Charles Sturt University

BIODIVERSITY SURVEY AND ASSESSMENT

CHARLES STURT UNIVERSITY DUBBO

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FloraSearch

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EXECUTIVE SUMMARY AND RECOMMENDATIONS

A biodiversity survey was conducted on lands managed by Charles Sturt University, Dubbo over two days in April 2013. The key findings of the survey were:

Flora

- The CSU Dubbo campus (the study area) supports at least 116 species of flora, of which 65 (56.0%) are native, 51 (44.0%) are wild growing exotic plants and 17 (14.7%) are planted Australian trees and shrubs, mostly from the local area, with some from other regions.

- The CSU Dubbo campus has lost all of its original pre European tree cover, except for two White Cypress Pine (*Callitris glaucophylla*) trees that survive in a grazing paddock.

- The original native shrub and ground cover has also been almost entirely eliminated over most of the study area, except for some areas dominated by native grasses.

- The lack of native vegetation remnants on the study area makes it difficult to determine what the original vegetation of the study area comprised. On the basis of soil types and the vegetation in surrounding areas it is likely the study area formerly supported the following communities:

    - Fuzzy Box – Grey Box Woodland.
      This community is part of the *Fuzzy Box Woodland on alluvial soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions Endangered Ecological Community* listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act).

    - Yellow Box – Apple Box grassy open woodland with patches of White Box and Blakely's Red Gum.
      This vegetation, known commonly as Box-Gum Woodland, is part of the *White Box Yellow Box Blakely's Red Gum Woodland Endangered Ecological Community* listed under the TSC Act and the *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland Critically Endangered Ecological Community* listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

- The main current vegetation types on the study area comprise;
    - Planted native woodlots
    - Native grassland
    - Cropping and grazing paddocks

  The vegetation in each of these is described.

- Five weeds listed as Noxious under the NSW Noxious Weeds Act were found on the study area. Two of these, African Boxthorn and Silverleaf Nightshade, are listed as Weeds of National Significance by the Australian Weeds Committee.

Fauna

- Forty one native and introduced fauna species were recorded for the study area in this survey, including 35 birds (34 native, 1 introduced), four mammals (1 native, 3 introduced), one reptile and one frog (both native).

- Two introduced mammal species recorded by the survey and /or previously, the Red Fox and House Cat, are regarded as pest animals. The effects of each on the environment and biodiversity are listed as Key Threatening Processes under the TSC Act.

Threatened Biodiversity

- No remnants of any threatened ecological communities persist on the study area.
- One threatened plant species was identified by the survey, Lobed Bluegrass (*Bothriochloa biloba*) which is listed as Vulnerable under the EPBC Act.
- No threatened fauna species were identified by the survey.

Environmentally Important Areas

- The most environmentally important elements on the CSU Dubbo campus are considered to be the woodlot plantings which provide foraging habitat for a wide range of birds, and possibly microbats.
- The native tree and shrub plantings around the main building and car parks also roosting and feeding habitat for a variety of native birds.
- The native grassland areas provide habitat for various seed and insect eating birds.

Environmental Issues

A number of environmental issues were observed, or reported to the author, during inspections of the study area including;

- Salinisation of the grazing paddocks north of Dubbo College and fronting Yarrandale Road.
- The presence of small infestations of noxious weeds.
- The prevalence of domestic cats and the Red Fox (*Vulpes vulpes*) which would be impacting adversely on native animals.

Impact Assessment

- Assessments (Seven Part Tests of Significance) under the NSW TSC Act of the likely impact of future development projects around the existing campus infrastructure showed there would not be significant effects on any threatened flora or fauna, including the Lobed Bluegrass, which is unlikely to be directly impacted by any foreseeable development.
- It is concluded that future developments on the CSU Dubbo campus would not adversely affect populations of the threatened Pine Donkey Orchid, Small Purple-pea, Silky Swainson-pea or Wybong Leek Orchid, as no populations are known or likely to occur on CSU land due to past disturbance and loss of habitat.
- It is concluded that future developments on the CSU Dubbo campus would not significantly affect populations of the 10 threatened fauna species, as suitable breeding habitat for all

species is absent on the study area. However, future developments that affect food resources for these species may result in a slight decrease in the foraging habitat available.

RECOMMENDATIONS

The report contains recommendations for biodiversity enhancement including the following;

- Any future developments should minimise harm to the existing woodlot plantings, which have established successfully and whose value as wildlife habitat will increase over time.

- Openings in the existing woodlots should be filled with plantings of local shrub species. A list of flora species that are likely to have occurred on the CSU Dubbo property prior to white settlement is given (Appendix 3).

- Woodlot plantings should be inter-planted with patches of local shrubs in a mosaic that includes open areas left as grassland.

- The woodlot / shrub / grassland mosaic should be extended in a 50 m wide corridor along the western and northern boundaries of the property to link with the Troy Creek Reserve opposite Merrilea Road. This corridor would revegetate low lying areas that were originally Fuzzy Box Woodland. It would be an excellent conservation initiative to recreate Fuzzy Box Woodland, an Endangered Ecological Community, in this corridor.

- Consideration should also be given to further plantings around the Yarrandale Road paddock boundaries for salinity control.

- A control program for the Red Fox should be implemented in cooperation with the Rural Lands Protection Board and adjoining landholders, if appropriate.

- The presence of noxious weeds should be monitored and control initiated if any increase significantly.

INTRODUCTION

FloraSearch was commissioned by Charles Sturt University (CSU) to conduct a biodiversity survey and assessment on the Dubbo campus (the Study Area) of the university as part of a planning process for future developments. The survey and assessment is conducted in accordance with Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act), NSW *State Environmental Planning Policy No. 44* (SEPP44) and the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1995* (EPBC Act).

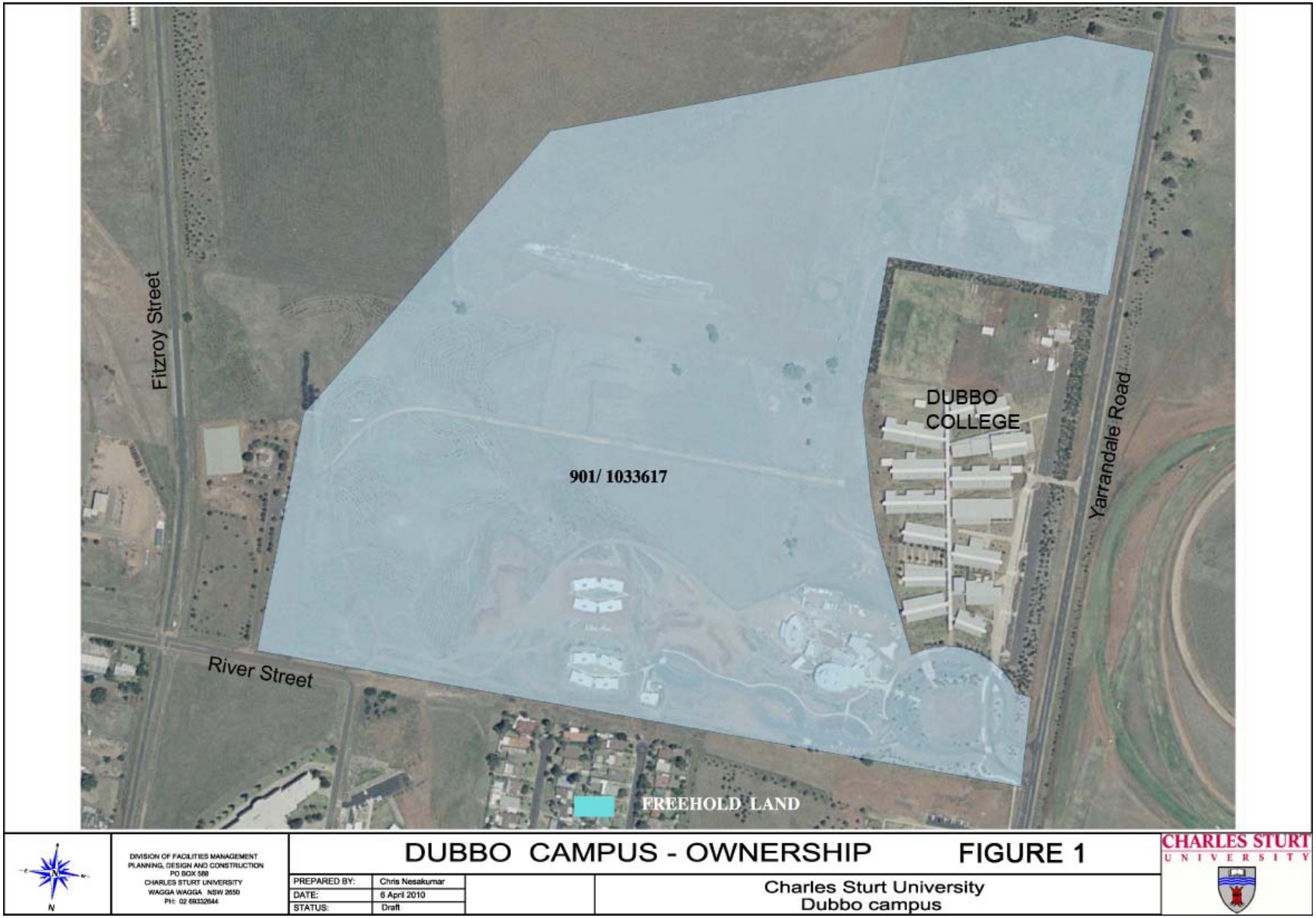
The objectives of the surveys and this report are to:

- define, describe and map the vegetation communities occurring on the Study Area;
- compile lists of flora and fauna species found on the Study Area;
- conduct targeted searches for threatened flora and fauna species, populations, ecological communities and critical habitat, considered possible occurrences within the study area (including those listed under the schedules of the NSW *Threatened Species Conservation Act 1995* (TSC Act) and the EPBC Act, and any flora species listed as rare or poorly known in *Rare or Threatened Australian Plants* [ROTAP]), and map the location of any threatened species identified;
- assess the condition of the vegetation;
- assess the potential impact of possible future developments on threatened flora and fauna species, populations, ecological communities and critical habitat via Seven Part Tests of Significance;
- define areas of environmental significance;
- define areas that harbour noxious weeds or pests;
- recommend how current levels of biodiversity can be maintained or enhanced in the longer term;

THE STUDY AREA

The study area comprises all lands vested in the university (Figure 1) and includes the built areas of the campus which are confined to the south eastern parts of the property, extensive grazing paddocks to their north and areas of planted woodlots to the west. The eastern boundary of the property fronts Yarrandale Road with a major excision occupied by Dubbo College (Figure 1). A short section of the southern boundary fronts River Street. Otherwise the boundaries are with neighbouring landowners. The eastern end of the northern boundary adjoins the Troy Creek Reserve fronting Yarrandale Road opposite Merrilea Road. This reserve includes walking tracks, rehabilitation plantings and educational signage.

The study area lies on the lower central western slopes of the Great Dividing Range on the northern outskirts of the City of Dubbo urban area. Dubbo is located on the Macquarie River a few kilometres south of its confluence with the Talbragar River. The property is generally flat, sloping very gradually northwards towards Troy Creek just outside the northern boundary. Elevation declines from approximately 278 m AHD in the south eastern corner to approximately 265 m on the northern boundary, a relief of only 13 m. There are no watercourses or well-defined drainage lines on the property. One water storage dam is situated in a grazing paddock adjacent to the western boundary of Dubbo College. An ephemeral ornamental pond has been constructed between the university entrance on Tony McGrane Drive and the main building. A shallow depression that sometimes holds water after significant rainfall is located in the grazing paddock in the north eastern corner of the property close to Yarrandale Road.


Fitzroy Street
River Street
Yarrandale Road
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DUBBO CAMPUS - OWNERSHIP
FIGURE 1
PREPARED BY: Chris Nesakumar
DATE: 6 April 2010
STATUS: Draft
Charles Sturt University
Dubbo campus
CHARLES STURT
UNIVERSITY

Current and Former Land Use

The site of the Dubbo campus was purchased by Charles Sturt University from Dubbo City Council in the mid-1990s (http://www.csu.edu.au/about/history/university-campuses/dubbo). Construction commenced on the site in 1999. Prior to ownership by Dubbo City Council, the property would have been farmed from the mid-1820s and has been cleared of almost all of the original tree and shrub cover. The predominant land uses since European settlement are likely to have been grazing by sheep and cattle, with cropping for fodder and grain production.

The CSU Dubbo campus currently includes the following land uses:

- Buildings occupy a relatively small proportion of the study area close to the southern boundary.

- Currently, the CSU-owned grazing paddocks north and west of the Dubbo College are managed by the college as part of its rural studies program. The paddocks are grazed by cattle and sheep and may be sown to fodder crops.

- Large plantings of native trees and shrubs were established in 2001 in the south western parts of the property, as a cooperative initiative between Landcare groups, the university and Dubbo City Council. The plantings were designed as a series of woodlots with open grassy areas between (Figure 2). The plantings are fenced off from the adjoining grazing paddocks to the north and east and are described in detail later.

Geology and Soils

The study area lies just within the southern margin of the vast Surat Basin geological formation which stretches from central northern NSW into central Queensland (Meakin and Morgan, 1999). The Surat Basin comprises Mesozoic sediments of early Jurassic to early Cretaceous age (170 to 140 million years ago). Two broad geological formations in Surat Basin sediments outcrop in the Dubbo area; the Purlawaugh Formation and the Pilliga Formation. In addition, Surat Basin rocks may be overlain around Dubbo by much younger volcanic rocks of the Tertiary period, laid down approximately 14 to 12 million years ago (Meakin and Morgan, (1999). Much of the City of Dubbo has been built on soils derived from older Napperby Formation sedimentary rocks of the Gunnedah Basin, which underlie Surat Basin sediments in northern NSW (Meakin and Morgan, 1999). A further complication is the proximity of the Macquarie River and the alluvial soils associated with it and its tributaries, including Troy Creek. Consequently, the geology in the vicinity of the study area is relatively complex and the study area itself may feature soils derived from several geological sources.

The Dubbo 1:250 000 Geological Map (Morgan *et al*. 1999) and the Dubbo 1:250 000 Soil Landscapes Map (Lawrie and Murphy, 1999) both show two geological units on the study area; Tertiary Volcanics and Pilliga Formation. These geological units represent contrasting rock types resulting in quite different soils.

- *Tertiary Volcanics*. The volcanic rocks around Dubbo are flows of fine to medium grained olivine tholeiitic basalt (Meakin and Morgan, 1999). Soils derived from these rocks are likely confined to the slightly elevated south eastern corner of the study area.

- *Pilliga Formation.* The Pilliga Sandstone comprises mainly '*massive, medium to very coarse-grained to conglomeratic, moderately well-sorted quartzose sandstone*'….. *The sandstone composition is generally 80% to 90% quartz, 5% to 10% rock fragments and about 5% clay matrix of kaolinite and illite, with cements of hematite and silica……The Pilliga Sandstone*

also contains minor mudstone, siltstone and fine-grained sandstone interbedded in the sequence (Meakin and Morgan, 1999).

Three broad Soil Landscapes have been described for the study area (Murphy and Lawrie, 1998); although the low resolution of the soil map (1:250 000) means that it cannot be used reliably for small areas. The three soil Landscapes are; Wongarbon Soil Landscape, Eulomogo Soil Landscape and Macquarie-Dubbo Soil Landscape. The Wongarbon Soil Landscape is derived from Tertiary Volcanic rocks, the Eulomogo Soil Landscape from sedimentary rocks of the Pilliga Formation and the Macquarie-Dubbo Soil Landscape from recent alluvium. The lack of fine scale soil mapping means the relative proportions of these Soil Landscapes on the study area are unknown.

1. *Wongarbon Soil Landscape.* The south eastern higher parts of the study area appear to belong to the Wongarbon Soil Landscape. The soils comprise Euchrozems plus Red and Brown Cracking Clays with moderate to high fertility and a high water holding capacity.

2. *Eulomogo Soil Landscape.* Areas of this soil landscape may occur in the south western parts of the property according to the mapping of Lawrie and Murphy (1999). The soils may include Red Earths with Yellow Solodic Soils; non-calcic Brown Soils may occur on mid-slopes.

3. *Macquarie-Dubbo Soil Landscape.* This soil landscape is associated with Troy Creek and the lower flat northern half of the study area. Soils are likely to include Red Earths and Red-brown earths derived from Pilliga Sandstone.

Climate

In general terms the climate of Dubbo is hot and semi-arid (Sahukar *et al.* 2003). The nearest Bureau of Meteorology weather station to the study area with a long run of data was at Darling Street, Dubbo and ran from 1870 to 2009. The mean daily maximum temperatures vary from 15.2 degrees C in July to 33.0 degrees C in January. The highest maximum temperature recorded in summer was 45.2 degrees C on January 13, 1939. The corresponding mean daily minimum temperatures vary from 2.6 degrees C in July to 17.9 degrees C in January. The lowest recorded temperature in winter was -6.7 degrees C on July 27, 1940. Frosts are common in winter.

Rainfall is moderate by Australian standards, averaging 583.9 mm per annum and spread fairly evenly through the year with slight summer dominance.

Biogeographical and Botanical Regions

The study area lies in the extreme south west of the Brigalow Belt South Bioregion (BBS) as defined in the Interim Biogeographic Regionalisation of Australia (IBRA) (Thackway and Cresswell, 1995). Within the BBS Bioregion, the study area falls within the Talbragar Valley Subregion (Sahukar *et al.*, 2003). The BBS bioregion extends up the western slopes of NSW into southern Queensland as far north as Rockhampton.

The study area also lies within the NSW Central Western Slopes Botanical Division (Anderson, 1961) and the catchment of the Macquarie River in the Central West Catchment Management Authority area.

LITERATURE

The earliest scientific publication on the flora of the Dubbo region is Biddiscombe (1963). More recently, the flora of the BBS Bioregion has been comprehensively surveyed as part of the NSW Western Regional Assessments conducted on behalf of the former Resource and Conservation Assessment Council (NPWS, 2000a, b, 2002a, b; Beckers and Binns, 2000; PlanningNSW, 2002, 2003; DIPNR, 2004). Survey work for the Western Regional Assessments was conducted mainly on crown lands such as National Parks, Nature Reserves, State Forests, Crown Reserves and roadsides where remnants of native vegetation occur. A vegetation survey and mapping program of the Macquarie and Castlereagh River catchments was carried out for the Central West Catchment Management Authority (CMA) between 2004 and 2006 (DEC, 2006). As a result, the Central West CMA website has descriptions and distribution maps of 82 'Broad Vegetation Types' identified within the CMA area (http://cw.cma.nsw.gov.au/OurNaturalAssets/maps.html).

Goldney *et al*. (2007) carried out a comprehensive inventory and status assessment of the native fauna of the Central West Catchment for the Central West CMA. This study included detailed summaries of threatening processes in the landscape and comprehensive recommendations to address them.

THREATENED BIODIVERSITY

Database searches were made in May 2013 of the following data sources to compile lists of threatened biodiversity that has been recorded in the surrounding region and may therefore have potential to occur on the study area. This involved searching for historical records of threatened flora and fauna species, populations, ecological communities and critical habitat. The databases consulted, and the search areas within them, were:

- BioNet website – Searches the NSW National Parks and Wildlife Service, NSW State Forests, Australian Museum and Royal Botanic Gardens Sydney databases. The search area comprised a 20 × 20 km square with the study area at its centre. This search returned a list of threatened species that have been recorded within the search area and a list of threatened species recorded from subregions of the Central West CMA area that overlap the search area; namely the Talbragar, Pilliga and Upper Slopes subregions. The output of threatened species from overlapping CMA subregions is a recent innovation in BioNet. However, given the very large size and diversity of the Pilliga and Upper Slopes bioregions, the lists contain many species that could not realistically have formerly occurred on the study area.

- Commonwealth Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) website – Protected Matters search tool (SEWPaC, 2013a). The search area comprised a 20 × 20 km square with the study area at its centre. The Protected Matters search tool uses actual records and habitat modelling to return a list of 'protected matters' that are known or predicted to occur in the search area, including threatened species, migratory species, ecological communities, wetlands of international significance, and national and world heritage properties.

Threatened Flora and Fauna Species

Flora

The BioNet search returned 6 threatened flora species listed under the TSC Act for which there are records within the 20 × 20 km square search area. In addition, BioNet reported 19 threatened flora species known from the entire distributions of the overlapping CMA subregions. Most of these

additional species have a nil or very low likelihood of occurring on the study area (Table 1). The SEWPaC Protected Matters Search returned 7 threatened flora species listed under the EPBC Act that are known or predicted to occur in the search area. All flora species identified by the Protected Matters Search Tool were also returned by the BioNet search. All 25 flora species are considered further in Table 1.

Fauna

The NSW BioNet search identified 25 threatened fauna species with records in the search area and an additional 37 species from the overlapping CMA subregions. The SEWPaC Protected Matters Search identified 14 Commonwealth listed threatened fauna, not all of which occurred on the NSW list. The species listed in Table 2 for further consideration comprise the 25 species with BioNet records in the search area and nine additional Commonwealth species.

The habitat requirements of the species in Tables 1 and 2 are reviewed and compared with the habitats available on the study area. Each species is assigned a nil, low, medium or high likelihood of having formerly occurred on the study area based on their documented habitat requirements. Threatened species whose habitats do not occur on the study area are not considered further in this report. Habitat filtering identified five flora species that are considered to have some likelihood (Low to high) of having once occurred on the study area (Table 1). Similarly, potential habitat is considered to exist on the study area for 13 fauna species that have low to high likelihoods of occurring (Table 2). These five plants and 13 animals were targeted in searches of potential habitat on the study area. The possible impact of developments on the study area on these species is evaluated in the assessment sections of this report.

Endangered Populations

Twenty five plant populations and 20 terrestrial fauna populations are listed as endangered under NSW TSC Act, as at May 2013. None are applicable to the study area.

Table 1
Threatened Flora Species Returned by Database Searches of the Surrounding Region.

Family Name	Scientific Name	Common Name	Conservation Status		Likely former presence?	Justification
			TSC Act[1]	EPBC Act[2]		
Apocynaceae	*Tylophora linearis*	-	V	E	Nil	*Tylophora linearis* occurs in relatively dry woodlands and forests, principally on the NSW Western Slopes. The ironbark, cypress pine and Allocasuarina species with which it is usually found do not occur on the study area (OEH, 2013a).
Asteraceae	*Calotis glandulosa*	Mauve Burr-daisy	V	V	Nil	Mauve Burr-daisy occurs on the NSW Southern Tablelands, and possibly the Central Tablelands in montane and alpine grasslands (SEWPaC, 2013). A single record of Mauve Burr-daisy from Dubbo in 1903 is considered dubious (OEH, 2013a). No other records are known from the NSW north western slopes.
Brassicaceae	*Lepidium aschersonii*	Spiny Peppercress	V	V	Nil	Found on ridges of gilgai clays dominated by Brigalow (*Acacia harpophylla*), Belah (*Casuarina cristata*), Buloke (*Allocasuarina luehmanii*) and Grey Box (*Eucalyptus microcarpa*) (OEH, 2013a). Similar habitat is absent from the study area.
Fabaceae (Faboideae)	*Indigofera efoliata*	Leafless Indigo	E	E	Nil	Leafless Indigo is confined to the Dubbo area and may now be extinct (OEH, 2013a). It has been recorded in *Eucalyptus crebra* and *Callitris glaucophylla* dry sclerophyll forest, and in *Eucalyptus microcarpa* and *Callitris glaucophylla* tall woodland. It seems to occur in rocky areas on sandy soils. Such habitats are absent from the study area.
	Swainsona murrayana	Slender Darling Pea	V	V	Nil	Slender Darling Pea is principally a species of the inland plains where it occurs in a variety of vegetation types including bladder saltbush, black box and grassland communities on level plains, floodplains and depressions (OEH, 2013a). Suitable habitat is unlikely to have formerly occurred on the study area.
	Swainsona recta	Small Purple-pea	E	E	Low	Small Purple-pea occurs in grassy box-gum woodlands and the lower slopes of montane forests (OEH, 2013a). As the study area is likely to have formerly supported a box-gum woodland, Small Purple-pea may once have occurred.
	Swainsona sericea	Silky Swainson-pea	V	-	High	The Silky Swainson-pea was formerly a widespread, common species in box-gum woodlands and is likely to have occurred in the Dubbo district (OEH, 2013a).

Family Name	Scientific Name	Common Name	Conservation Status		Likely former presence?	Justification
			TSC Act[1]	EPBC Act[2]		
Fabaceae (Mimosoideae)	*Acacia ausfeldii*	Ausfield's Wattle	V	-	Nil	Ausfeld's Wattle is confined to the Mudgee – Ulan – Gulgong area, where it grows in woodlands dominated by White Box, Blakely's Red Gum and Callitris pines (OEH, 2013a). It is unlikely to have once occurred on the study area.
Myrtaceae	*Eucalyptus alligatrix* subsp. *miscella*		V	V	Nil	This subspecies is confined to an area south west of Rylestone (OEH, 2013a), over 100 km from Dubbo, where it occurs on relatively infertile soils with a range of tree species absent from the Dubbo area. It is considered highly unlikely to have once occurred on the study area.
	Eucalyptus cannonii	Capertee Stringybark	V	V	Nil	Capertee Stringybark is recorded from Tablelands Grassy Woodland Complex communities and Talus Slope Woodland (OEH, 2013a), neither of which occur on the study area. The nearest records to Dubbo are over 100 km away.
	Eucalyptus robertsonii subsp. *hemisphaerica*	Robertson's Peppermint	V	V	Nil	The nearest records of Robertson's Peppermint to Dubbo are over 100 km away in the northern Mullions Range east of Mullion Creek and Kerrs Creek on different geology, at much higher altitudes (approximately 900 m) and in different plant associations than those on the study area (OEH, 2013a).
	Homoranthus darwinoides		V	V	Nil	This species is confined to Pilliga Sandstone and Narrabeen Sandstone environments in various woodland habitats with shrubby understoreys, usually in gravely sandy soils. Landforms include flat sunny ridge tops with scrubby woodland, sloping ridges and gentle south-facing slopes (OEH, 2013a). These environments do not occur on the study area.
Orchidaceae	*Diuris tricolor*	Pine Donkey Orchid	V	-	High	The Pine Donkey Orchid grows in sclerophyll forest among grass, often with native Cypress Pine (*Callitris* spp.). It is generally found in sandy soils, either on flats or small rises. There are several records in the Dubbo area (BioNet, 2013). It may once have occurred on the study area which retains remnant old growth White Cypress Pines, albeit on clay soils.
	Prasophyllum sp. Wybong		-	CE	Low	The nearest records to Dubbo attributable to this species are at Yeoval and Ilford where they occur in Box-Gum Woodlands (SEWPaC, 2013b). Box-Gum woodlands are likely to have occurred on the study area prior to European settlement.

Family Name	Scientific Name	Common Name	Conservation Status		Likely former presence?	Justification
			TSC Act[1]	EPBC Act[2]		
Poaceae	*Bothriochloa biloba*	Lobed Bluegrass	-	V	High	There are several records of Lobed Bluegrass in the Dubbo area, particularly to the south east where fertile clay soils that it favours are present (BioNet, 2013). Similar soils occur on the study area.
	Dichanthium setosum	Bluegrass	V	V	Nil	The core distribution of Bluegrass is on the Northern Tablelands and North West Slopes of NSW (BioNet, 2013a), although there are records at Narromine west of Dubbo and Dripstone south east of Wellington. The black basaltic plains soils favoured by this species do not occur on the study area (OEH, 2013a).
	Digitaria porrecta	Finger Panic Grass	E	E	Nil	Finger Panic Grass often associates with White Box and Weeping Myall in grasslands and grassy woodlands on fertile soils (OEH, 2013a). It is most prominent on black soil plains, which are absent from the study area. There are no records close to Dubbo (BioNet, 2013).
Proteaceae	*Grevillea divaricata*		E	-	Nil	A poorly known and possibly extinct species known only from the Bathurst area (OEH, 2013a).
	Persoonia marginata	Clandulla Geebung	V	V	Nil	Clandulla Geebung is confined to Narrabeen Sandstone ridgetops in the Portland – Cullen Bullen to Kandos areas. Suitable habitat is absent from the study area, which is over 100 km from the nearest records of the species.
Rhamnaceae	*Pomaderris queenslandica*	Scant Pomaderris	E	-	Nil	Scant Pomaderris is a widespread but uncommon species found from the coast to drier inland habitats. It generally occurs in shrubby forests and woodlands (OEH, 2013a). In all likelihood the study area was formerly a grassy woodland and Scant Pomaderris is unlikely to have been present.
Rutaceae	*Philotheca ericifolia*	-	-	V	Nil	*Philotheca ericifolia* grows chiefly in dry sclerophyll forest and heath on damp sandy flats and in gullies. The species has been collected from open woodland, heathland, dry sandy creek beds and rocky ridge and cliff tops. Preferred soils have a sandy, gravelly or rocky component (SEWPaC, 2012b). The study area lacks suitable habitat for this species.
	Zieria ingramii	Keith's Zieria	E	E	Nil	Keith's Zieria occurs in Ironbark, Grey Box and Black Cypress Pine forests on sandy loam soils derived from Pilliga Sandstone (OEH, 2013a). Such habitats are absent from the study area.

Family Name	Scientific Name	Common Name	Conservation Status		Likely former presence?	Justification
			TSC Act[1]	EPBC Act[2]		
Rutaceae (cont.)	*Zieria obcordata*	-	E	E	Nil	*Zieria obcordata* grows on gentle to moderately steep, west- to north-facing slopes of low hills or ridges at altitudes from 500 to 830 m. All sites have granite boulders, outcrops, and/or exposed granite. Plants typically occur around the base of granite boulders and in crevices between them (OEH, 2013a). No habitat for *Z. obcordata* occurs on the study area.
Scrophulariaceae	*Euphrasia arguta*	-	E	CE	Nil	*Euphrasia arguta* has been recorded from grassy areas near rivers at elevations up to 700 m above sea level, with an annual rainfall of 600 mm and grassy forests or regrowth vegetation (SEWPaC, 2013b). The study area is lower than known locations for this species.
Sterculiaceae	*Rulingia procumbens*		V	V	Nil	*Rulingia procumbens* is a species of sandstone environments and is mainly known from Pilliga Sandstone areas (OEH, 2013a). There is one old (1887) record for Dubbo (BioNet, 2013) that probably refers to the nearby Goonoo CCA. Coarse sandy soils do not occur on the study area.

[1] NSW *Threatened Species Conservation Act, 1995.*

[2] Commonwealth *Environment Protection and Biodiversity Conservation Act*, *1999.*

E Endangered.

CE Critically Endangered

V Vulnerable.

Table 2
Threatened Fauna Species Returned by Database Searches of the Surrounding Region

Class	Family Name	Scientific Name	Common Name	Conservation Status		Likelihood to be on Study Area	Justification
				TSC Act[1]	EPBC Act[2]		
Actinopterygii (ray-finned fishes)[3]	Percichthyidae	*Maccullochella macquariensis*	Trout Cod	E	E	Nil	The two fish species listed here only occur in large permanent rivers with deep waterholes. Such habitat does not occur on the study area (SEWPaC, 2013b).
		Maccullochella peelii	Murray Cod	-	V	Nil	
Reptilia (reptiles)	Pygopodidae	*Aprasia parapulchella*	Pink-tailed Legless Lizard	V	V	Nil	The Pink-tailed Legless Lizard inhabits sloping, open woodland areas with predominantly native grassy ground layers, particularly those dominated by Kangaroo Grass (*Themeda australis*). Sites are typically well-drained, with rocky outcrops or scattered, partially-buried rocks. Similar habitat does not occur on the study area (OEH, 2013a).
Aves (birds)	Megapodiidae	*Leipoa ocellata*	Mallee Fowl	E	V	Nil	Mallee Fowl are found in semi-arid to arid shrublands and low woodlands, especially those dominated by mallee and/or acacias. A sandy substrate and abundance of leaf litter are required for breeding (Benshemesh, 2007). A population persists in the Goonoo CCA north east of Dubbo (OEH, 2013a). Suitable habitat is absent from the study area and surrounds.
	Anseranatidae	*Anseranas semipalmata*	Magpie Goose	V	-	Low	Magpie Geese are associated with wetlands, dry ephemeral swamps, wet grasslands and floodplains (OEH, 2013a). There are two records on the Macquarie River at Dubbo (BioNet, 2013). Core habitat is absent from the study area, although there is some possibility birds may occasionally graze in the open paddocks.
	Phaethontidae	*Phaethon rubricauda*	Red-tailed Tropic Bird	V	-	Nil	A single record of a vagrant Red-tailed Tropic Bird was made in Dubbo in 1994 (BioNet 2013) following a severe storm event that blew the bird inland from its normal oceanic habitat (OEH, 2013a).
	Ardeidae	*Botaurus poiciloptilus*	Australasian Bittern	E	E	Nil	The Australasian Bittern requires permanent freshwater wetlands with dense emergent vegetation of Cumbungi, Lignum or similar (OEH, 2013a). Suitable habitat is lacking on the study area.
	Accipitridae	*Circus assimilis*	Spotted Harrier	V	-	Low	The Spotted Harrier occurs in grassy open woodland including *Acacia* and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands (OEH, 2013a). It may potentially forage over the grazing paddocks on the study area.
		Hieraaetus morphnoides	Little Eagle	V	-	High	Little Eagle occurs throughout NSW and soars over open country looking for prey (Blakers *et al*., 1984). There are multiple records in the region around Dubbo in BioNet (2013). It is likely to hunt over the grazing paddocks on the study area.

Class	Family Name	Scientific Name	Common Name	Conservation Status		Likelihood to be on Study Area	Justification
				TSC Act[1]	EPBC Act[2]		
Aves (birds) cont.	Falconidae	*Falco subniger*	Black Falcon	V	-	Low	Black Falcons occur primarily along inland watercourses and forage for bird prey in eucalypt woodland (Blakers *et al*. 1984). There is one relatively recent record near Dubbo. There is a low potential for this species to forage in treed areas of the campus.
	Rostratulidae	*Rostratula australis*	Australian Painted Snipe	E	V	Nil	Australian Painted Snipe inhabits freshwater swamps and marshes (Blakers *et al*., 1984). Suitable habitat is absent from the study area.
	Cacatuidae	*Calyptorhynchus lathami*	Glossy Black Cockatoo	V	-	Nil	The Glossy Black Cockatoo inhabits open forest and woodlands in which stands of She-oak species, particularly Black She-oak (*Allocasuarina littoralis*), Forest She-oak (*A. torulosa*) or Drooping She-oak (*A. verticillata*) occur (OEH, 2013a). It is widespread in the larger blocks of remnant natural bushland in the Dubbo region (BioNet, 2013), although habitat is lacking on the study area.
		Lophochroa leadbeateri	Major Mitchell's Cockatoo	V	-	Nil	The core distribution area of Major Mitchell's Cockatoo is the western plains of NSW (OEH, 2013a; BioNet 2013). Birds assumed to be vagrants or aviary escapes are occasionally observed in the east, including one record at Dubbo in 2010. The study area lacks habitat for this species.
	Psittacidae	*Glossopsitta pusilla*	Little Lorikeet	V	-	High	The Little Lorikeet is a nomadic nectar feeding species that is regularly recorded in the Dubbo region (BioNet, 2013). It can be expected to occur on the study area when eucalypts are in flower.
		Lathamus discolor	Swift Parrot	E	E	Low	The Swift Parrot is a migratory species that breeds in Tasmania and winters on the mainland, where it feeds on flowering eucalypts (OEH, 2013a). There is only one record near Dubbo (BioNet, 2013). It may potentially feed on flowering planted eucalypt trees on the CSU campus.
		Polytelis swainsonii	Superb Parrot	V	V	Low	The Superb Parrot occurs in tall woodlands and forests west of the Tablelands (Blakers *et al*., 1984). There are multiple records of the species close to Dubbo. Suitable woodland habitat with old growth trees having hollow limbs for breeding is absent on the study area, although birds may occasionally visit to forage.
	Strigidae	*Ninox connivens*	Barking Owl	V	-	Low	The Barking Owl occurs in eucalypt woodland and is widespread in eastern NSW. It is known to occur in the Dubbo area (BioNet, 2013). Requires very large foraging areas (2000+ ha) and large trees for roosting and nesting (OEH, 2013a). The study area may form part of a larger foraging territory but is unlikely to serve as breeding habitat.
	Climacteridae	*Climacteris picumnus victoriae*	Brown Treecreeper (eastern subspecies)	V	-	Nil	The Brown Treecreeper is widespread in bushland remnants with old growth trees around Dubbo (BioNet, 2013). It inhabits grassy woodlands with rough-barked trees at close to natural densities, sparse shrub cover and fallen timber on the ground (OEH, 2013a). Suitable habitat does not occur on the study area.

Class	Family Name	Scientific Name	Common Name	Conservation Status		Likelihood to be on Study Area	Justification
				TSC Act[1]	EPBC Act[2]		
Aves (birds) cont.	Acanthizidae	*Chthonicola sagittata*	Speckled Warbler	V	-	Nil	A sedentary species of natural relatively undisturbed open woodland on rocky ridges or in gullies (OEH, 2013a). Recorded sparsely but widely in the surrounding region in larger blocks of remnant woodland (BioNet, 2013). Suitable habitat is lacking on the study area.
	Meliphagidae	*Anthochaera phrygia*	Regent Honeyeater	E	E	Low	A nomadic nectar-dependent species found in flowering eucalypts, which has been recorded rarely in the region around the study area (BioNet, 2013). It has potential to visit the study area when Eucalypts are flowering, especially Yellow Box (OEH, 2013a).
		Ephianura albifrons	White-fronted Chat	V	-	Nil	There is one record for the White-fronted Chat in the Dubbo area (BioNet, 2013). The preferred habitat is wet grasslands or marshes (OEH, 2013a), of which there are none on the study area.
		Melithreptus gularis	Black-chinned Honeyeater	V	-	Nil	The Black-chinned Honeyeater is rarely observed in the Dubbo area; (BioNet, 2013). It requires relatively large feeding areas and tends to occur mainly in larger bushland remnants (OEH, 2013a). Suitable mature woodland habitat is absent from the study area.
	Pomatostomidae	*Pomatostomus temporalis temporalis*	Grey-crowned Babbler (eastern subspecies)	V	-	Nil	The Grey-crowned Babbler is relatively common in the Dubbo area (BioNet, 2013). It prefers open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains, all with dense low trees below the canopy (OEH, 2013a). Suitable habitat does not occur on the study area.
	Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella	V	-	Nil	Birds of woodlands and open forests, usually with rough-barked eucalypts (OEH, 2013a). Widespread in the Dubbo region (BioNet, 2013), but confined to remnant woodlands with mature trees. Unlikely to occur on the study area.
	Petroicidae	*Melanodryas cucullata*	Hooded Robin	V	-	Nil	The Hooded Robin occurs sparingly in the Dubbo region (BioNet, 2013). They occur in open eucalypt woodlands with saplings, shrubs and native grasses (OEH, 2013a). Suitable habitat is absent on the study area.
	Estrildidae	*Stagonopleura guttata*	Diamond Firetail	V	-	Moderate	Widespread in open forest and woodland mostly on the inland side of the Great Dividing Range in eastern NSW (Blakers *et al*., 1984). Recorded regularly in semi-cleared farmland around Dubbo BioNet, 2013). Favours open grassy woodlands and has some potential to occur on the study area.
Mammalia (mammals)	Thylacomyidae	*Macrotis lagotis*	Bilby	E	V	Nil	There are no recent records of the Bilby in the Dubbo area. Old records at Gilgandra and Dubbo date to 1899 and 1932, respectively. It is likely to be extinct in the region (OEH, 2013a).
	Phascolarctidae	*Phascolarctos cinereus*	Koala	V	V	Nil	Koalas are widespread in eastern NSW and have been recorded sparingly in the region around Dubbo (BioNet, 2013). However, there are no records close to Dubbo. The Koala requires large mature trees in which to roost and feed and these are lacking on the study area.

Class	Family Name	Scientific Name	Common Name	Conservation Status		Likelihood to be on Study Area	Justification
				TSC Act[1]	EPBC Act[2]		
Mammalia (mammals) cont.	Macropodidae	*Petrogale penicillata*	Brush-tailed Rock Wallaby	E	V	Nil	Inhabits rocky areas in sclerophyll forest, usually slopes that receive direct sunlight for most of the day and with caves, crevices or jumbled boulders to provide shelter (Maynes and Sharman, 1983). No such habitat occurs on the study area.
	Pteropodidae	*Pteropus poliocephalus*	Grey-headed Flying-fox	V	V	Low	The Grey-headed Flying Fox mostly occurs on the eastern side of the Great Dividing Range, but may establish temporary roosts west of the divide when food supplies are abundant. There is one record close to Dubbo in 2004 (BioNet, 2013). Remnant trees suitable for Flying Fox roosting are absent from the study area. May feed on flowering eucalypts (OEH, 2013a).
	Emballonuridae	*Saccolaimus flaviventris*	Yellow-bellied Sheathtail Bat	V	-	Low	The Yellow-bellied Sheathtail Bat has been recorded sparingly in the region around Dubbo (BioNet, 2013). It roosts in tree hollows and forages over the tree canopy or open country (OEH, 2013a). Tree hollows are lacking on the study area, although there is a low potential that it may forage locally.
	Vespertilionidae	*Chalinolobus dwyeri*	Large-eared Pied Bat	V	V	Nil	The Large-eared pied Bat has not been recorded close to Dubbo, although there are records approximately 50 km north and south east of Dubbo (BioNet, 2013). It roosts in caves, mine tunnels and the abandoned nests of Fairy Martins (Dwyer, 1983). The Large-eared Pied Bat forages over areas of continuous forest habitat (Richards and Associates, 2000), which is lacking on the study area.
		Chalinolobus picatus	Little Pied Bat	V	V	Low	There are two records of the Little Pied Bat close to Dubbo and scattered records in the wider region (BioNet, 2013). It occurs in dry open forest, open woodland, mulga woodlands, chenopod shrublands, cypress pine forest, and mallee and Bimbil box woodlands. It roosts in caves, rock outcrops, mine shafts, tunnels, tree hollows and buildings (OEH, 2013a). There is limited potential for it to nest or roost on the study area, but it may potentially forage in the woodlots.
		Nyctophilus corbeni	South-eastern Long-eared Bat	V	V	Nil	The South-eastern Long-eared Bat inhabits large areas of remnant bushland and is absent from cleared farming country. It requires trees with hollows or strips of shedding bark for roosting (OEH, 2013a). The nearest records to Dubbo are in the Hervey Range and Goonoo CCA (BioNet, 2013). It is unlikely to occur on the study area.

[1] NSW *Threatened Species Conservation Act, 1995.*
[2] Commonwealth *Environment Protection and Biodiversity Conservation Act*, *1999.*
[3] NSW *Fisheries Management Act 1994.*
E Endangered.
CE Critically Endangered
V Vulnerable.

Threatened Ecological Communities

The database searches indicated that six endangered ecological communities listed in the schedules of the TSC Act may potentially occur on the study area (Table 3). Four of these, and one additional community, are also listed as Endangered or Critically Endangered under the EPBC Act. Review of the literature indicated four of these communities are unlikely to occur as they occupy soil types not found on the study area. The remaining three communities are considered to have potentially occurred on the study area prior to European settlement, as follows:

- *Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions*.

- *Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions* (TSC Act), which is equivalent to *Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia* (EPBC Act).

- *White Box Yellow Box Blakely's Red Gum Woodland endangered ecological community* (TSC Act), which is broadly equivalent to *White Box-Yellow Box-Blakely's Red Gum grassy woodlands and derived native grasslands critically endangered ecological community* (EPBC Act).

Critical Habitat

No Critical Habitat for flora has been declared on or near the study area under the TSC Act or the EPBC Act.

METHODS

SURVEY TIMING AND SCOPE

Field surveys were carried out over 2 days in April (8th and 9th), 2013. The survey encompassed all environments on the campus including native woodland plantings, native ornamental plantings around buildings and car parks, and grazing and cropping paddocks in order to sample and identify all vegetation types present and to record as much of the wildlife as practicable. All habitat types were searched to maximise the chances of finding populations of any threatened species that may occur.

The autumn timing of the survey meant that reptiles and most amphibians were not active, and that summer migratory bird species were absent. Similarly, although flowers were absent from spring flowering plants, much of the vegetation was in active growth and many species carried fruits and/or seeds enabling them to be positively identified. This was particularly true of the native grasses and many herbaceous species which had grown profusely following good rainfall in late January and early March and carried mature seed heads at the time of the survey.

WEATHER CONDITIONS

Field sampling was carried out after good rainfall in late January (54.6 mm on the 27th) and early March (59.8 mm on the 1st). Accordingly, conditions were ideal for plant growth and reproduction resulting in high levels of ground cover vegetation throughout the study area, despite intensive grazing by domestic farm animals in the grazing paddocks.

Table 3
Threatened Terrestrial Ecological Communities Known to Occur within the Wider Region

Title(s)	Conservation Status[1]		Comment	Likelihood of Occurrence
	TSC Act	EPBC Act		
Carex Sedgeland of the New England Tableland, Nandewar, Brigalow Belt South and NSW North Coast Bioregions	E	-	Carex Sedgelands are fens dominated by sedges, grasses and semi-aquatic herbs. Carex Sedgeland falls within the general formation of montane bogs and fens (OEH, 2013a). This community potentially occurs in the Dubbo region in drainage depressions. However, such depressions are absent from the study area.	Nil
Coolibah-Black Box Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain and Mulga Lands Bioregion (TSC Act). Coolibah – Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions (EPBC Act).	E	E	A woodland community of flora and fauna found on the grey, self-mulching clays of periodically waterlogged floodplains, swamp margins, ephemeral wetlands, and stream levees. The structure of the community may vary from tall riparian woodlands to very open 'savanna like' grassy woodlands with a sparse midstorey of shrubs and saplings (OEH, 2013a). Typically these woodlands form mosaics with grasslands and wetlands, and are characterised by Coolibah (*Eucalyptus coolabah*) and, in some areas, Black Box (*E. largiflorens*). Grey self-mulching clays are absent from the study area, as are the dominant trees.	Nil
Fuzzy Box Woodland on alluvial soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions	E	-	This community occurs on brown loam or clay, alluvial or colluvial soils on prior streams, slight depressions on undulating plains of the western slopes. It occurs upslope of frequently inundated floodplain River Red Gum communities, as well as on lower slopes and valley flats (OEH, 2013a). It is endemic to the Dubbo area and may have occurred on the lower parts of the study area in the north.	High
Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions (TSC Act) Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia (EPBC Act)	E	E	Inland Grey Box Woodland includes those woodlands in which the most characteristic tree species, *Eucalyptus microcarpa* (Inland Grey Box), is often found in association with *E. populnea* subsp. *bimbil* (Bimble or Poplar Box), *Callitris glaucophylla* (White Cypress Pine), *Brachychiton populneus* (Kurrajong), *Allocasuarina luehmannii* (Bulloak) or *E. melliodora* (Yellow Box), and sometimes with *E. albens* (White Box). There is a correlation between the distribution of *Eucalyptus microcarpa* communities and soils of Tertiary and Quaternary alluvial origin, largely corresponding with the Red Brown Earths (OEH, 2013a). It is known to occur in the Dubbo region. Soils on the study area do not match those most favoured by this community.	Low
Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions (TSC Act) Weeping Myall Woodlands (EPBC Act)	E	E	This ecological community is scattered across the eastern parts of the alluvial plains of the Murray-Darling river system. Myall (*Acacia pendula*) woodlands occur on alluvial or stagnant alluvial soil landscapes on the lower south west slopes and plains of NSW (NSW Scientific Committee, 2011). Typically, it occurs on red-brown earths and heavy textured grey and brown alluvial soils. Associated tree species include Belah (*Casuarina cristata*), Yarran (*Acacia homalophylla*), Miljee (*Acacia oswaldii*), Rosewood (*Alectryon oleifolius*) and Warrior Bush (*Apophyllum anomalum*). Alluvial and stagnant alluvial soils are absent from the study area.	Nil
Natural grasslands on basalt and fine-textured alluvial plains of northern New south Wales and southern Queensland.	-	CE	This community is strongly reliant on soil type as it is associated with fine textured, often cracking clays derived from either basalt or quaternary alluvium. The ecological community generally occurs on flat to low slopes, of no more than 5% (or less than 1 degree) inclination (OEH, 2013a). The study area does not comprise basaltic or quarternary alluvium.	Nil

Title(s)	Conservation Status[1]		Comment	Likelihood of Occurrence
	TSC Act	EPBC Act		
White Box Yellow Box Blakely's Red Gum Woodland (TSC Act) White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (EPBC Act)	E	CE	This ecological community, commonly known as Box-Gum Woodland, is widespread on the NSW western slopes and tablelands (OEH, 2013a). It was formerly one of the dominant communities in the region south and east of Dubbo. It occurs on relatively deep high fertility soils, such as the Wongarbon Soil Landscape that is widespread on the study area. Accordingly, it is likely that this community formerly occurred on the study area.	High

[1] E Endangered; CE Critically Endangered.


SS3
SS4
SS11
SS12
SS13
SS5
SS7
SS6
SS1
SS8
SS9
SS2
SS10
Merrilea Rd
Yarrandale Rd
McCullum Rd
BIODIVERSITY ASSESSMENT
CHARLES STURT UNIVERSITY
DUBBO CAMPUS
FIGURE 2
Survey Sites
Charles Sturt University
Legend
Spot Sample:
Study Area Boundary:
Google earth

VEGETATION SAMPLING

In the absence of any substantial remnants of the original tree or shrub cover, the vegetation was documented by spot sampling, detailed below. Figure 2 shows the locations of flora sample sites.

Spot Sampling

Thirteen spot samples were conducted at locations selected to encompass the full range of flora diversity on the study area. Spot samples listed all vascular plants present within approximately 20 m of the point at which the GPS reading was taken. The locations of spot samples are given in Table 4 and shown on Figure 2.

Table 4
Locations of Vegetation Spot Samples (Figure 2)

Spot Sample Number	Easting[1]	Northing	Location
1	0653925	6432525	Woodlot planting
2	0652812	6432427	Woodlot planting
3	0653522	6432911	North-eastern grazing paddock
4	0653447	6432878	North-eastern grazing paddock
5	0652926	6432628	Woodlot planting
6	0652820	6432587	Woodlot planting
7	0652845	6432629	Grazed native grassland between woodlots
8	0653013	6432506	Fallow paddock
9	0653142	6432475	Cropping/grazing paddock
10	0653423	6432265	Ephemeral pond
11	0653223	6432774	Cropping/grazing paddock
12	0653102	6432679	Cropping/grazing paddock
13	0653106	6432710	Cropping/grazing paddock

[1] GDA94, Zone 55H

An abundance rating was assigned to each species recorded at each spot sample site, as follows:

a abundant
c common
o occasional
u uncommon
r rare

Plantings

Plantings of native and introduced species in windbreaks, shelterbelts and garden beds around buildings were examined to record the main species used, with particular reference to the presence of any listed threatened species.

Searches for Threatened Species

The entire area of the built campus and farm lands were searched for potential habitat of threatened flora species. The known habitats of the species in Tables 1 and 2 are described in fact sheets and profiles of threatened species published on the websites of the NSW Office of Environment and Heritage (OEH) and the Commonwealth SEWPaC, as well as on the PlantNet website of the Royal Botanic Gardens and Domain Trust (RBGDT) Sydney. The high levels of historical disturbance suggest there is a low likelihood that any habitat for threatened flora species remains.

Flora Species Listing

All observed plant species were recorded, whether identified on formal sample sites or not. Some less common plants were only observed on one occasion whilst moving around the site. Where plants could not be quickly identified in the field, a sample was taken for examination. Samples were preserved in a plant press and later identified using a binocular microscope and flora keys. The principal reference was the Flora of New South Wales (Ed. G. Harden 1990-2002) and it is used as the basis for nomenclature in this report along with any updates on the PlantNet web site of the RBDGT.

FAUNA SAMPLING

Owing to the highly modified and developed nature of the study area, surveys for fauna comprised observational techniques and visual assessment of habitat quality, rather than intensive trapping methods.

Amphibians

A search for amphibians was conducted on one night (April 8) around the farm dam. Twenty minutes was spent sitting quietly and listening for frog calls. Calls were identified using the David Stewart (2001) frog call CD. Frog calls were also identified in the reserve outside the northern boundary of the study area, since any frogs detected here are also likely to utilise the study area.

Reptiles

No searches for reptiles were conducted owing to the autumn timing of the survey. Since they are poikilothermic (cold-blooded) reptiles are torpid (inactive) in cold weather. It was not considered appropriate to dislodge reptiles from their shelter when temperatures were too cold for them to retreat back to cover.

Birds

Birds were systematically surveyed at several sites in the study area, including the woodlot plantings and the plantings around the main building and car park (Figure 2). A total of four hours was devoted to observing and recording the bird species present. Birds were also recorded opportunistically while conducting the flora surveys and moving around the study area.

Mammals

Native and introduced mammals were recorded while moving around the study area and by spot lighting on the night of 8 April. Spot lighting was carried out in the planted woodlots, in the windbreaks around the Dubbo College and in the plantings around the main building and car park.

Observations were also made in the reserve adjoining the northern boundary of the study area owing to the presence of several old growth trees with hollow limbs that may provide habitat for arboreal mammals. Fauna scats were sought for identification using the Triggs (2004) field guide.

Habitat Trees

All native trees in remnant woodland patches were examined individually for the presence of hollow limbs, spouts and openings in the trunk that may potentially be used by possums, gliders and bats for denning, or birds for nesting. Each tree with hollows was identified to species and its GPS coordinates taken.

Habitat Quality

Habitat quality was assessed qualitatively taking account of the presence or absence of factors important for wildlife. These included:

- Native overstorey cover, especially old growth eucalypts.
- Native midstorey cover, including shrubs with potential to provide nectar when flowering or edible sap.
- Native groundcover – grasses, presence or absence of native grasses
- Native groundcover – shrubs
- Native groundcover – other, presence or absence of native herbs, sedges, rushes, ferns and other groundcover species
- Exotic plant cover, presence or absence of exotic species.
- Trees with hollows
- Regeneration, presence of juvenile eucalypts or native shrubs.
- Fallen logs, presence of large fallen logs

Fauna Species Listing

Lists were compiled of all amphibian, bird and mammal species observed, or inferred from evidence of scats, on the study area.

RESULTS AND DISCUSSION

FLORA

A complete list of the plant species found on the study area is given in Appendix 1 for each sample site. In addition to flora species recorded at spot sample sites, Appendix 1 includes plants recorded opportunistically while moving around the area. A total of 116 species was recorded, of which 65 (56.0%) are native to the study area, 51 (44.0%) are wild growing exotic plants and 17 (14.7%) are planted Australian trees and shrubs, mostly from the local area, but some from other regions. It is likely that some exotic and native planted species have not been listed since it was not practical to document all garden plants around the built parts of the campus. The main plant families represented are the Poaceae (Grasses) (31 species), Asteraceae (Daisies) (14 species) and Myrtaceae (Eucalypts and relatives) (10 species).

Remnant Native Vegetation

Remnant native trees and tall shrubs are almost completely absent from the study area. Only a few specimens remain of two species that are likely to have grown on the study area prior to European

settlement. These are two old growth White Cypress Pine (*Callitris glaucophylla*) trees and a few Cooba Wattles (*Acacia salicina*). The White Cypress Pines are isolated paddock trees in the grazing paddocks west of Dubbo College (Figure 3). Cooba Wattles occur along the southern fenceline of the property adjacent to the car parks, with a few juvenile specimens on the south side of the ephemeral pond at the university entrance. A low native shrub, Smooth Senna (*Senna barclayana*) occurs in areas that are not mown, ploughed or grazed, including the planted woodlots and along some paddock fence lines.

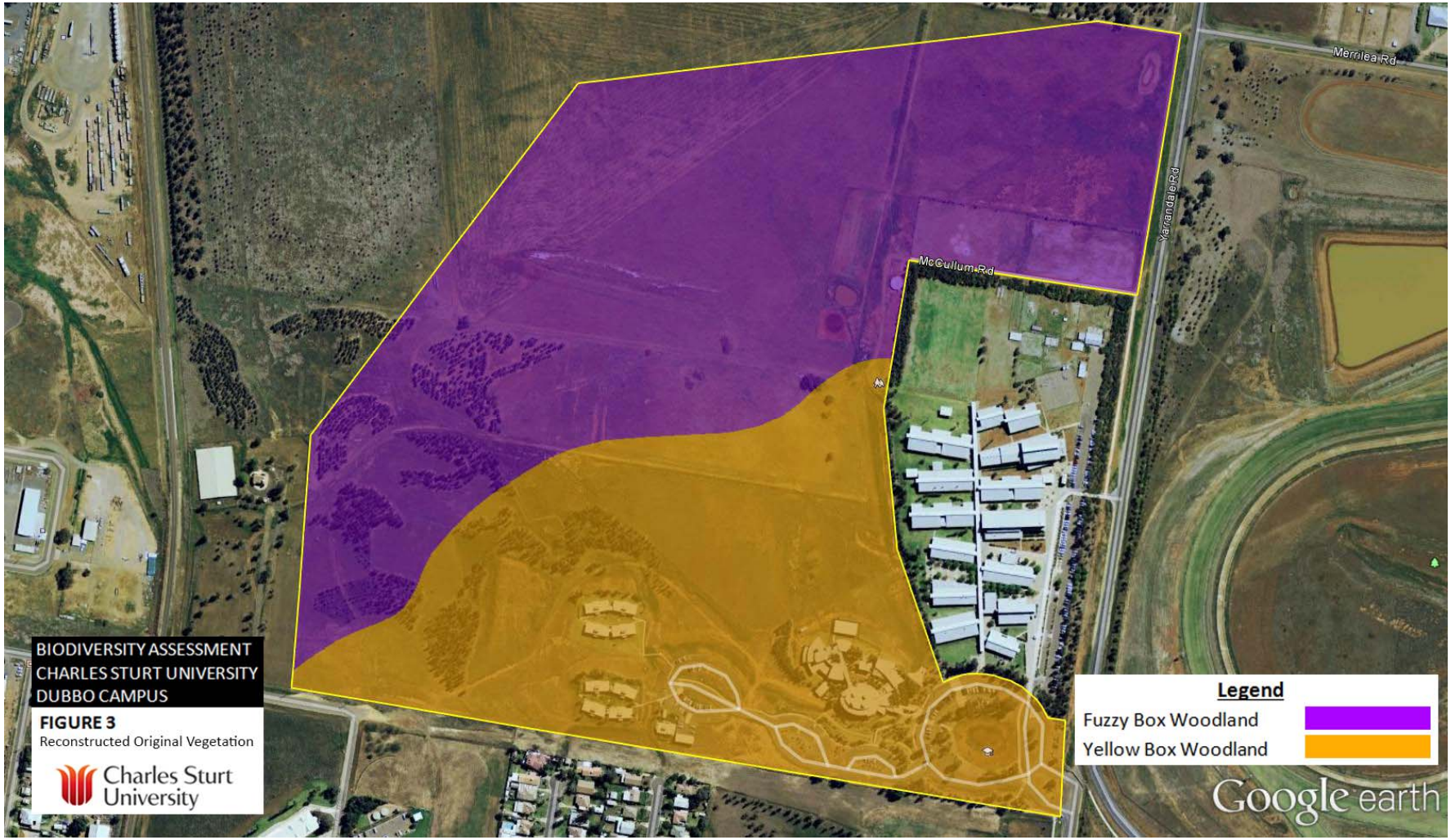
By contrast to the lack of remnant native trees and shrubs, large areas are dominated by native ground covers, mainly grasses (Figure 3). Native grasses occur throughout the property including the cropping and grazing paddocks, mown areas around buildings and car parks, and within and between the planted woodlots (Figure 3).

The Original Vegetation

The few remnant native trees left on the study area are insufficient to allow an accurate reconstruction of the pre European vegetation. However, remnant native trees in the surrounds of the study area strongly suggest that flat northern half was formerly dominated by Fuzzy Box (*Eucalyptus conica*). Mature Fuzzy Box trees are present in the Troy Creek Reserve, on the eastern side of Yarrandale Road opposite the study area and along Purvis Lane. The south eastern half of the study area comprising the Wongarbon Soil Landscape was likely dominated by Yellow Box, although there is no nearby corroboration. However, other areas of the Wongabon Soil Landscape to the south east of Dubbo are dominated by White Box (*Eucalyptus albens*) on the hills with Yellow Box (*Eucalyptus melliodora*) on the lower slopes and gullies. White Cypress Pine (*Callitris glaucophylla*), of which two remnant trees remain (Plate 1), would have been part of these communities.

Plate 1. Remnant White Cypress Pines (nearest and farthest trees)

Figure 3 shows the approximate original distribution of the two vegetation communities on the study area based mainly on topography. A better understanding of soil types would allow more accurate mapping.


Merrilea Rd
Yarrandale Rd
McCullum Rd
BIODIVERSITY ASSESSMENT
CHARLES STURT UNIVERSITY
DUBBO CAMPUS
FIGURE 3
Reconstructed Original Vegetation
Charles Sturt University
Legend
Fuzzy Box Woodland
Yellow Box Woodland
Google earth

The Current Vegetation

Leaving aside the built areas of the campus, three main vegetation types can be distinguished:

1. Planted native woodlots (4 sample sites)
2. Native grassland (1 sample site)
3. Cropping and grazing paddocks (7 sample sites)

The existing vegetation in each of these areas is described in the following sections. In addition a single sample was conducted in the dry pond at the university entrance.

1. Planted woodlots

The south western corner of the study area was planted out with extensive patches of native trees and shrubs in 2001 (Kevin Faulkner, pers. comm.) (Figure 4). The plantings comprise a range of species mostly found through inland NSW, though not necessarily from sites similar to the study area.

Plates 2 & 3. Woodlot plantings showing sparse ground cover below canopy.


Merrilea Rd
Yarrandale Rd
McCullum Rd
Legend
Cropping / Grazing Paddocks
Native Grassland
Planted Woodlots
White Cypress Pine
Pepper Tree
White Cedar
Google earth
BIODIVERSITY ASSESSMENT
CHARLES STURT UNIVERSITY
DUBBO CAMPUS
FIGURE 4
Vegetation
Charles Sturt University

The main tree species in the woodlots include:

- Poplar Box (*Eucalyptus populnea*)
- Red Ironbark (*Eucalyptus sideroxylon*)
- Yellow Box (*Eucalyptus melliodora*)
- Blakely's Red Gum (*Eucalyptus blakelyi*)
- Grey Box (*Eucalyptus microcarpa*)
- Yellow Gum (*Eucalyptus leucoxylon* subsp. *leucoxylon*)

Shrubs are scattered among the trees as individuals and do not form large dense clumps. They include:

- Deane's Wattle (*Acacia deanei*)
- Mallee Honeymyrtle (*Melaleuca acuminata* subsp. *acuminata*
- Hakea Wattle (*Acacia hakeoides*)
- Currawang (*Acacia doratoxylon*)
- Rosy Paperbark (*Melaleuca erubescens*)
- Narrow-leaved Bottlebrush (*Callistemon linearis*)
- Weeping Myall (*Acacia pendula*)
- Myall (*Acacia melvillei*)
- Cootamundra Wattle (*Acaia baileyana*)

The trees in the woodlots are planted more densely than would occur naturally with the result that the ground below is shaded and relatively bare (Plates 2 & 3). The ground cover generally comprises sparse native grasses, low numbers of native herbs and some sparse introduced species. Ground cover density is much higher where there are openings in the tree canopy within the woodlots and in the areas between woodlots. The composition of the ground cover is described below under 'native grassland'.

Plate 4. Native grassland between woodlots.

2. Native grassland

Native grassland occurs in the open spaces between the planted woodlots in the south west corner of the study area (Figure 3). The most prominent grasses are Red Grass (*Bothriochloa decipiens*) and

Couch (*Cynodon dactylon*). Also common are Cotton Panic Grass (*Digitaria brownii*), Umbrella Grass (*Digitaria divaricatissima*), Windmill Grass (*Enteropogon acicularis*) and to a lesser extent Warrego Grass (*Paspalidium jubiflorum*) and Lobed Bluegrass (*Bothriochloa biloba*). Native forbs are generally sparse, the most frequently recorded were Fuzzweed (*Vittadinia cuneata* var. *hirsuta*), a Bluebell (*Wahlenbergia luteola*), Crumbweed (*Dysphania pumilio*), a Bindweed (*Convolvulus angustissimus* subsp. *angustissimus*), Corrugated Sida (*Sida corrugata*) and Tarvine *Boerhavia dominii*). The native shrub Smooth Senna (*Senna barclayana*) is scattered through the area, occasionally in small patches.

Introduced weeds, although not often dominant, are nevertheless common in the openings among the woodlots. The most prominent were Mayne's Pest (*Aristigera glandulifera*), Wild Oats (*Avena sativa*), Twiggy Mullein (*Verbascum virgatum*), Hairy Brassica (*Hirschfeldia incana*), Paterson's Curse (*Echium plantagineum*), Prickly Lettuce (*Lactuca serriola*) and Greater Beggar's Ticks (*Bidens subalternans*).

Plate 5. Native grasses in ungrazed areas between woodlot plantings.

3. Cropping and grazing paddocks.

The open paddocks north of the built areas of the campus and the woodlot plantings are managed by the Dubbo College as part of its rural studies courses. The paddocks are grazed by cattle and/or sheep and may be sown to forage or grain crops. The southern paddocks had been recently sown to oats at the time of the survey and the large paddock with the farm dam appeared to have carried a summer crop that had been harvested or grazed. Seven spot samples were carried out in these paddocks (Appendix 1).

Several occurrences of paddock trees are located in the centre to the west of Dubbo College (Figure 3). Two of the trees are old growth White Cypress Pines that are likely to be remnants of the original vegetation on the study area. The others were likely planted by former land owners and include White Cedar (*Melia azedarach*) and Pepper Tree (*Schinus areira*). A dense concentration of White Cedars and Pepper Trees in the north east corner of the centre paddock is likely to signify the site of a former farmhouse (Figure 3).

In their fallow phases the paddocks carry a similar range of native grasses and weeds as found in the woodlot area with some additional species being prominent. The main native grasses include Red Grass (*Bothriochloa decipiens*), Couch (*Cynodon dactylon*), Warrego Grass (*Paspalidium jubiflorum*)

and Hairy Armgrass (*Urochloa piligera*). Cotton Panic Grass (*Digitaria brownii*) and Umbrella Grass (*Digitaria divaricatissima*) are sporadically common. Frequent introduced grasses include Stinkgrass (*Eragrostis cilianensis*) and Paspalum (*Paspalum dilatatum*).

Native herbs are generally uncommon and sparsely distributed. The most common is Tarvine (*Boerhavia dominii*); less common species include Woodsorrel (*Oxalis perennans*), Pigweed (*Portulaca oleracea*) and Crumbweed (*Dysphania pumilio*). A wide range of introduced weedy herbs occur in the paddocks, particularly members of the daisy family. The most frequent weeds are Mayne's Pest (*Glandularia aristigera*), Caltrop (*Tribulus terrestris*), Greater Beggar's Ticks (*Bidens subalternans*), Saffron Thistle (*Carthamus lanatus*), Flaxleaf Fleabane (*Conyza bonariensis*), Paterson's Curse (*Echium plantagineum*), Hairy Brassica (*Hirschfeldia incana*) and African Peppercress (*Lepidium africanum*).

Plate 6. Sown paddock north of security fence with woodlots behind.

Plate 7. Planted White Cedar trees in grazing paddock.

4. Ephemeral pond

The circular ephemeral pond at the university entrance is a unique environment on the study area. Its excavation has exposed lower layers in the soil profile that have different characteristics to the surrounding surface soils. Additionally, it partially fills in wet periods before drying out again, creating an environment suitable for water plants adapted to ephemeral wetlands. Consequently, a number of flora species found in the pond are absent elsewhere on the study area. The dominant species are the grasses, Couch (*Cynodon dactylon*), Red Grass (*Bothriochloa decipiens*), Queensland Blue Grass (*Dichanthium sericeum*) and Paspalum (*Paspalum dilatatum*), which also occur elsewhere on the study area. However, unique to the pond were the grasses Native Millet (*Panicum decompositum*), Clustered Lovegrass (*Eragrostis elongata*), Awnless Barnyard Grass (*Echinochloa colona*) and Kangaroo Grass (*Themeda australis*). Wet habitat species in the pond included Lesser Joyweed (*Alternanthera denticulata*), Noogoora Burr (*Xanthium occidentale*), Tall Sedge (*Carex appressa*), Umbrella Sedge (*Cyperus eragrostis*), Triangular Sedge (*Schoenoplectus mucronatus*) and the rush, *Juncus subglaucus*.

Noxious and Nationally Significant Weeds

Weeds declared as Noxious in the Dubbo City Council area under the NSW *Noxious Weeds Act 1993* (DPI, 2013) and/or are listed as Weeds of National Significance that were found on the study area are listed in Table 5. Weeds of National Significance are declared by the Australian Weeds Committee of the Commonwealth Government (www.weeds.org.au).

Table 5
Noxious Weeds and Weeds of National Significance

Common Name	Scientific Name	Noxious Class in NSW	Weed of National Significance
African Boxthorn	*Lycium ferocissimum*	4	✓
Bathurst Burr	*Xanthium spinosum*	4	
Blue Heliotrope	*Heliotropium amplexicaule*	4	
Noogoora Burr	*Xanthium occidentale*	4	
Silverleaf Nightshade	*Solanum elaeagnifolium*	4	✓

NSW Noxious Weed Class 4: The growth of the plant must be managed in a manner that reduces its numbers, spread and incidence and continuously inhibits its reproduction and the plant must not be knowingly sold or distributed.

All species listed in Table 5 occurred in very low numbers (Appendix 1) indicating they are not serious problems on the study area. All are categorised as Class 4, which requires action to inhibit their reproduction, and reduce their numbers, spread and incidence. Comments on the status of each noxious weed species are given below.

African Boxthorn

African Boxthorn was recorded at only one location; near the gate from the grazing paddocks into the woodlot area north of the security fence.

Bathurst Burr

Bathurst Burr was recorded at five sample sites (Appendix 1) in low numbers, either as uncommon or rare. Two recordings were in the woodlot area and the other three were in the grazing paddocks. It is noteworthy that Bathurst Burr was only recorded on uncultivated sites, indicating that periodic cultivation is an effective control on the study area. Supplementary spraying may be required to remove it from uncultivated sites such as fencelines, woodlots and the spoil mound in the grazing paddock west of the small dam.

Blue Heliotrope

Blue Heliotrope was recorded as sporadically present at one site in the woodlot area, one in a grazing paddock (site 11) and on the large mound of spoil between the new dentistry building and the student residences.

Noogoora Burr

Noogoora Burr was rare on the study area being observed only in the dry pond near the university entrance. Noogoora Burr favours ephemerally wet areas and germinates and grows when the pond dries out after partially filling.

Silverleaf Nightshade

Silverleaf Nightshade was recorded sparingly at two sites in the woodlots and two sites in the grazing paddocks, mostly south of the security fence. Although it has potential to form large dense infestations, this does not appear to be the case on the study area.

FAUNA

Birds

A total of 35 bird species was recorded in this survey on CSU land of which 34 are native and one is introduced (Appendix 2). Three of the recorded species, the Straw-necked Ibis, Little Pied Cormorant and the Nankeen Kestrel were flying over the property rather than actively utilising it. The sulphur-crested Cockatoo and Barn Owl were reported by CSU staff. One waterbird, the Australasian Grebe was observed on the small farm dam. The Boobook Owl was detected during spot-lighting at night for nocturnal mammals. Few birds were observed in the open grazing paddocks and only one species was restricted to them, Richards Pipit. Most species were observed in the planted woodlots and the plantings around the main building and car parks. The continuous tree cover of the woodlots and the scattered shrubs provide habitat for a range of small birds including Weebills, Thornbills, Gerygones, Fairy-wrens, Honeyeaters, Fantails, Pardalotes and Robins. The Yellow-rumped Thornbill and Double-barred Finches forage on the ground amongst the native grasses. These small birds were foraging in multi-species flocks at the time of the survey. More wide-ranging species include the larger Galahs, Crested Pigeons, Pee Wees, Magpies, Red-rumped Parrots, Rosellas, Pied Butcher-bird, Pied Currawong and Little Crow.

Some of the birds observed in this survey can be considered year round residents of the study area, although many are likely to range more widely with the study area being part of their home range.

Mammals, Reptiles and Frogs

The mammals, reptiles and frogs observed in the survey are listed in Table 6. One native mammal was recorded during the survey. A mob of approximately 10 Eastern Grey Kangaroos (*Macropus giganteus*) was observed in the woodlots on several occasions. Spot-lighting throughout the property and in the adjoining reserve on the northern boundary failed to reveal any nocturnal mammal species. Two introduced mammals were recorded in this survey, the House Cat and European Hare (Table 6), while the Red Fox was reported as occurring by CSU staff. The weather during the survey period was too cold for significant reptile activity, although one lizard was seen but could not be identified.

Good rainfall in the first quarter of 2013 filled the farm dam in the grazing paddock west of Dubbo College, and pools in the watercourse in the reserve north of the study area. However, at the time of the survey there had been no substantial rainfall for over five weeks and conditions were not highly favourable for frog activity. Only one species of frog was calling during the survey; the Beeping Froglet (*Crinia parinsignifera*), which was common in the reserve, but called infrequently in the farm dam.

Table 6
Mammals, Reptiles and Frogs Recorded on CSU land

Scientific Name	Common Name	Comment
MAMMALIA - Marsupialia/Diprotodontia		
Macropodidae		
Macropus giganteus	Eastern Grey Kangaroo	A mob trapped within the security fence.
Eutheria/Carnivora		
Canidae		
**Vulpes Vulpes*	Red Fox	Reported by CSU staff
Felidae		
**Felis catus*	House Cat	One seen in the survey; reported as common by CSU staff.
Eutheria/Lagomorpha		
Leporidae		
**Lepus timidus*	European Hare	Several observations.
AMPHIBIA - Anura		
Myobatrachidae		
Crinia parinsignifera	Beeping Froglet	One observed in the farm dam; common in the reserve on the northern boundary
REPTILIA - Squamata		
Elapidae		
Pseudonaja textilis	Eastern Brown Snake	Reported by CSU staff

* Introduced species

Habitat Trees

No trees with hollows suitable for nesting or denning by wildlife are present on the study area. Although there are many trees in the woodlot plantings and around the main building and car parks, all are 12 years old or less and too young to have developed wildlife hollows. Eucalypts generally do not begin to form wildlife hollows until they are 80 or more years old.

Pest Animals

Two pest animals that occur on CSU Dubbo land, the House Cat and Red Fox are listed as Key Threatening Processes under the TSC Act. Key Threatening Processes are agents that adversely affect threatened species, populations or ecological communities or have potential to cause species, populations or ecological communities that are not threatened to become threatened. There is no requirement for landholders to control these pest species, if there is no direct threat to threatened species, populations or ecological communities. However, House Cats and Red Foxes on CSU land pose a threat to wildlife attracted to the woodlots and other plantings on the property. Consequently, it is recommended that CSU participates in regional control programs for the Red Fox to minimise harm to local biodiversity.

THREATENED BIODIVERSITY

Threatened Flora Species

One threatened flora species was identified by the survey, Lobed Bluegrass (*Bothriochloa biloba*), which is listed as Vulnerable under the EPBC Act. None of the other four species listed in Table 1 as potentially formerly occurring on the study area was found. Nor were any species identified that are listed as Rare or Poorly Known in *Rare or Threatened Australian Plants* (ROTAP) (Briggs and Leigh, 1995).

Table 7
Threatened Flora Species for Impact Assessment.

Scientific Name	Common Name	Description
Bothriochloa biloba	Lobed Bluegrass	Lobed Bluegrass is a tall (to 1.5 m) tussock grass that is taller and more robust that the related Red Grass (*Bothriochloa decipiens*) with which it often occurs. It favours heavy-textured soils such as brown or black clays (SEWPaC, 2013b). It occurred on three sites on the study area, two in the woodlots and on the ephemeral pond near the university entrance. It has a wide distribution from the Darling Downs in Queensland down the NSW north western slopes to Dubbo and the upper Hunter Valley (SEWPaC, 2013b).
Diuris tricolor	Pine Donkey Orchid	A terrestrial orchid with 1 to 3 leaves, to 30 cm long and 4mm wide. The 20-40 cm high flower stalk has 2-6 flowers, which are bright yellow to orange, speckled with purple and white markings (OEH, 2013a). Sporadically distributed on the western slopes of NSW, from south of Narrandera to northern NSW and extending into the Upper Hunter Valley (OEH, 2013a). Occurs in Box-Gum Woodlands and White Cypress Pine forests.
Swainsona recta	Small Purple-pea	Small Purple-pea is a slender, erect perennial herb growing to 30 cm tall. The leaves are divided into up to six pairs of 10 mm long, very narrow leaflets, each with a pointed tip. There is also a single leaflet at the end of each divided leaf. It bears one to several sprays of between 10 and 20 purple, pea-shaped flowers, between late September and early December (OEH, 2013a).
Swainsona sericea	Silky Swainson-pea	Silky Swainson-pea is a prostrate or low growing herb to 10 cm high. Plants are densely hairy, including the 2 to 7 cm long leaves with 5 to 13 leaflets. It has upright racemes of 2 to 8 purple pea flowers (OEH, 2013a).
Prasophyllum sp. Wybong	Wybong Leek Orchid	Prasophyllum sp. Wybong is a terrestrial orchid that grows to approximately 30 cm high. It has a single, tubular, fleshy, dull-green leaf and a single flower spike with numerous fragrant flowers (SEWPaC, 2013b). It is known from seven populations in open eucalypt woodland and grassland in New South Wales. The species' area of occupancy is estimated to be 1.5 km^2 with an estimated population size based on surveys in 2006 of 460 mature individuals. It is known to occur in Box-Gum woodland.

The assessment section below considers the impact of potential future campus development on Lobed Bluegrass. Although none of the threatened species listed in Table 1 was found by the survey, there is a possibility that small residual populations of one or more of them may have been overlooked, since some are small inconspicuous species when not in flower. Consequently, four herbaceous species, Small Purple-pea, Silky Swainson-Pea, Pine Donkey Orchid and *Prasophyllum* sp. Wybong are also subjected to impact assessments below. Brief descriptions of these species are given in Table 7.

Threatened Ecological Communities (TEC)

The composition of the original vegetation communities on the study area is uncertain. However, it is likely to have included two TECs (Figure 3), viz.

- *White Box Yellow Box Blakely's Red Gum Woodland Endangered Ecological Community* (TSC Act), which is equivalent to the *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland Critically Endangered Ecological Community* (EPBC Act) (commonly known as Box-Gum Woodlands).
- *Fuzzy Box Woodland on alluvial soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions Endangered Ecological Community* (TSC Act).

In any event, there are no remaining natural remnants of either TEC on the study area. The site has lost all of its original tree cover, apart from two White Cypress Pines, all of its original shrub cover, except for a few Smooth Sennas and almost all of its original ground cover, except for some grazing tolerant grasses and a few resilient herbs. In short, almost all of the original biodiversity has disappeared and is no longer capable of natural regeneration. Consequently, future developments on the site would not affect a TEC. Accordingly, no assessment of impact for any future projects on TECs is required.

Threatened Fauna Species

No threatened fauna species was found by the survey.

The fauna survey techniques were not designed to detect all potential threatened species, particularly bats. Rather, owing to the highly modified nature of the study area, the approach taken was to assess the value of the habitats on the study area for threatened fauna. The natural values of the study area are highly degraded as a result of past land use practices. The following list summarises key wildlife habitat values that have been lost:

- The original tree layer is absent
- There is no native shrub layer
- Native ground cover forbs have been largely eliminated
- There are no large fallen trees, hollow logs or branches on the ground
- There are no old growth eucalypt trees with hollow limbs

These factors indicate that the habitat is unsuitable for native fauna that require:

- A continuous or semi-continuous mature native tree canopy
- Relatively large natural areas to maintain viable population sizes
- Natural shrub and ground cover vegetation layers
- Ground debris including logs, branches and leaf litter

- Tree hollows for nesting and denning

Other site characteristics that operate against most wildlife are:

- High levels of human activity
- Intensive grazing and cropping of paddocks
- The presence of domestic cats due to the proximity of the Dubbo urban area.
- The presence of red foxes

Factors suitable for some wildlife on the study area include:

- Planted woodlots of eucalypt trees
- Open spaces suitable for foraging by large birds of prey

The above considerations can be applied to the threatened species listed in Table 2 that are considered to have low, moderate or high probabilities of utilising the study area in order to determine whether suitable habitat critical to the survival of local populations exists there. This analysis, given in Table 8, shows that for all threatened fauna species, one or more critical habitat requirements are missing from the study area. Consequently, some of the threatened fauna species in Table 8 are considered unlikely to ever occur on the study area and are not considered further in this report. Owing to a lack of suitable habitat resources, especially remnant woodland containing old growth trees that are big enough to support large nests or to have hollow limbs, it is considered that no threatened species can breed on the study area or establish permanent populations there. At best up to ten of the threatened species may occasionally be able to utilise the study area to forage for food. However, in all cases the study area would only provide a limited portion of their food requirements and would be a small part of a much larger foraging area.

The impact of potential development on part of the study area on these species is considered below in the assessment sections of this report.

Table 8
Analysis of Habitat Suitability of the Study Area for Threatened Fauna Species.
(X = factor missing or unsuitable, ✓ = factor present, NA = not applicable)

Species	Factor				Special Requirements	Comments	Habitat Suitable?
	Shrub Layer	Ground Cover	Tree Canopy	Hollows			
Magpie Goose	NA	NA	NA	NA	Associated mainly with wetlands, dry ephemeral swamps, wet grasslands and floodplains, may occasionally graze in farm paddocks near areas of core habitat.	Habitat on the lower parts of the study area may be suitable for Magpie Geese in very wet seasons. However, at such times better habitat would be widely available elsewhere. Core habitat for Magpie Geese is absent locally.	Foraging only
Spotted Harrier	NA	✓	NA	NA	Native grassland. Nesting trees.	Spotted Harriers prefer to forage over extensive native grasslands which are absent from the study area. Nest sites absent.	No
Little Eagle	NA	✓	X	NA	Tall trees as lookouts. Woodland for nesting.	Could forage over the CSU grazing paddocks. Nesting trees absent.	Foraging only
Black Falcon	X	NA	✓	NA	Sparsely wooded country near water. Old nests of other birds, usually hawks or crows.	Woodlots are likely to be too dense for this species. Nest sites absent.	No
Little Lorikeet	NA	NA	✓	✓	Requires flowering eucalypts for feeding and tree hollows near water for nesting.	There are no old growth trees capable of producing large nectar flows. However, many of the younger planted trees are starting to flower and would be attractive to Lorikeets at the right time of year, especially Yellow Box and Red Ironbark. Nesting trees absent.	Foraging only
Swift Parrot	NA	NA	✓	NA	Requires winter flowering eucalypts	Migratory species, a favoured food tree in the NSW Central West, Red Ironbark, is planted in small numbers on the study area.	Foraging only
Superb Parrot	NA	✓	✓	X	Forages on ground mainly, also seeding Acacias	Nests in high tree hollows.	Foraging only
Barking Owl	NA	NA	✓	X	Need open spout-like hollows in woodland for nesting.	Could potentially nest elsewhere in the district and forage in the study area.	Foraging only
Regent Honeyeater	NA	NA	✓	NA	Flowering eucalypts	Nomadic, feeds mainly on nectar	Foraging only
Diamond Firetail	X	✓	✓	NA	Native grass seed in open grassy woodlands.	Sedentary species requiring dense shrubs for nesting and roosting.	No
Grey-headed Flying Fox	NA	NA	X	NA	Feeds on eucalypt nectar and succulent fruits.	May be attracted to flowering eucalypts in the Dubbo area when poor feeding conditions occur on the coast.	Foraging only

Species	Factor				Special Requirements	Comments	Habitat Suitable?
	Shrub Layer	Ground Cover	Tree Canopy	Hollows			
Yellow-bellied Sheathtail Bat	NA	NA	✓	X	Requires tree hollows for nesting.	Forages over woodland and open ground.	Foraging only
Little Pied Bat	NA	NA	✓	X	Requires tree hollows, caves, mine shafts, tunnels, open buildings for nesting. Forages mainly in various kinds of woodlands and forests.	Nesting habitat is lacking on the study area. It may forage in the woodlots.	Foraging only.

AREAS IMPORTANT FOR BIODIVERSITY

The most important biodiversity elements on the CSU Dubbo campus are the planted woodlots. Biodiversity value also exists in the native tree and shrub plantings around the main building and car parks. The plantings have allowed forest and woodland dependent bird species to recolonise parts of the campus. As these plantings grow and mature their value for wildlife will increase. As tree size increases, increasing limb sizes would be able to support the nests of larger birds, eventually including birds of prey. With further ageing some of the larger limbs may break off in storms allowing the entry of wood-rotting pathogens resulting in the development of hollows that can be utilised by wildlife for breeding or shelter. The woodlot plantings should be supplemented with new plantings of native trees and shrubs to increase habitat area, habitat diversity and tree ages. It will be valuable to extend and link these plantings in a wider network across the property.

ENVIRONMENTAL ISSUES

Owing to the gentle terrain, there are no major soil stability problems. Also, the pastures are not over grazed and noxious weeds are not prominent.

The main environmental issues are;

- Salinisation
- Noxious animal control
- Noxious weeds

Salinisation

Salinity is reported to be increasing in the surface soils in the paddocks adjacent to Yarrandale Road (Kevin Faulkner, pers. comm.). Some plantings of native trees have been made along the paddock fence lines in this area, although it is not known if these were specifically designed to address the salinity issue. In any event, it appears that rising water tables may be bringing salt to the surface. Additional plantings of deep rooted trees and shrubs may be advisable to lower the water table in this area.

Noxious animal control

Red Foxes are reported to occur on CSU land. The Red Fox is not only a threat to young lambs, but a major threat to wildlife. It is likely that foxes are having a significant impact on birds and other fauna attracted to the native woodlots. Conversely, foxes are also likely to be controlling hares, rabbits, rats and mice. Nevertheless, it is recommended that the university participates in fox control programs organised by the Rural Lands Protection Board, if it is not already doing so.

Noxious weed control

Noxious weeds are present on the study area in only low numbers and do not warrant an urgent control program. They should be monitored and action taken if any significant change is noted.

RECOMMENDATIONS FOR BIODIVERSITY ENHANCEMENT

Principles

The following guidelines for revegetation were developed for the farmed areas of the CSU Orange campus in the 'College Farm Property Plan' developed in 1996. The guiding objectives of the plan were;

- Reduction in surface wind speeds, to benefit livestock and plants,
- increased water use, reducing areas subject to waterlogging, and reducing the rate of soil salinisation and acidification,
- reduction in soil movement,
- increased diversity of native wildlife species,
- provision of habitat for beneficial animals such as pest controllers,
- reduction in the abundance of introduced pest species, and
- the movement of wildlife through the property from nearby bush remnants.

The plan also included a set of revegetation policies;

- Ecological and biophysical outcomes take precedence over tradition and appearance,
- all plantings should be of native species, local species used wherever possible,
- shrubs and ground cover should be introduced, in addition to trees,
- regeneration should be encouraged by fencing off good stands of existing native vegetation,
- direct seeding should be used, where possible, using seeds gathered locally,
- revegetation objectives should be included in the monitoring system for the College Farm, and
- establishment and maintenance should be consistent with the requirements of native vegetation (e.g. no fertiliser).

These objectives and strategies are largely applicable to the study area, although not all are relevant.

Biodiversity Recommendations

The following recommendations are intended to achieve the above objectives while securing useful biodiversity outcomes.

Woodlot plantings

The existing woodlot plantings are well designed and have a generally appropriate mix of species, even though some species are unlikely to have originally occurred on the site. The value of the woodlots could be enhanced by supplementing them with a range of local shrub species to increase habitat diversity and by linking them with corridors of trees and shrubs to other native vegetation remnants and plantings nearby.

It is recommended that:

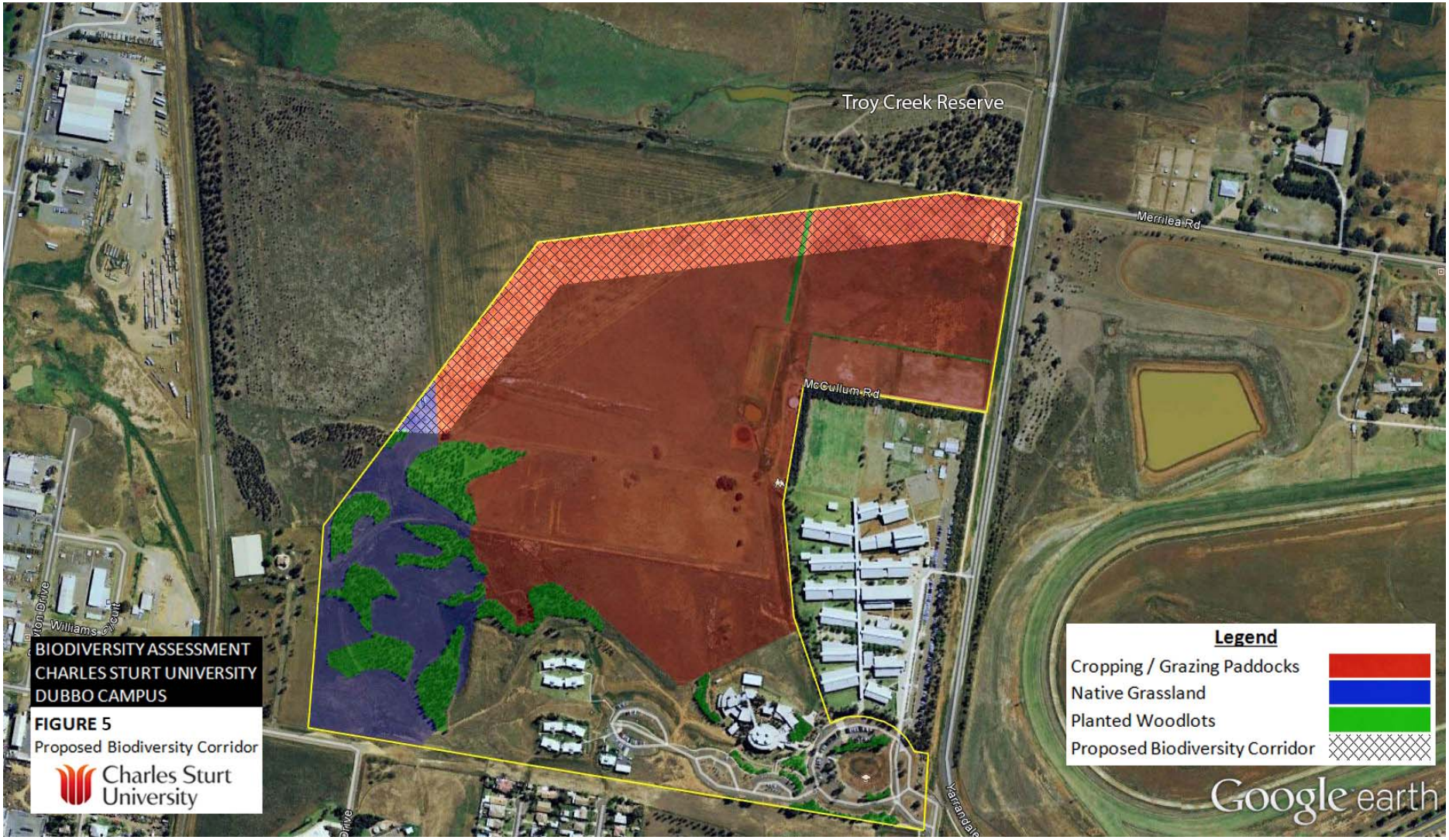
- Openings in the existing woodlots should be filled with plantings of local shrub species. Appendix 3 presents a list of flora species that are likely to have occurred on the CSU Dubbo property prior to white settlement.

- Woodlot plantings should be inter-planted with patches of local shrubs in a mosaic that includes open areas left as grassland.

- The woodlot / shrub / grassland mosaic should be extended in a 50 m wide corridor along the western and northern boundaries of the property to link with the Troy Creek Reserve opposite Merrilea Road (Figure 5). This corridor would revegetate low lying areas that were originally Fuzzy Box Woodland (Figure 3). It would be an excellent conservation initiative to recreate Fuzzy Box Woodland, an Endangered Ecological Community, in this corridor. Appendix 4 is an Office of Environment and Heritage information sheet on Fuzzy Box Woodland, including lists of the characteristic species of the community.

- Consideration should also be given to further plantings around the Yarrandale Road paddock boundaries for salinity control.

- A control program for the Red Fox should be implemented in cooperation with the Rural Lands Protection Board and adjoining landholders, if appropriate.


Troy Creek Reserve
Merrilea Rd
McCullum Rd
Williams Croft
Yarrandale
Legend
Cropping / Grazing Paddocks
Native Grassland
Planted Woodlots
Proposed Biodiversity Corridor
Google earth
BIODIVERSITY ASSESSMENT
CHARLES STURT UNIVERSITY
DUBBO CAMPUS
FIGURE 5
Proposed Biodiversity Corridor
Charles Sturt University

IMPACT ASSESSMENT

This section provides an assessment of the impacts of potential future development of the CSU Dubbo campus on flora and fauna based on the preceding survey findings and analysis. The assessment meets the requirements of Section 5A of the NSW *Environmental Planning and Assessment Act (1979)* (EP&A Act) and the Commonwealth EPBC Act.

The likelihood of development significantly affecting the five flora species in Table 7 and the 10 fauna species in Table 8 or their habitats is assessed below in accordance with the seven factors of assessment (Seven Part Tests of Significance) set out in the *Threatened Species Assessment Guidelines: The Assessment of Significance* (DECC, 2007) which are:

(a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the lifecycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

(b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the lifecycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

(c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

- ***(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or***
- ***(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.***

(d) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

(e) In relation to the habitat of a threatened species, population or ecological community:

- ***(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed;***
- ***(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and***
- ***(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.***

(f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

(g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

However, in the case of Lobed Bluegrass, which is listed only under the EPBC Act, the assessment is conducted using the EPBC Act Significant Impact Criteria for Vulnerable species (SEWPaC, 2013c), which are:

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- ***lead to a long-term decrease in the size of an important population of a species***
- ***reduce the area of occupancy of an important population***
- ***fragment an existing important population into two or more populations***

- ***adversely affect habitat critical to the survival of a species***
- ***disrupt the breeding cycle of an important population***
- ***modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline***
- ***result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat***
- ***introduce disease that may cause the species to decline, or***
- ***interfere substantially with the recovery of the species.***

ASSESSMENTS OF SIGNIFICANCE

FLORA

Two assessments are presented for flora; the first is for Lobed Bluegrass (*Bothriochloa biloba*), which was found at three locations by the survey. The second is for Pine Donkey Orchid (*Diuris tricolor*), Small Purple-pea (*Swainsona recta*), Silky Swainson-pea (*Swainsona sericea*) and the Wybong Leek Orchid (*Prasophyllum* sp. Wybong) which were not detected by the survey, but were assessed above as having potentially occurred on the study area prior to European settlement.

Lobed Bluegrass (*Bothriochloa biloba*)

Lobed Bluegrass is listed as Vulnerable under the Commonwealth EPBC Act. It was formerly also listed under the NSW TSC Act, but was delisted following a re-appraisal of its distribution and abundance in NSW (NSW Scientific Committee, 2004). Lobed Bluegrass is assessed below using the EPBC Act Significant Impact Criteria for Vulnerable species. The criteria refer to 'important' populations of the species which are defined as populations necessary for a species' long term survival and recovery. The occurrences of Lobed Bluegrass in the Dubbo region have importance because they are near the south western limits of its natural range. However, the part of the population on CSU land is small, isolated and may not be viable in the long term. There are estimated to be no more than 100 plants on the study area, which contrasts with many populations seen by the author in the Denman area that number in the tens of thousands or millions of plants.

Factors of Assessment

Would a future development lead to a long-term decrease in the size of an important population of a species?

Lobed Bluegrass was recorded at spot sample sites 5, 7 and 10 (Figure 2). Sites 5 and 7 are in the planted woodlot area north of the security fence and 10 is around the ephemeral pond at the university entrance. Future developments are unlikely to occur in these areas. In addition, these locations and the records of Lobed Bluegrass in BioNet (2013) suggest it is relatively widespread in the Dubbo area, especially on the Wongarbon Soil Landscape. Consequently, it is unlikely that a building development on CSU Dubbo land would place either the whole Dubbo region population at risk, or that part of it on the CSU campus. That is, likely future developments on the CSU Dubbo campus would not reduce the size of known populations of the Lobed Bluegrass.

Would a future development reduce the area of occupancy of an important population?

The population on CSU Dubbo land is not considered to be an 'important' population, given its small size, fragmentation and isolation from other known occurrences of the species. In any event, it is unlikely that future developments would impact on these occurrences which are on parts of the campus that are unlikely to be developed in the near future. Accordingly, developments that are likely to take place in the foreseeable future would not reduce the known area of occupancy of the population.

Would a future development fragment an existing important population into two or more populations?

There is already a high degree of fragmentation of the Lobed Bluegrass population in the Dubbo area. The population is naturally fragmented by the patchy distribution of the clay soils associated with the Wongarbon Soil Landscape. It is further fragmented by the existing Dubbo urban area; the CSU part of the population is on the northern side of Dubbo, while many of the records in BioNet (2013) are south of Dubbo. In addition, the CSU campus population is itself divided by campus infrastructure between the plants at the university entrance and those in the northern part of the woodlots. Future developments on the Dubbo campus may result in a small increase in the existing fragmentation of this population.

Would a future development adversely affect habitat critical to the survival of a species?

Critical habitat, as defined by the EPBC Act, has not been declared for the Lobed Bluegrass on the the Commonwealth Register of Critical Habitat (SEWPaC, 2013d) anywhere in the species distribution.

Would a future development disrupt the breeding cycle of an important population?

Lobed Bluegrass is wind-pollinated and not dependent on insects or other biotic agents for pollination. Future developments are unlikely to affect wind pollination of the population on CSU land.

Would a future development modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

Potential habitat for Lobed Bluegrass on the study area includes all areas of the Wongarbon Soil Landscape. The current known occurrences of Lobed Bluegrass occupy only a small part of the habitat potentially available. Consequently, it is possible that future developments would reduce the potential habitat available. However, given that the likely locations of future developments on the Dubbo campus would not interfere with Lobed Bluegrass occurrences north of the security fence, they are unlikely to cause a decline of the species on the study area.

Would a future development result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?

Competition from exotic grass species, such as Coolatai Grass, African Lovegrass, Paspalum, Guinea Grass, Feathertop and Johnson Grass, is recognised as a threat to Lobed Bluegrass (SEWPaC, 2013b). Soil disturbance associated with a new development may facilitate the invasion of the site by exotic grasses such as Coolatai Grass or African Lovegrass. However, it is unlikely that developments would occur on the sites of the known populations of Lobed Bluegrass. Consequently, the threat of invasive grasses would be avoided.

Would a future development introduce disease that may cause the species to decline?

The disease status and susceptibility to diseases of Lobed Bluegrass is unknown. However, no diseases have been reported with potential to harm Lobed Bluegrass to the extent that it would decline significantly (SEWPaC, 2013b).

Would a future development interfere substantially with the recovery of the species?

There is no recovery plan for Lobed Bluegrass and no populations in NSW appear to be the subject of specific recovery actions, including any in the Dubbo region. Accordingly, developments on the CSU Dubbo campus would not interfere with recovery actions for this species.

Conclusion.

It is concluded that future developments on the CSU Dubbo campus are unlikely to impact adversely on the known populations of the Lobed Bluegrass on the study area, provided they do not occur in the planted woodlot area north of the security fence, or in the ephemeral pond at the university entrance. Accordingly, there would be no requirement to refer a development to SEWPaC on account of Lobed Bluegrass.

Other Threatened Flora

***Diuris tricolor* (Pine Donkey Orchid)**
***Swainsona recta* (Small Purple-pea)**
***Swainsona sericea* (Silky Swainson-pea),**
***Prasophyllum* sp. Wybong (Wybong Leek Orchid)**

The above four threatened flora species that are likely to have occurred on the study area prior to European settlement are considered together here. All are small perennial herbaceous species (Table 7) and none were observed during the survey. All are also highly intolerant of disturbance to the natural communities in which they occur. They are likely to succumb to cultivation, competition from exotic grasses and are also likely to be intolerant of intensive grazing by introduced herbivores, especially sheep and rabbits. The apparent absence of these species from the study area and their rarity in the wider region is attributable to a long history of habitat disturbance and grazing by introduced mammals.

Since all four species are listed under the TSC Act, they are assessed here using Seven Part Tests of Significance as per DECC (2007). Seven Part Tests cover off the same issues as the EPBC Act Significant Impact Criteria.

Factors of Assessment

(a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Future developments on the CSU Dubbo campus would involve removal of vegetation and earth works for new buildings, roads and car parks. Such activities would result in the death and permanent loss of individual plants of the Pine Donkey Orchid, Small Purple-pea, Silky Swainson-pea and Wybong Leek Orchid, if they were present on the site, and would have the potential to place local populations at risk of extinction. However, no populations were found by the survey and it is

considered highly unlikely that these species occur anywhere on CSU land owing to the long history of agriculture and grazing on the site.

(b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable. As at May 2013, no Endangered Populations have been declared for any of these species in the Central West CMA area or elsewhere (NSW Scientific Committee, 2013).

(c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

***(ii) is likely to substantially and adversely modify the composition of the ecological* community such that its local occurrence is likely to be placed at risk of extinction,**

Not applicable.

(d) In relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

As indicated above, future development projects on the CSU Dubbo campus would have potential to remove, modify, fragment and isolate habitat for the Pine Donkey Orchid, Small Purple-pea, Silky Swainson-pea and Wybong Leek Orchid, if they were present on the site. However, it is clear that considerable habitat modification has occurred in the past on the built parts of the campus such that habitat for these species has likely been eliminated over those areas. The remainder of the study area has been affected by cultivation, weed invasion and heavy grazing. There is no indication that these species could have survived on CSU land. Consequently, it is considered highly unlikely that future developments on the Dubbo campus would result in the loss, modification, fragmentation or isolation of habitat of the Pine Donkey Orchid, Small Purple-pea, Silky Swainson-pea and Wybong Leek Orchid.

(e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

Critical habitat, as defined by the TSC Act or the EPBC Act, has not been declared for the Pine Donkey Orchid, Small Purple-pea, Silky Swainson-pea and Wybong Leek Orchid on the NSW Critical Habitat register (OEH, 2013b) or the Commonwealth Register of Critical Habitat (SEWPaC, 2013d) in the study area or surrounds.

(f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No recovery plans exist for the Pine Donkey Orchid, Small Purple-pea, Silky Swainson-pea or Wybong Leek Orchid. Recovery actions are listed in their profiles on the threatened species pages of the NSW OEH website (OEH, 2013).

All recovery actions in the profiles refer to the protection and management of known populations of the species. Since no populations of Pine Donkey Orchid, Small Purple-pea, Silky Swainson-pea or Wybong Leek Orchid are known or likely to occur on the CSU Dubbo campus, the recovery actions are not relevant to future developments on the campus.

(g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Key Threatening Processes that may be relevant to future developments on the CSU Dubbo campus include:

- Clearing of native vegetation, and
- Invasion of native plant communities by exotic perennial grasses
- Competition and grazing by the feral European rabbit (*Oryctolagus cuniculus*)

However, these actions would not threaten the Pine Donkey Orchid, Small Purple-pea, Silky Swainson-pea and Wybong Leek Orchid, since no populations of these species are known or likely to occur on the study area.

Conclusion.

It is concluded that future developments on the CSU Dubbo campus would not adversely affect populations of the Pine Donkey Orchid, Small Purple-pea, Silky Swainson-pea and Wybong Leek Orchid since and no populations are known to occur on CSU land and the species have likely been eliminated by past disturbance.

EPBC Act

One of the above species, Small Purple-pea is listed as Endangered under the EPBC Act. The above analysis indicates that any future development projects on the CSU Dubbo campus are highly unlikely to impact on natural populations of this species. Consequently, there is no requirement to refer such projects to SEWPaC on account of the Small Purple-pea.

FAUNA

In this section 10 species of threatened fauna that may temporarily utilise food sources on the study area (Table 8) are subjected to a Seven Part Test of Significance. The above analysis of the value of the habitats on the study area for fauna concluded that none of the threatened fauna species have potential to breed in the study area. The Little Eagle and Barking Owl may potentially hunt for prey over the grazing paddocks and other open spaces, and the Magpie Goose may potentially, albeit rarely, graze in the paddocks. Several species may potentially utilise planted eucalypt trees for food including nectar or insects; Little Lorikeet, Swift Parrot, Regent Honeyeater and Grey-headed Flying Fox. Superb Parrots may forage for seeds or insects on the ground. The Yellow-bellied Sheathtail Bat and Little Pied Bat may forage aerially for insects over the tree canopy. The ten species are assessed together using Seven Part Tests of Significance as per DECC (2007).

Factors of Assessment

(a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

The ten threatened fauna species have potential to forage on CSU land, but are unlikely to breed there. The main potential impact of a future building project on visiting threatened fauna may be a reduction in available food resources. The main potential food resources that may be affected are nectar from flowering eucalypts, prey such as mice and rabbits from open space or grazing paddocks and seeds from native grasses. However, no individuals of these species would be able to glean all their food requirements from the study area which lacks the size and diversity to support any of the species all year round. Consequently, visits to the area would be temporary and confined to limited periods when food resources are available, e.g. during a mouse plague, or when eucalypts are flowering.

Since none of the migratory or nomadic species is known or likely to depend on the study area for maintaining an existing viable population, it is highly unlikely that a future development could put such a population at risk. Rather, the study area would most likely function as a minor occasional supplementary source of food. While this is obviously useful, it is not likely to be critical to the survival of populations of these species, which depend on the availability of food over a wide area. Local populations of such migratory and nomadic species may encompass very large areas. Their success is often more dependent on climatic conditions than the availability of resources at a point source.

(b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable. As at May 2013, no Endangered Populations have been declared for any of these species in the Central West CMA area (NSW Scientific Committee, 2013).

(c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

***(ii) is likely to substantially and adversely modify the composition of the ecological* community such that its local occurrence is likely to be placed at risk of extinction,**

Not applicable.

(d) In relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

Areas potentially available for development at CSU Dubbo are confined to the vicinity of the existing infrastructure in the south of the study area. This area lacks high quality native bushland or prime

breeding habitat for the 10 threatened fauna species. Consequently, future development near the existing infrastructure would not remove, modify, fragment or isolate any habitat important to the long term survival of the subject species.

(e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

Critical habitat, as defined by the TSC Act or the EPBC Act, has not been declared for any of the subject species on the NSW Critical Habitat register (OEH, 2013b) or the Commonwealth Register of Critical Habitat (SEWPaC, 2013d) in the study area or surrounds.

(f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

Recovery plans have been prepared only for the Swift Parrot (Swift Parrot Recovery Team, 2001) and Regent Honeyeater (Menkhorst *et al.,* 1999). On ground recovery actions are listed, among many other recommendations, for the 10 species in their profiles on the threatened species pages of the NSW OEH website (OEH, 2013a) summarised as follows;

Action	Magpie Goose	Little Eagle	Little Lorikeet[1]	Swift Parrot	Superb Parrot	Barking Owl	Regent Honeyeater	GH Flying Fox	Yellow-bellied Sheathtail Bat	Little Pied Bat
Protect areas of habitat from overgrazing						✓				
Protect known populations and areas of potential habitat from clearing, fragmentation or disturbance, including grazing	✓	✓				✓				✓
Retain and protect nesting, roosting and foraging habitat, including standing dead trees, hollow bearing trees, feeding trees		✓				✓	✓	✓	✓	✓
Buffer or fence habitat areas from the impacts of other activities		✓				✓				
Rehabilitate known and potential habitat, increase remnant size	✓	✓					✓			
Identify and map the extent and quality of foraging and roosting habitat on private and public land.				✓	✓					✓
Protect, manage and restore habitat on private land through conservation agreements, management agreements and incentive payments.				✓	✓				✓	✓
Reduce collisions in areas where birds are foraging by closing window blinds etc.				✓						
Retain stands of preferred feed-trees, particularly large mature individuals and mistletoe				✓			✓	✓		
Revegetate with preferred feeding tree species				✓						
Participate in surveys to locate the winter foraging areas				✓						
Local Councils must give consideration to nesting and foraging habitat within their LEPs					✓					
Ensure that forestry prescriptions and harvesting plans provided effective protection from direct and indirect impacts to nest sites, including buffers for all nest trees and protection from planned burns					✓					
Encourage landholders/managers to remove or reduce grazing in known Box-Gum Woodland foraging habitat using incentives					✓					
Apply mosaic pattern hazard reduction techniques						✓				
Retain and enhance vegetation along watercourses and surrounds, remove stock						✓	✓			✓
Maintain a captive population							✓			
Use incentives on private land to encourage landholders to manage key areas	✓						✓			✓
No further loss of woodland and forest habitat from development					✓		✓			
Conduct research into non-breeding habitat and long distance movements				✓	✓		✓			
Investigate impacts of interspecific competition and nest predation							✓			
Retain dead timber on the ground in open forests and woodlands					✓					
Avoid exotic berry-producing shrubs to minimise predation by Currawongs										
Control feral predators near habitat and nest sites	✓									
Link remnant populations via corridors in the landscape										
Control feral predators and reduce attacks by domestic dogs										

Action	Magpie Goose	Little Eagle	Little Lorikeet[1]	Swift Parrot	Superb Parrot	Barking Owl	Regent Honeyeater	GH Flying Fox	Yellow-bellied Sheathtail Bat	Little Pied Bat
Signage on roads to minimise road kills										
Manage and enforce licensed shooting and investigate non-lethal crop protection measures								✓		
Research roost tree fidelity, foraging range, attributes of roost trees, effective of logging prescriptions, burning regimes, effects of pesticides									✓	✓
Restore natural hydrological regimes to freshwater wetlands, and maintain existing hydrological regimes.	✓									
Improve the protection of Magpie Goose habitat by excluding stock, reducing grazing pressure and controlling weeds in wetlands. Avoid placing powerlines over or near wetlands/ nest sites.	✓									
Reduce nutrient runoff into wetlands, and avoid the use of herbicides and pesticides near or in wetlands.	✓									
Identify areas of private land that contain high densities of trees with hollows and dead standing trees as areas of high conservation value for planning and land management instruments.										✓
Ensure the largest hollow bearing trees and standing dead trees (inc. small dead trees such as mulga, gidgee, leopardwood) are given highest priority for retention in PVP assessments or other land assessment tools.										✓

Potential future developments on CSU Dubbo land may be counter to some of the above 34 recovery actions, particularly those related to habitat clearing or loss. However, potential habitat clearing would be confined to trees planted 12 years ago that have not yet developed high conservation or habitat value, although they would over time. The impacts of such clearing would be slight, given that none of the threatened fauna species under consideration has a permanent local population on the study area. Accordingly, the only likely impact of clearing vegetation near the existing infrastructure would be a slight reduction in potential foraging habitat for migratory or nomadic species, for which similar habitat occurs widely in the surrounding region.

(g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Key Threatening Processes that may be relevant to future developments on the CSU Dubbo campus include:

- Clearing of native vegetation, and
- Invasion of native plant communities by exotic perennial grasses
- Competition and grazing by the feral European rabbit (*Oryctolagus cuniculus*)

No naturally occurring vegetation remains on CSU Dubbo land in good condition relative to pristine habitat, owing to past land uses. Depending on where developments take place, some clearing of planted woodlot trees or other plantings may occur, but would be minimised.

Soil disturbed by earth works for building projects is likely to be colonised by introduced grass species. However, except for some parts of the study area dominated by native grasses (Figure 3), all areas likely to be considered for development are already highly disturbed. Future development is likely to decrease potential habitat for rabbits rather than increasing it.

Consequently, future developments are unlikely to significantly increase the impact of these key threatening processes.

Conclusion.

It is concluded that future developments on the CSU Dubbo campus would not significantly affect local populations of the 10 threatened fauna species under consideration here. No suitable breeding habitat exists for any on the study area. In addition, no populations of the 10 species are known to occur on CSU land. However, future developments that affect food resources for these species may result in a slight decrease in the foraging habitat available for transient visitors.

EPBC Act

Five of the above fauna species, the Swift Parrot, Superb Parrot, Regent Honeyeater, Grey-headed Flying Fox and Little Pied Bat are listed as threatened under the EPBC Act. The above analysis indicates that any future development projects on the CSU Dubbo campus would have no significant impacts on the survival of natural populations of these species. Consequently, there is no requirement to refer such projects to SEWPaC on account of the Swift Parrot, Superb Parrot, Regent Honeyeater, Grey-headed Flying Fox or Little Pied Bat.

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APPENDIX 1. Flora Species List

		Woodlots					Grazing Paddocks							Pond	Opp
	Spot Sample No.	1	2	5	6	7	3	4	8	9	11	12	13	10	
Scientific Name	**Common Name**														
CLASS MAGNOLIOPSIDA															
SUBCLASS MAGNOLIIDAE															
Amaranthaceae															
Alternanthera denticulata	Lesser Joyweed													c	
**Alternanthera pungens*	Khaki Weed	u	r	r		u	u	r					u		
**Amaranthus retroflexus*	Redroot Amaranth														●
**Gomphrena celosioides*	Gomphrena Weed				u			u		r				o	
Anacardiaceae															
**Schinus areira*	Pepper Tree														●
Asteraceae															
**Aster subulatus*	Wild Aster						u		o					a	
**Bidens pilosa*	Cobblers Pegs												r		
**Bidens subalternans*	Greater Beggar's Ticks		o	o		u		o	o	o				o	
Calotis lappulacea	Yellow Burr-daisy			r		u							u		
**Carthamus lanatus*	Saffron Thistle		r	u		o	o	o	u		o	u			
**Chondrilla juncea*	Skeleton Weed			o			u			o				u	
**Cirsium vulgare*	Spear Thistle						r	u	r						
**Conyza bonariensis*	Flaxleaf Fleabane		r				u	u	u		u	u		u	
**Conyza sumatrensis*	Tall Fleabane								o						
**Lactuca serriola*	Prickly Lettuce	o		o		u			u					o	
**Sonchus oleraceus*	Common Sowthistle					u	u	u							
Vittadinia cuneata var. *hirsuta*	Fuzzweed		o	r	u								u		
**Xanthium occidentale*	Noogoora Burr													o	
**Xanthium spinosum*	Bathurst Burr		r			u	r	u					r		
Boraginaceae															
**Echium plantagineum*	Paterson's Curse	r	o	o		a	c	c	o	c	c				
**Heliotropium amplexicaule*	Blue Heliotrope	o									o				●

		Woodlots					Grazing Paddocks							Pond	Opp
	Spot Sample No.	**1**	**2**	**5**	**6**	**7**	**3**	**4**	**8**	**9**	**11**	**12**	**13**	**10**	
Scientific Name	**Common Name**														
**Heliotropium europaeum*	Potato Weed									o					
Brassicaceae															
**Hirschfeldia incana*	Hairy Brassica	u	o	o		u	o		o	u			r	u	
**Lepidium africanum*	African Peppercress		u								c	u	r		
Campanulaceae															
Wahlenbergia gracilis	Sprawling Bluebell													u	
Wahlenbergia luteola	A Bluebell	u		u	o	o				u			u		
Casuarinaceae															
†Casuarina cunninghamiana	River Sheoak			●										●	
Chenopodiaceae															
**Dysphania multifida*	Scented Goosefoot						r								
Dysphania pumilio	Crumbweed	u	o			o					c	u	u		
Maireana microphylla	Small-leaf Bluebush												r		●
Salsola australis	Buckbush														●
Sclerolaena birchii	Galvanized Burr												o		●
Sclerolaena muricata	Black Rolypoly												r		
Convolvulaceae															
Convolvulus angustissimus subsp. *angustissmus*		u	c	u		u									
Curcurbitaceae															
**Citrullus lanatus*	Wild Melon											r			●
Euphorbiaceae															
Chamaesyce drummondii	Caustic Weed		u												
Fabaceae: Caesalpinioideae															
Senna barclayana	Smooth Senna		c	u	u	u	u	u					u	u	
Fabaceae: Faboideae															
Hardenbergia violacea	Purple Coral Pea													r	
**Trifolium angustifolium*	Narrow-leaved Clover								c					a	
**Trifolium tomentosum*	Woolly Clover						●								

		Woodlots					Grazing Paddocks							Pond	Opp
	Spot Sample No.	**1**	**2**	**5**	**6**	**7**	**3**	**4**	**8**	**9**	**11**	**12**	**13**	**10**	
Scientific Name	**Common Name**														
Fabaceae: Mimosoideae															
†Acacia baileyana	Cootamundra Wattle													●	
†Acacia deanei	Deane's Wattle		●		●										
†Acacia doratoxylon	Currawang				●										
†Acacia hakeoides	Hakea Wattle				●										
†Acacia melvillei	Myall		●												
†Acacia pendula	Weeping Myall		●	●											
Acacia salicina	Cooba													o	
Lamiaceae															
**Marrubium vulgare*	White Horehound						r								
**Salvia verbenaca*	Vervain	u		u						o			o	c	
Malvaceae															
**Malva parviflora*	Small-flowered Mallow												r		
**Modiola caroliniana*	Red-flowered Mallow							c			u		r		
Sida corrugata	Corrugated Sida	o		c	o					o					
Meliaceae															
Melia azedarach	White Cedar							u							
Myrtaceae															
†Callistemon linearis	Narrow-leaved Bottlebrush			●											
†Callistemon sp.				●											
†Eucalyptus blakelyi	Blakely's Red Gum		●												
†Eucalyptus leucoxylon subsp. *leucoxylon*	Yellow Gum		●												
†Eucalyptus melliodora	Yellow Box		●	●	●										
†Eucalyptus microcarpa	Grey Box				●									●	
†Eucalyptus populnea	Poplar Box		●	●											
†Eucalyptus sideroxylon	Mugga Ironbark		●												
†Melaleuca acuminata subsp .*acuminata*	Mallee Honey-myrtle		●	●	●										
†Melaleuca erubescens	Rosy Paperbark				1										
Nyctaginaceae															

		Woodlots					Grazing Paddocks							Pond	Opp
	Spot Sample No.	**1**	**2**	**5**	**6**	**7**	**3**	**4**	**8**	**9**	**11**	**12**	**13**	**10**	
Scientific Name	**Common Name**														
Boerhavia dominii	Tarvine		o	u	u		r	u		u	c	a	o		
Oxalidaceae															
Oxalis perennans	A Woodsorrel			u		u	o	u			o				
Polygonaceae															
**Emex australis*	Three-cornered Jacks												r		
**Polygonum aviculare*	Wireweed						o				a				
Rumex brownii	Swamp Dock	u				o							r		
**Rumex crispus*	Curled Dock				o		u		o						
Rumex tenax	Shiny Dock							u							
Portulacaceae															
Portulaca oleracea	Pigweed		o			o		u			o	r			
Scrophulariaceae															
**Verbascum virgatum*	Twiggy Mullein	o	o	o	r	u									
Solanaceae															
**Datura ferox*	Fierce Thornapple											r			●
**Lycium ferocissimum*	African Boxthorn														●
**Solanum elaeagnifolium*	Silver-leaved Nightshade		r	u					u	u					
Verbenaceae															
**Glandularia aristigera*	Mayne's Pest	c	a	c	o	c	u	c	a	c	a	a	o	o	
**Verbena bonariensis*	Purpletop			r		u			c					u	
**Verbena officinalis*	Common Verbena														●
Zygophyllaceae															
**Tribulus terrestris*	Caltrop		o					c		a	o	a	r		
SUBCLASS LILIIDAE															
Amaryllidaceae															
Crinum flaccidum	Darling Lily	r													
Cyperaceae															
Carex appressa	Tall Sedge													r	
Carex inversa	Knob Sedge														●

		Woodlots					Grazing Paddocks							Pond	Opp
	Spot Sample No.	**1**	**2**	**5**	**6**	**7**	**3**	**4**	**8**	**9**	**11**	**12**	**13**	**10**	
Scientific Name	**Common Name**														
**Cyperus eragrostis*	Umbrella Sedge						o							c	
Schoenoplectus mucronatus	Triangular Sedge													o	
Juncaceae															
Juncus subglaucus	A Rush					o	o							u	
Poaceae															
Aristida personata	Purple Wire-grass		r	r	u								o		
Austrostipa scabra subsp. *scabra*	Speargrass		u												
**Avena sativa*	Oats	o		u	u	o			u	a				u	
Bothriochloa biloba	Lobed Bluegrass			o		o								u	
Bothriochloa decipiens	Red Grass	a	o	o	a	o	a	a	c	o			o	c	
**Bromus hordeaceus*	Soft Brome	o													
Chloris truncata	Windmill Grass							o							
**Chloris virgata*	Feathertop														●
Cynodon dactylon	Couch	a	o	c	r	c	a	a	c	u			a	o	
**Cynodon incompletus*	Blue Couch												r		
Dichanthium sericeum	Queensland Bluegrass		o						r					c	
Digitaria brownii	Cotton Panic Grass	c	o	u		c			o	c					
Digitaria divaricatissima	Umbrella Grass	a	c	u		c			a	u				a	
Echinochloa colona	Awnless Barnyard Grass													r	
Enteropogon acicularis	Windmill Grass		a	a	o		o	o					u		
Eragrostis alveiformis	A Lovegrass								r						
**Eragrostis cilianensis*	Stinkgrass					u		u		u	a	o			
**Eragrostis curvula*	African Lovegrass								o						
Eragrostis elongata	Clustered Lovegrass													u	
Eragrostis leptostachya	Paddock Lovegrass			r											
**Hordeum leporinum*	Barley Grass						o								
Panicum decompositum	Native Millet													o	
Paspalidium jubiflorum	Warrego Grass	u	o	r		c	r	a	o	u					
**Paspalum dilatatum*	Paspalum			u		u	a	u	a					c	

		Woodlots					Grazing Paddocks							Pond	Opp
	Spot Sample No.	**1**	**2**	**5**	**6**	**7**	**3**	**4**	**8**	**9**	**11**	**12**	**13**	**10**	
Scientific Name	**Common Name**														
**Pennisetum clandestinum*	Kikuyu Grass						r								
Rytidosperma bipartitum	Wallaby Grass				u			u	u					u	
Rytidosperma carphoides	Short Wallaby Grass							r	r						
Sporobolus creber	Western Rat-tail Grass		u			o			c						
Themeda australis	Kangaroo Grass													o	
**Urochloa panicoides*	Liverseed Grass		o					c		o			u	o	
Urochloa piligera	Hairy Armgrass	u	o			o				c	a	a			

Opp Opportunistic sighting
***** Introduced Species
† Planted species
a abundant
c common
o occasional
u uncommon
r rare
● present

No. Native Species	65
No. Introduced Species	51
Total Species	116

APPENDIX 2 - Bird Species List

Scientific Name	Common Name	General observations	Woodlots (north)	Woodlots (south)	Car Parks
CICONIIFORMES					
Threskiornithidae					
Threskiornis spinicollis	Straw-necked Ibis			●	
COLUMBIFORMES					
Columbidae					
Ocyphaps lophotes	Crested Pigeon	●	●		●
FALCONIFORMES					
Accipitridae					
Elanus axillaris	Black-shouldered Kite	●			●
Falconidae					
Falco cenchroides	Nankeen Kestrel			●	
PELECANIFORMES					
Phalacrocoracidae					
Phalacrocorax melanoleucos	Little Pied Cormorant		●		
PODICIPEDIFORMES					
Podicipedidae					
Tachybaptus novaehollandiae	Australasian Grebe	●			
PSITTACIFORMES					
Cacatuidae					
Cacatua galerita	Sulphur-crested Cockatoo	●			
Cacatua roseicapilla	Galah	●	●	●	●
Psittacidae					
Psephotus haematonotus	Red-rumped Parrot	●			
Platycercus eximius	Eastern Rosella	●	●		●
STRIGIFORMES					
Strigidae					
Ninox novaeseelandiae	Boobook Owl	●			
Tytonidae					
Tyto alba	Barn Owl	●			
PASSERIFORMES					
Acanthizidae					
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	●			
Gerygone fusca	Western Gerygone	●			
Smicrornis brevirostris	Weebill	●	●	●	●
Artamidae					
Cracticus nigrogularis	Pied Butcher Bird		●		
Gymnorhina tibicen	Australian Magpie	●		●	●
Strepera graculina	Pied Currawong				●
Corvidae					
Corvus bennetti	Little Crow		●		
Estrildidae					
Taeniopygia bichenovii	Double-barred Finch			●	
Maluridae					
Malurus cyaneus	Superb Fairy-wren			●	
Meliphagidae					
Acanthagenys rufogularis	Spiny-cheeked Honeyeater			●	
Anthochaera carunculata	Red Wattlebird	●	●	●	●
Lichenostomus chrysops	Yellow-faced Honeyeater	●			

Lichenostomus penicillatus	White-plumed Honeyeater	●	●	●	●
Manorina flavigula	Yellow-throated Miner			●	●
Philemon corniculatus	Noisy Friarbird		●		
Monarchidae					
Grallina cyanoleuca	PeeWee	●	●		●
Rhipidura albiscapa	Grey Fantail	●	●	●	
Rhipidura leucophrys	Willie Wagtail	●		●	
Motacillidae					
Anthus novaeseelandiae	Richard's Pipit	●			
Pardalotidae					
Pardalotus punctatus	Spotted Pardalote	●		●	
Paradlotus striatus	Striated Pardalote		●		
Petroicidae					
Petroica goodenovii	Red-capped Robin		●	●	
Sturnidae					
**Sturnus vulgaris*	Common Starling	●			●

* Introduced species; Opp. = Opportunistically observed species.

APPENDIX 3 - Suggested Plant Species for Rehabilitation Plantings

Scientific Name	Common Name
Trees	
Acacia homalophylla	Yarran
Acacia implexa	Hickory
Acacia leucoclada	-
Acacia pendula	Weeping Boree
Acacia salicina	Cooba
Allocasuarina luehmannii	Buloke
Brachychiton populneus	Kurrajong
Callitris glaucophylla	White Cypress Pine
Eucalyptus albens	White Box
Eucalyptus blakelyi	Blakely's Red Gum
Eucalyptus bridgesiana	Apple Box
Eucalyptus conica	Fuzzy Box
Eucalyptus melliodora	Yellow Box
Eucalyptus microcarpa	Grey Box
Eucalyptus sideroxylon	Red Ironbark
Shrubs	
Acacia deanei	Deane's Wattle
Acacia decora	Western Silver Wattle
Acacia hakeoides	Hakea Wattle
Acacia paradoxa	Kangaroo Thorn
Brachyloma daphnoides	Daphne Heath
Bursaria spinosa	Kangaroo Thorn
Dodonaea viscosa	Sticky Hopbush
Hibbertia obtusifolia	
Indigofera australis	Austral Indigo
Maireana microphylla	Eastern Cotton-bush
Melichrus urceolatus	Urn Heath
Myoporum montanum	Western Boobialla
Ozothamnus diosmifolius	Sago Bush
Pittosporum angustifolium	Weeping Pittosporum
Santalum acuminatum	Sweet Quandong
Senna artemisioides subsp. *zygophylla*	-

APPENDIX 4
Office of Environment and Heritage
Information Sheet on
FUZZY BOX WOODLAND

NSW GOVERNMENT | Environment, Climate Change & Water

Fuzzy Box Woodland on alluvial soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South bioregions

Introduction

These guidelines provide background information to help land managers to identify remnants of the Endangered Ecological Community (EEC): Fuzzy Box on alluvial soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South bioregions. For more detailed information refer to the EEC profile for Fuzzy Box Woodland which includes the Final Determination of the NSW Scientific Committee, on the Department of Environment, Climate Change and Water (DECCW) Threatened Species website: www.threatenedspecies.environment.nsw.gov.au

What is an Endangered Ecological Community?

An ecological community is a unique and naturally occurring assemblage of plants and animals. The presence of an ecological community can be determined by factors such as soil type, position in the landscape, climate and water availability, all of which influence species composition. An EEC is an ecological community listed under the *Threatened Species Conservation Act 1995* as being at risk of extinction, unless the threats affecting it are managed and reduced.

Although most ecological communities are recognised by their typical plant species, these communities include all the organisms that occur in that particular area. The survival of each species relies on complex interactions among all of the inhabitants of an ecological community, through biotic mechanisms such as food webs, mutualisms and pollination, and through abiotic mechanisms such as water, nitrogen and carbon cycles. Consequently, the loss of any species may have detrimental flow-on effects for the ecological functioning of the whole community.

What is a particular area?

The NSW Scientific Committee defines a particular area as the Bioregion and Local Government Area where an EEC may be found. The particular area may be further delineated by using other supplementary factors such as landscape, soil type and climatic variables.

Fuzzy Box Woodland in Weddin Mountains National Park, with low herbaceous and grassy groundcover Photo: M. Porteners

What is Fuzzy Box Woodland?

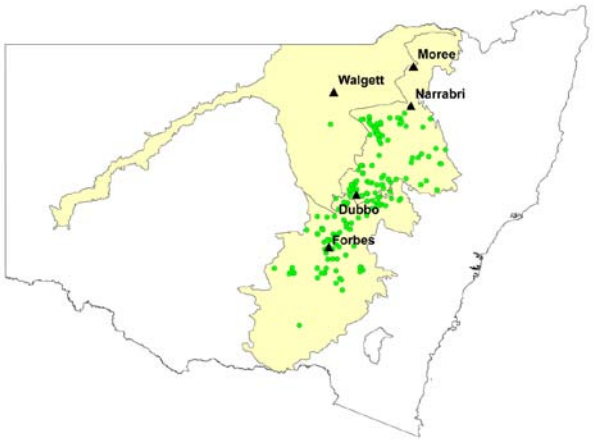
Fuzzy Box Woodland is a plant community recognised by a tall woodland dominated by Fuzzy box (*Eucalyptus conica*), often with inland grey box (*Eucalyptus microcarpa*), yellow box (*Eucalyptus melliodora*), bulloak (*Allocasuarina luehmannii*) or kurrajong

(*Brachychiton populneus*). Shrubs are usually sparse, with the groundcover dominated by grasses and low forbs, the density and composition of which will vary considerably from season to season. Fuzzy Box Woodland may form a mosaic of patches with other woodland communities at any one site, but it is recognised by a dominance of *E. conica*, with any other tree species present in lower abundances.

See 'Identifying Fuzzy Box Woodland EEC' below for further help.

Where is Fuzzy Box Woodland found?

Fuzzy Box Woodland is found on alluvial soils of the South Western Slopes, Brigalow Belt South and Darling Riverine Plains Bioregions, mainly in the Dubbo–Narromine–Parkes–Forbes area, (see Map). It is most abundant in the Forbes district but extends north to Narromine, with outliers near Bylong in the east. Less than 5% of the original extent is estimated to remain. The community occurs on a variety of soils on flats, low slopes, prior streams and abandoned channels or slight depressions on the undulating plains, mainly of the western slopes.



Bioregions in NSW where Fuzzy Box Woodland EEC can occur and the locations where fuzzy box as a species has been recorded to date. Fuzzy Box EEC occurs elsewhere in the bioregions.

It is often found upslope from River Red Gum communities, above the more frequently inundated areas of the floodplain. It also occurs on the lower slopes and valley flats, sometimes with other forest types such as the White Box–Yellow Box–Blakely's Red Gum Woodland EEC. Fuzzy box as a species is more widely distributed than the EEC on the western slopes of NSW, and it may occur in association with other eucalypt species to form other communities. Other woodland communities with similar floristic composition but where fuzzy box occurs only sporadically and is not the dominant tree canopy species are not part of the EEC.

Description of the community

The tree layer

The tree or upper canopy layer of Fuzzy Box Woodland EEC is dominated by *E. conica*, often growing with inland grey box (*E. microcarpa*), yellow box (*E. melliodora*) or kurrajong (*B. populneus*). Bulloak (*A. luehmannii*) and white cypress pine (*Callitris glaucophylla*) are also common in places.

The understorey: small trees and shrubs

Small trees and shrubs that may be present in the understorey include: wilga (*Geijera parviflora*), Deane's wattle (*Acacia deanei*), hop bush (*Dodonaea viscosa*), hickory wattle (*Acacia implexa*), silver cassia (*Senna artemisioides* sens. lat.), dolly bush (*Cassinia aculeata*), water bush (*Myoporum montanum*), eastern cottonbush (*Maireana microphylla*) and black roly-poly (*Sclerolaena muricata*).

Fuzzy Box Woodland roadside remnant at Emu Creek, south of Grenfell Photo: J. Plaza, RBG Sydney

The Understorey: groundcover plants

Groundcover species that are common across the range of Fuzzy Box Woodland include: native forbs such as purple burr-daisy (*Calotis cuneifolia*), corrugated sida (*Sida corrugata*), berry saltbushes (*Einadia hastata* and *E. nutans*), blue flax-lily (*Dianella revoluta*) and sticky everlasting (*Bracteantha viscosa*), low prostrate shrubs such as amulla (*Eremophila debilis*) and wingless fissure-weed (*Maireana enchylaenoides*), and native grasses, including speargrass (*Austrostipa scabra*), windmill grass (*Chloris truncata*), common wheatgrass (*Elymus scaber*), kangaroo grass (*Themeda australis*) and small-flowered wallaby grass (*Austrodanthonia setacea*).

Characteristic species list

There are over 200 plant species that occur in the Fuzzy Box Woodland environment. A list of plant species that generally characterise a patch of Fuzzy Box Woodland across its range is provided in Table 1. Not all the species listed need to occur in any one site for it to be considered Fuzzy Box Woodland EEC, and sites may include others species not listed as characteristic.

There are a number of variations in floral composition and structure within this community throughout its range, and in some individual cases the species in Table 1 may occur infrequently or not at all. Unseen species may be represented below ground in the soil seed bank or as dormant structures such as bulbs, corms, rhizomes, rootstock or lignotubers. Your final decision should be based on a weight of evidence from the key indicators outlined below. If in doubt refer to the full NSW Scientific Committee determination or seek further help from DECCW or your local catchment management authority.

Identifying Fuzzy Box Woodland EEC

The following are key indicators to look for when determining whether Fuzzy Box Woodland exists on a site:

1. Is the site on the western slopes of NSW and in the South Western Slopes, Darling Riverine Plains or Brigalow Belt South Bioregion? (see Map)
2. Is the site on a prior stream, abandoned channel, slight depression, undulating plain or flat with alluvial or colluvial soils?
3. Is the site a woodland dominated by fuzzy box with a sparse shrubby understorey and/or open forb and grassy groundcover?

Fuzzy Box Woodland roadside remnant
Photo: J. Benson, RBG Sydney

4. Does the site contain a combination of the diagnostic tree species marked in bold in Table 1?
5. Is the site situated on an upper floodplain above the level of frequent inundation and upslope from a River Red Gum community, or on a lower slope or valley flat with other tree species, such as inland grey box, yellow box, white box or Blakely's red gum?
6. Are there any plant species present at the site from those listed as characteristic in Table 1? (See photos in this guideline, check with a local botanist, consult reference books or NSW Flora Online: plantnet.rbgsyd.nsw.gov.au).

If you answered yes to the above questions, your site is likely to consist of Fuzzy Box Woodland.

What does this mean for my property?

As a listed EEC under the *Threatened Species Conservation Act 1995,* Fuzzy Box Woodland has significant conservation value, and some activities affecting the EEC may require consent or approval. Please contact the Department of Environment, Climate Change and Water for further information.

EECs that may adjoin or intergrade with Fuzzy Box Woodland

This community would have previously occurred with the following other western slopes and plains vegetation types that are now also listed as EECs:

1. *White Box–Yellow Box–Blakely's Red Gum Woodland* throughout its range, particularly on the lower landscapes and more fertile soils in eastern areas
2. *Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South bioregions*, predominantly on red-brown earths in the south to south-western parts of its range.

Determining the conservation value of remnants

The degree of disturbance (i.e. the site condition) of any remnant of Fuzzy Box Woodland may vary depending on past land use, management practices and/or natural disturbance, and this should be considered at the time of assessment. Although the following list is not exhaustive, it describes a number of variations of Fuzzy Box Woodland you may encounter on your land:

1. as an isolated remnant within heavily cleared country, or as scattered trees within a paddock or confined to narrow roadside corridors
2. modified sites where the main tree species are present but the ground layer is predominantly composed of exotic species with few native grasses, herbs or shrubs remaining
3. a stand of trees of an older age-class or senescent trees, (the result of a lack of natural regeneration of the canopy species)
4. extreme seasonal variation in the density and species composition of the understorey: dense herbaceous groundcover composed largely of annual species in cooler seasons, versus very dry and sparse perennial cover with bare soil patches during the hotter months
5. dense incursions of the weeds Paterson's curse (*Echium plantagineum*), Maltese cockspur (*Centaurea melitensis*), smooth catsear (*Hypochaeris glabra*), capeweed (*Arctotheca calendula*), silvery hairgrass (*Aira cupaniana*), perennial ryegrass (*Lolium perenne*) or great brome (*Bromus diandrus*).

The conservation significance of each remnant should be assessed at each site, noting that even where a remnant is considered to be heavily degraded and in poor condition, it may still have conservation value for a number of reasons, including:

1. as part of a wildlife corridor that has connective importance at local and/or regional scales
2. as an important habitat and food source for birds, small and large mammals, terrestrial invertebrates and insectivorous bats
3. because it contains threatened species of flora in their own right, or rarely seen and elusive plants such as terrestrial orchids, rare herbs and bryophytes, thus contributing to the local biodiversity
4. maintaining a healthy native seed bank, which is crucial for the perpetuation of vegetation communities and individual species in highly cleared and fragmented landscapes.

Any native vegetation remnant has habitat value and contributes to regional biodiversity. It is important to take these factors into account when determining the conservation significance of remnants.

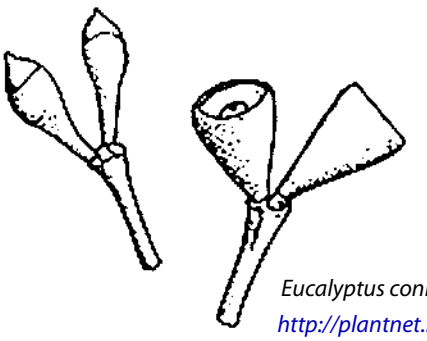
Fuzzy Box Woodland
Photo: J. Plaza, RBG Sydney

Table 1. Characteristic species recorded in the Fuzzy Box Woodland EEC

Common name	Scientific name
Overstorey – tree or shrub layer species (1.5 m+)	
Deane's wattle+	*Acacia deanei* subsp. *deanei*
Ironwood+ (NW)	*Acacia excelsa*
Western black wattle+	*Acacia hakeoides*
Hickory wattle+ (SE)	*Acacia implexa*
Mountain hickory+ (SE)	*Acacia penninervis* var. *longiracemosa*
Bulloak+	***Allocasuarina luehmannii***
Kurrajong+	***Brachychiton populneus* subsp. *populneus***
White cypress pine+	*Callitris glaucophylla*
Belah+	*Casuarina cristata*
Blakely's red gum+	*Eucalyptus blakelyi*
Fuzzy box+	***Eucalyptus conica***
Western red box+ (NW)	*Eucalyptus intertexta*
Yellow box+	***Eucalyptus melliodora***
Western grey box+	***Eucalyptus microcarpa***
Poplar box+	*Eucalyptus populnea* subsp. *bimbil*
Wilga+	*Geijera parviflora*
Needlewood+ (NW)	*Hakea leucoptera*
Sugarwood+	*Myoporum platycarpum* subsp. *perbellum*
Native olive+ (SE)	*Notelaea microcarpa*
Groundcover/understorey species (0-1.5 m)	
shrubs / forbs	
Lesser joyweed	*Alternanthera denticulata*
Hairy joyweed+	*Alternanthera nana*
Slender-fruited saltbush+ (NW)	*Atriplex leptocarpa*
Creeping saltbush+	*Atriplex semibaccata*
Sticky everlasting+	*Bracteantha viscosa*
Purple burr-daisy+	*Calotis cuneifolia*
Yellow burr-daisy	*Calotis lappulacea*
Tufted burr-daisy+	*Calotis scapigera*
Dolly bush+	*Cassinia aculeata*
Maltese cockspur+	*Centaurea melitensis**
Crested goosefoot+	*Chenopodium cristatum*
Desert goosefoot+	*Chenopodium desertorum*
Mistletoe+	*Dendrophthoe glabrescens*
Blue flax-lily+	*Dianella longifolia* var. *longifolia*
Blue flax-lily+	*Dianella revoluta* var. *revoluta*
Wedge-leaf hopbush+	*Dodonaea viscosa* subsp. *cuneata*
Paterson's curse	*Echium plantagineum**
Berry saltbush+	*Einadia hastata*
Climbing saltbush+	*Einadia nutans* sens. lat.
Amulla+	*Eremophila debilis*
Peppercress	*Lepidium pseudohyssopifolium*
Wingless fissure-weed+	*Maireana enchylaenoides*
Small fissure-weed+	*Maireana humillima*
Eastern cottonbush	*Maireana microphylla*
Horehound	*Marrubium vulgare**
Water bush+	*Myoporum montanum*
Australian broomrape+	*Orobanche cernua* var. *australiana*
Lamb's tails+	*Ptilotus semilanatus*
Thorny saltbush+ (NW)	*Rhagodia spinescens*
Slender dock	*Rumex brownii*
Galvanised burr + (NW)	*Sclerolaena birchii*
Black roly-poly+	*Sclerolaena muricata* var. *muricata*
Silver cassia+	*Senna artemisioides* sens. lat.
Corrugated sida+	*Sida corrugata*
Rock sida+ (NW)	*Sida petrophila*
London rocket	*Sisymbrium irio**
Quena+	*Solanum esuriale*
Fuzzweed+	*Vittadinia cuneata* sens. lat.
Herbs / ferns	
Pimpernel	*Anagallis arvensis**
Capeweed	*Arctotheca calendula**
Small vanilla-lily+	*Arthropodium minus*
Tarvine+	*Boerhavia dominii*
Variable daisy	*Brachyscome ciliaris* var. *lanuginosa*
Golden lily+	*Bulbine bulbosa*
Leek lily	*Bulbine semibarbata*
Blue fairy orchid	*Caladenia caerulea*
Pink fingers	*Caladenia carnea*
Small purslane	*Calandrinia eremaea*
Garland lily	*Calostemma purpureum*
Caustic weed+	*Chamaesyce drummondii*
Rock fern+ (SE)	*Cheilanthes austrotenuifolia*
Rock fern	*Cheilanthes sieberi* subsp. *sieberi*
Australian bindweed+	*Convolvulus erubescens*
Dense stonecrop	*Crassula colorata* var. *acuminata*
Native carrot	*Daucus glochidiatus*
Kidney weed+	*Dichondra repens*
Kidney weed	*Dichondra* species A
Nodding chocolate-lily+	*Dichopogon fimbriatus*
Blue crowsfoot	*Erodium crinitum*
Native geranium	*Geranium solanderi* var. *solanderi*
Silky glycine	*Glycine canescens*
Twining glycine+	*Glycine clandestina*

Common name	Scientific name
Variable glycine+	*Glycine latifolia*
Variable glycine	*Glycine tabacina*
Stinking pennywort	*Hydrocotyle laxiflora*
Smooth catsear	*Hypochaeris glabra**
Burr medic	*Medicago polymorpha**
Common onion orchid	*Microtis unifolia*
Wood sorrel+	*Oxalis chnoodes*
Yellow wood sorrel	*Oxalis perennans*
Proliferous pink	*Petrorhagia nanteuilii**
Sago weed+	*Plantago cunninghamii*
Common pigweed+	*Portulaca oleracea*
Midget greenhood orchid	*Pterostylis mutica*
Small-flowered buttercup	*Ranunculus sessiliflorus* var. *sessiliflorus*
Pink tongues+	*Rostellularia adscendens* subsp. *adscendens*
Common sowthistle	*Sonchus oleraceus**
Creamy candles+	*Stackhousia monogyna*
Chickweed	*Stellaria media**
Slender sun orchid	*Thelymitra pauciflora*
Haresfoot clover	*Trifolium arvense**
Tufted bluebell	*Wahlenbergia communis*
River bluebell+	*Wahlenbergia fluminalis*
Native bluebell+	*Wahlenbergia luteola*
Native bluebell+ (SE)	*Wahlenbergia victoriensis*
Grasses / sedges	
Silvery hairgrass	*Aira cupaniana**
Bunch wiregrass+	*Aristida behriana*
Wiregrass+	*Aristida muricata*
Purple wiregrass+	*Aristida ramosa* var. *speciosa*
Ringed wallaby grass	*Austrodanthonia caespitosa*
Wallaby grass	*Austrodanthonia racemosa*
Small-flowered wallaby grass+	*Austrodanthonia setacea*
Plains grass+	*Austrostipa aristiglumis*
Foxtail speargrass+	*Austrostipa densiflora*
Feather speargrass+	*Austrostipa elegantissima*
Stout bamboo grass+	*Austrostipa ramosissima*
Rough speargrass	*Austrostipa scabra* subsp. *falcata*
Rough speargrass+	*Austrostipa scabra* subsp. *scabra*
Slender bamboo-grass+	*Austrostipa verticillata*
Corkscrew grass	*Austrostipa setacea*
Wakool speargrass+ (SE)	*Austrostipa wakoolica*

Common name	Scientific name
Pitted bluegrass+	*Bothriochloa decipiens*
Red-leg grass+	*Bothriochloa macra*
Shivery grass	*Briza minor**
Great brome	*Bromus diandrus**
Tall sedge+	*Carex appressa*
Sedge+ (SE)	*Carex incomitata*
Windmill grass+	*Chloris truncata*
Button grass+	*Dactyloctenium radulans*
Queensland bluegrass+	*Dichanthium sericeum*
Cotton panic grass+	*Digitaria brownii*
Finger grass	*Digitaria diffusa*
Spreading umbrella grass+	*Digitaria divaricatissima*
Common wheatgrass+	*Elymus scaber* var. *scaber*
Bottlewashers+	*Enneapogon* spp.
Windmill grass+	*Enteropogon acicularis*
Canegrass+	*Eragrostis australasica*
Weeping lovegrass+	*Eragrostis parviflora*
Slender cupgrass+	*Eriochloa procera*
Rush+	*Juncus flavidus*
Rush	*Juncus remotiflorus*
Umbrella Canegrass+	*Leptochloa digitata*
Perennial ryegrass	*Lolium perenne**
Many-flowered mat-rush+	*Lomandra multiflora* subsp. *multiflora*
Meadow rice-grass	*Microlaena stipoides* var. *stipoides*
Long-leaved wallaby grass+ (SE)	*Notodanthonia longifolia*
Native millet+	*Panicum decompositum*
Pepper grass+	*Panicum laevinode*
Pale summer-grass+	*Paspalidium albovillosum*
Tussock grass+	*Poa labillardieri* var. *labillardieri*
Kangaroo grass+	*Themeda australis*



Eucalyptus conica buds and fruits
http://plantnet.rbgsyd.nsw.gov.au

Key indicator species from Final Determination are marked + (diagnostic species in **BOLD***). Weed species are marked *.*
Common names are as per Royal Botanic Gardens, see: http://plantnet.rbgsyd.nsw.gov.au
Additional species are from Porteners (2007), Benson (2008) and Armstrong, Porteners & Koen (2009) (see references).
SE = south to east of EEC range; NW = north to west of EEC range.

For further help

This and other EEC guidelines are available on the DECCW website at threatenedspecies.environment.nsw.gov.au/tsprofile/home_tec.aspx or www.environment.nsw.gov.au/pnf/eecfieldidguidelines.htm

The resources listed below also provide information on NSW plants, native vegetation and EECs.

- Botanic Gardens Trust plant identification help: www.rbgsyd.nsw.gov.au/plant_info/identifying_plants/
- Department of Environment, Climate Change and Water threatened species profiles: www.threatenedspecies.environment.nsw.gov.au/tsprofile/home_species.aspx
- information on bioregions of New South Wales (determinations use IBRA version 4 boundaries): www.environment.nsw.gov.au/bioregions/Bioregions.htm
- NSW Scientific Committee determinations: www.environment.nsw.gov.au/committee/ListofScientificCommitteeDeterminations.htm
- Armstrong, R.C., Porteners, M.F. & Koen, T. (2009) *Identification, Prioritisation and Conservation Management Recommendations for Endangered Ecological Communities in the Narromine, Dubbo and Wellington Local Government Areas*. A report to the Central West Catchment Management Authority. (NSW Department of Environment and Climate Change: Dubbo).
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- Porteners, M.F. (2007) *Weddin Mountains National Park, Fuzzy Box Monitoring Project. Report to the Department of Environment and Conservation (NSW)* (Marianne Porteners Environmental Consulting: Sydney).

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