| *Maccullochella peelii peelii* | Murray Cod | | V | No | Waterways of the Murray–Darling Basin in a wide range of warm water habitats that range from clear, rocky streams to slow flowing turbid rivers and billabongs. The upper reaches of the Murray and Murrumbidgee Rivers are considered too cold to contain suitable habitat. |
| *Macquarie australasica* | Macquarie Perch | | E | No | Occurs widely in riverine and lake habitats. In Sydney basin only known from Cataract and Cordeaux River catchments. Upland streams and migrates upstream to gravel beds to spawn. |
| **Threatened species - Frogs** | | | | | |
| *Litoria booroolongensis* | Booroolong Frog | E | | No | Restricted to NSW and north-eastern Victoria, predominantly along the western-flowing streams of the Great Dividing Range. Live along permanent streams with some fringing vegetation cover such as ferns, sedges or grasses |
| *Litoria raniformis* | Southern Bell Frog | E | V | No | Usually found in or around permanent or ephemeral Black Box/Lignum/Nitre Goosefoot swamps, Lignum/Typha swamps and River Red Gum swamps or billabongs along floodplains and river valleys. They are also found in irrigated rice crops, particularly where there is no available natural habitat |
| **Threatened species - Snakes** | | | | | |


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| Scientific Name | Common Name | Status | | Likelihood | Habitat |
|---|---|---|---|---|---|
| | | TSC Act | EPBC Act | | |
| *Aprasia parapulchella* | Pink-tailed Worm-lizard | V | V | Unlikely | In general, lizards occur in open grassland habitats that have a substantial cover of small rocks |
| *Delma impar* | Striped Legless Lizard | V | V | Unlikely | Lowland native grasslands |
| **Threatened species - Birds** | | | | | |
| *Ardea alba* | Great Egret, White Egret | | M | No | Shallows of rivers, estuaries, tidal mudflats, freshwater wetlands, larger dams |
| *Ardea ibis* | Cattle Egret | | M | Potential | Stock paddocks, pastures, croplands, garbage tips, wetlands, tidal mudflats |
| *Burhinus grallarius* | Bush Stone-curlew | E | | No | Well wooded floodplain forests, amongst fallen timber |
| *Cacatua leadbeateri* | Major Mitchell's Cockatoo | V | | Unlikely | Near water on timbered watercourses |
| *Callocephalon fimbriatum* | Gang-gang Cockatoo | V | | No | Wetter forests, and woodlands, from sea level to 2000m on divide. From timbered foothills and valleys to suburban gardens. |
| *Climacteris picumnus victoriae* | Eastern subspecies of Brown Treecreeper | V | | Yes | Drier forests / woodlands / scrubs with fallen branches. |
| *Gallinago hardwickii* | Latham's Snipe, Japanese Snipe | | M | No | Soft wet ground or shallow water with tussocks and other green and dead growth. Wet drainage areas |
| *Grus rubicundus* | Brolga | V | | No | Though Brolgas often feed in dry grassland or ploughed paddocks or even desert claypans, they are dependent on wetlands too, especially shallow swamps, where they will forage with their head entirely submerged |
| *Haliaeetus leucogaster* | White-bellied Sea-Eagle | | M | No | Rivers, large dams. Roost and nest on large platforms built in large Eucalypts |
| *Hirundapus caudacutus* | White-throated Needletail | | M | Potential | Open space above canopy. Forages over large areas |
| *Lathamus discolor* | Swift Parrot | E | E, M | Yes | Forests, woodlands, plantations, banksias, street trees and gardens on the mainland |


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| Scientific Name | Common Name | Status | | Likelihood | Habitat |
|---|---|---|---|---|---|
| | | TSC Act | EPBC Act | | |
| *Leipoa ocellata* | Malleefowl | E | V, M | No | Predominantly inhabit mallee communities, preferring the tall, dense and floristically-rich mallee found in higher rainfall (300-450 mm mean annual rainfall) areas. Less frequently found in other eucalypt woodlands |
| *Melanodryas cucullata* | Hooded Robin | V | | Unlikely | Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas |
| *Melithreptus gularis gularis* | Black-chinned Honeyeater (eastern subspecies) | V | | Unlikely | Ironbark woodlands, extensively wooded areas |
| *Merops ornatus* | Rainbow Bee-eater | | M | Potential | Open woodlands with sandy, loamy soils, dunes, cliffs, mangroves golf courses |
| *Myiagra cyanoleuca* | Satin Flycatcher | | M | Unlikely | Heavily vegetated gullies in forests, and taller woodlands of coastal south-east Australia. Also occurs in various sites during migration including farms and parks |
| *Neophema pulchella* | Turquoise Parrot | V | | Potential | Open grassy woodland, with dead trees, near permanent water and forested hills. |
| *Ninox connivens* | Barking Owl | V | | No | Open forests, woodlands, dense scrubs, other large trees near watercourses. Nest in tree hollow. |
| *Pachycephala inornata* | Gilbert's Whistler | V | | No | The Gilbert's Whistler occurs in ranges, plains and foothills in arid and semi-arid timbered habitats. In NSW it occurs mostly in mallee shrubland, but also in box-ironbark woodlands, Cypress Pine and Belah woodlands and River Red Gum forests. |
| *Pedionomus torquatus* | Plains Wanderer | E | V | No | Most of the vegetation is <5 cm high but some vegetation up to a maximum of 30 cm is important for concealment, grass tussocks are spaced 10-20 cm apart |


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| Scientific Name | Common Name | Status | | Likelihood | Habitat |
|---|---|---|---|---|---|
| | | TSC Act | EPBC Act | | |
| *Polytelis swainsonii* | Superb Parrot | V | V | Yes | Breeds along inland rivers in river red gum, feeding in box woodland with 10km of nest tree. West of dividing range. |
| *Pomatostomus temporalis temporalis* | Grey-crowned Babbler (eastern subspecies) | V | | Yes | Inhabits open Box-gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains |
| *Pyrrholaemus sagittatus* | Speckled Warbler | V | | Unlikely | Well vegetated woodlands, diverse structure |
| *Rostratula australis* | Australian Painted Snipe | | V | No | Well vegetated margins of wetlands |
| *Rostratula benghalensis australis* | Painted Snipe (Australian subspecies) | E | V, M | No | Well vegetated margins of wetlands |
| *Stagonopleura guttata* | Diamond Firetail | V | | Unlikely | Open eucalypt forests, woodlands. |
| *Stictonetta naevosa* | Freckled Duck | V | | No | Prefer permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. During drier times they move from ephemeral breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds |
| *Grantiella picta* | Painted Honeyeater | V | - | Unlikely | Boree, Brigalow and Box-gum woodlands and box – ironbark forests. Inhabits vegetation with 5 or more mistletoe per hectare. |
| *Xanthomyza phrygia* | Regent Honeyeater | E | E, M | No | Dry open forests, woodlands, especially red ironbark, yellow box, yellow gum |
| **Threatened species - Mammals** | | | | | |
| *Dasyurus maculatus* | Spotted-tailed Quoll | V | E | No | Occurs in wide variety of habitats in large remnants. Dens in tree hollows, hollow log or rock crevice |
| *Macrotis lagotis* | Bilby | Ex | V | No | Sandy desert areas in spinifex (*Triodia* species) grasslands |
| *Myotis adversus* | Large-footed Myotis | V | | Unlikely | Known from a range of habitats close to water from lakes, small creeks to large lakes and mangrove lined estuaries |


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| Scientific Name | Common Name | Status | | Likelihood | Habitat |
|---|---|---|---|---|---|
| | | TSC Act | EPBC Act | | |
| *Saccolaimus flaviventris* | Yellow-bellied Sheathtail Bat | V | - | Potential | Forages in most habitats across its very wide range, with and without trees. Roosts and breeds in living or dead hollow bearing trees. |
| *Chalinolobus picatus* | Little Pied bat | V | - | Potential | Dry open forest, open woodland , mulga woodlands, chenopod shrublands, cypress pine forest, malle and bramble box. Roosts and breeds in tree hollows, fissures or cracks, buildings, power poles, fence posts, caves, cliff crevices, mineshafts and tunnels. |
| *Nyctophilus timoriensis* (south eastern form) | Eastern Long-eared Bat | V | V | Potential | Inhabits a variety of vegetation types, including mallee, bulloak Allocasuarina luehmannii and box eucalypt dominated communities, but it is distinctly more common in box/ironbark/cypress-pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland |
| *Petaurus norfolcensis* | Squirrel Glider | V | | Yes | In the region occurs in Box-gum woodlands, box-ironbark woodlands and river red gum woodland. |
| *Phascolarctos cinereus* | Koala | V | | No | Inhabit eucalypt woodlands and forests |
| *Phascogale tapoatafa* | Brush-tailed Phascogale | V | - | No | Prefer dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter. Also inhabit heath, swamps, rainforest and wet sclerophyll forest. |
| **Threatened species - Plants** | | | | | |
| *Ammobium craspedioides* | Yass Daisy | V | V | No | Known from natural temperate grassland sites. |
| *Amphibromus fluitans* | River Swamp Wallaby-grass | V | V | No | Swamps or low-lying areas which become periodically water-logged, usually on clayey soils. |


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| Scientific Name | Common Name | Status | | Likelihood | Habitat |
|---|---|---|---|---|---|
| | | TSC Act | EPBC Act | | |
| *Austrostipa wakoolica* | | E | E | No | Grows on floodplains of the Murray River tributaries, in open woodland on grey, silty clay or sandy loam soils; habitats include the edges of a lignum swamp with box and mallee; creek banks in grey, silty clay; mallee and lignum sandy-loam flat; open Cypress Pine forest on low sandy range; and a low, rocky rise |
| *Brachycome muelleroides* | Claypan Daisy | V | V | No | Grows in damp areas on the margins of claypans in moist grassland with *Pycnosorus globosus*, *Agrostis avenacea* and *Austrodanthonia duttoniana* |
| *Brachycome papillosa* | Mossgiel Daisy | V | V | No | Recorded primarily in clay soils on Bladder Saltbush (*Atriplex vesicaria*) and *Maireana aphylla* plains, but also in grassland and in Grey Box (*Eucalyptus microcarpa*) - Cypress Pine (*Callitris spp*.) woodland |
| *Diuris tricolor* | Tricolour Diuris | V | V | No | Sporadically distributed on the western slopes of NSW. Associated species include Callitris glaucophylla, Eucalyptus populnea, Eucalyptus intertexta, Ironbark and Acacia shrubland. The understorey is often grassy with herbaceous plants such as Bulbine species |
| *Senecio garlandii* | Wooly Ragwort | V | V | No | Woolly Ragwort occurs on sheltered slopes of rocky outcrops |
| *Swainsona murrayana* | Slender Darling-pea | V | V | No | Grows in a variety of vegetation types including bladder saltbush, black box and grassland communities on level plains, floodplains and depressions and is often found with *Maireana* species. Plants have been found in remnant native grasslands or grassy woodlands that have been |


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| Scientific Name | Common Name | Status | | Likelihood | Habitat |
|---|---|---|---|---|---|
| | | TSC Act | EPBC Act | | |
| | | | | | intermittently grazed or cultivated. |
| *Swainsona recta* | Small Purple-pea | E | E | No | Before European settlement Mountain Swainson-pea occurred in the grassy understorey of woodlands and open-forests dominated by Blakely's Red Gum *Eucalyptus blakelyi*, Yellow Box *E. melliodora*, Candlebark Gum *E. rubida* and Long-leaf Box *E. goniocalyx* |
| *Thesium australe* | Austral Toadflax | V | V | No | Often found in damp sites in association with Kangaroo Grass (*Themeda australis*) |
| **Threatened Ecological Populations** | | | | | |
| *Petaurus norfolcensis* – endangered population Wagga Wagga | Squirrel Glider population in the Wagga Wagga LGA | E | | Yes | Inhabits a wide range of open forest, woodland and riverine forest habitats. Utilise remnants of various sizes, including small remnants and even small stands of trees within Travelling Stock Reserves, roadside reserves or private land. Often utilise linear remnant vegetation along roadsides or rivers and streams |
| **Threatened Ecological Communities** | | | | | |
| | White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland | E | CE | Yes | Western slopes and plains |


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